Procurement #: 49337>

CITY OF PROVIDENCE, RHODE ISLAND

Department: Public Property

RFP Title: GENERAL CONTRACTOR SERVICES FOR DAVEY LOPES RECREATION CENTER CPF IMPROVEMENTS

Opening Date: 06/02/2025

Addendum #: 1

Issue Date: 05/21/2025

The purpose of this addendum is:

To provide the pre-bid conference sign in sheet, updated Spec and Drawing sheets, and respond to bidder RFIs.

Providence City Hall
25 Dorrance Street
Providence, RI 02903

BARGMANN HENDRIE + ARCHETYPE, INC.
Architecture | Planning | Interior Design

9 Channel Center Street
Suite 300
Boston, MA 02210

617 350 0450
bha@bhplus.com
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addendum no. 01

to: All Plan Holders

date: May 16, 2025

project name & number: **Davey Lopes Recreation Center**
Providence, RI
BH+A Project No.3524

prepared by: Bargmann Hendrie + Archetype, Inc.
9 Channel Center Street, Suite 300
Boston, MA 02210

This Addendum forms part of the Contract Documents and modifies the original Bidding issued on April 18, 2025, as noted below.

Acknowledge receipt of this Addendum in the space provided in the appropriate space on the Form for General Bid. Failure to do so will subject the Bidder to disqualification.

This Addendum consists of ___13__ (x) pages and _12__ (x) attachments

attachments: Pre-Bid Walk-Through Attendees List

Section 044013 Architectural Granite dated May 16, 2025
Section 087100 Door hardware revised May 16, 2025
Section 230000 HVAC revised May 16, 2025
Section 220000 Plumbing revised May 16, 2025

Drawing A006 Partition and Roof Types revised May 16, 2025
Drawing D101 First Floor Demolition Plan revised May 16, 2025
Drawing A100 Basement Plan revised May 16, 2025
Drawing A101 First Floor Plan revised May 16, 2025
Drawing A102 Second Floor Plan revised May 16, 2025
Drawing A103 Roof Plan revised May 16, 2025
Drawing A201 Building Elevations revised May 16, 2025
Drawing A202 Building Elevations – Brick Work dated May 16, 2025
Drawing A300 Partial Building Sections revised May 16, 2025
Drawing A301 Partial Building Sections revised May 16, 2025
Drawing A400 Enlarged Views - Front Entrance Lobby revised May 16, 2025
Drawing A402 Enlarged Views - Multi-Purpose Room revised May 16, 2025
Drawing A403 Enlarged Views - Locker Rooms & Restrooms revised May 16, 2025
Drawing A404 Enlarged Views - Restrooms revised May 16, 2025

Drawing A405 Enlarged Views - Zoom Rooms and Misc. revised May 16, 2025
Drawing A501 Exterior Details revised May 16, 2025
Drawing A510 Interior Details -Typical revised May 16, 2025
Drawing A512 Interior Details revised May 16, 2025
Drawing A515 Millwork Details - Reception Desk revised May 16, 2025
Drawing A516 Millwork Details - Feature Wall revised May 16, 2025
Drawing A517 Millwork Details - Kitchenette revised May 16, 2025
Drawing A600 Door Schedule & Details revised May 16, 2025
Drawing A610 Window Schedule & Details revised May 16, 2025
Drawing A700 Room Finish Legend & Schedule revised May 16, 2025
Drawing A721 First Floor reflected Ceiling Plan revised May 16, 2025

Drawing C101 Civil Site Plan revised May 16, 2025
Drawing C103 Construction Details revised May 16, 2025

Drawing S102 Second Floor Framing Plan revised May 16, 2025
Drawing S200 Typical Details revised May 16, 2025
Drawing S300 Sections revised May 16, 2025

Drawing H000 HVAC Legend revised May 16, 2025
Drawing HD101 HVAC Demolition First Floor Plan revised May 16, 2025
Drawing H100 HVAC Basement Plan revised May 16, 2025
Drawing H101 HVAC First Floor Ductwork Plan revised May 16, 2025
Drawing HP101 HVAC First Floor Piping Plan revised May 16, 2025
Drawing H102 HVAC Second Floor Plan revised May 16, 2025
Drawing H103 HVAC Roof Plan revised May 16, 2025
Drawing H200 HVAC Schedules revised May 16, 2025
Drawing H201 HVAC Schedules revised May 16, 2025
Drawing H301 HVAC Details revised May 16, 2025
Drawing H400 HVAC Schematics revised May 16, 2025
Drawing H401 HVAC Piping Diagrams revised May 16, 2025

Drawing E100 Electrical Basement Floor Plan revised May 16, 2025
Drawing E101 Electrical First Floor Plan revised May 16, 2025
Drawing E102 Electrical Second Floor Plan revised May 16, 2025
Drawing E103 Electrical Roof Plan revised May 16, 2025
Drawing E200 Electrical Basement & 2nd Floor Part Plan revised May 16, 2025
Drawing E201 Electrical First Floor Plan revised May 16, 2025
Drawing E300 Electrical One-Line and Schedules revised May 16, 2025
Drawing E400 Electrical Panel Schedules revised May 16, 2025

Drawing FP100 Fire Protection Basement Plan revised May 16, 2025
Drawing FP101 Fire Protection First Floor Plan revised May 16, 2025

Drawing PD100 Plumbing Basement Demo Plan revised May 16, 2025

Drawing PD101 Plumbing Demolition First Floor Plan revised May 16, 2025
Drawing PD103 Plumbing Demolition Roof Plan revised May 16, 2025
Drawing P100 Plumbing Underground Plan revised May 16, 2025
Drawing P101A Plumbing Waste & Vent First Floor Plan revised May 16, 2025
Drawing P101B Plumbing Domestic Water First Floor Plan revised May 16, 2025
Drawing P102 Plumbing Second Floor Plan revised May 16, 2025
Drawing P103 Plumbing Roof Plan revised May 16, 2025
Drawing P200 Plumbing Details revised May 16, 2025

Information Available To Bidders

List of Bidders Attending the May 13, 2025 Pre-Bid

PROJECT MANUAL CHANGES

Bid Package Specifications Page 15 of 20

Insert the following text under Provisions of this Project:

- The Work shall be Substantially Complete by June 23, 2026.
- Liquidated damages of $500 per day will be accessed for every calendar day the Work is not completed by the date of Substantial Completion.

REQUEST FOR PROPOSAL

1. Page 8 of 21, Allowance #1. Delete reference to "Exterior".

Section 012100 - ALLOWANCES

1. Article 3.3 Delete paragraph A in its entirety and insert the following:

A. Allowance No. 1: Lump-Sum Allowance: Include the sum of $3,000.00 for a dedication plaque in the lobby of the building. Refer to Section 101416 Plaques for general description and mounting requirements.

Section 024119- SELECTIVE DEMOLITION

1. Article 1.1 Add subparagraph 2:

2. Removal, salvage, and protection of the garage door artwork panels facing on the west elevation of the Multi-Purpose Room.

2. Add Article 3.5:

3.5 REMOVE AND SALVAGE

B. Artwork Panels: Special attention is required at the removal and salvage of the existing artwork panels. Refer to drawings for requirements.

Section 044013-ARCHITECTURAL GRANITE

1. Insert this Section.

Section 055313- BAR GRATINGS

1. Article 1.1 add subparagraph A3.

   3. Hardware for removal grating sections

2. Article 2.2 Add subparagraph D6:

   6. Provide bolted hold down clips at removeable grate sections

Section 087100 DOOR HARDWARE

1. Delete this Section in its entirety and insert revised Section.

Section 102813- TOILET ACCESSORIES

1. Article 3.3 Toilet Accessory Schedule: Delete paragraph C TBA-2 in its entirety and insert the following:

   C. TBA-2 Toilet Paper Dispenser
      1. Owner Provided

2. Article 3.3 Toilet Accessory Schedule: Delete paragraph E TBA-4 in its entirety and insert the following:

   E. TBA-4 Soap Dispenser
      1. Owner Provided

3. Article 3.3 Toilet Accessory Schedule: Insert paragraph G.1, TBA-6B

   G.1 TBA-6B; Grab Bar Showers: Where this designation is indicated, provide stainless-steel grab bar complying with the following:
      2. Products: Bobrick model B-58616 or approved equal.
      3. Description: Two-Wall Grab-Bar 24 inch by 36 inch
      4. Material: Stainless-Steel Nominal Thickness: 18 gage
      5. Mounting: Concealed with manufacturer's standard flanges and anchors
      6. Gripping Surfaces: Manufacturer's standard slip-resistant "peened" texture
      7. Outside Diameter: 1-1/4 inches (32 mm) for heavy-duty applications

4. Article 3.3 Toilet Accessory Schedule: Insert paragraph m, TBA-11

   M. TBA-11 Paper Towel Dispenser
      1. Owner Provided

Section 105126- PLASTIC LOCKERS

1. Article 2.2 Standard Plastic Lockers sub-paragraph G 1. Add the following to the end of sub-paragraph:

   "50% red, 50% black."

Section 220000 Plumbing

1. Article 2.16 Trap Primers: Section revised. Delete this section in its entirety and replace with revised section 2.16 Trap Primers.

Section 230000 HVAC

1. Article 2.48 Textile Air Dispersion System: Section added in its entirety.
2. Article 3.17 Textile Air Dispersion System: Section added in its entirety to replace existing section 3.17. All sections following 3.17 Textile Air Dispersion System are renumbered. Replace section 3.17 through 3.27 with revised section sequence.
3. Article 3.28 Sequences of Operation: Section to replace existing section: Sequences of Operation.

Section 323300- SITE IMPROVEMENTS

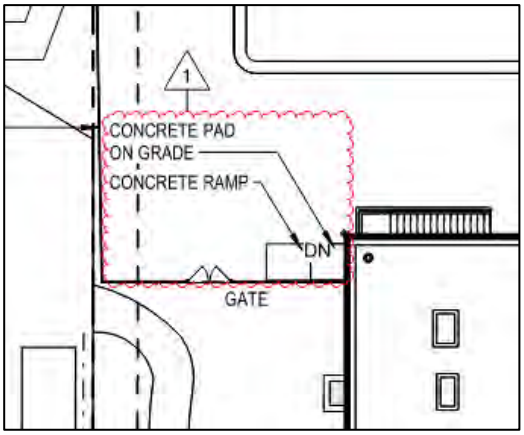
1. Article 2.3 Metal Edge Plate: Delete paragraph A and insert the following:

   A. End plate on wall at new site wall openings:
      1. Plaque Material: Galvanized steel
      2. Plaque Thickness: ½ inch thick.
      3. Mounting: concealed

DRAWING CHANGES

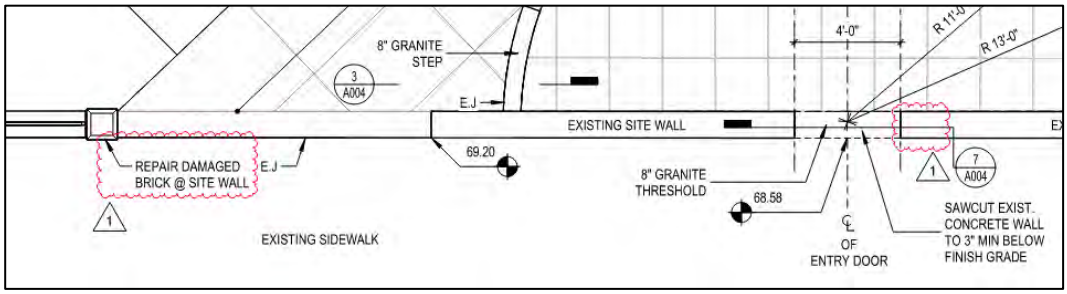
Drawing A000 Cover Sheet
Insert reference to new Sheet A202 Building Elevations-Brick Work

Drawing A003- Architectural Site Plan
Revise drawing as follows:

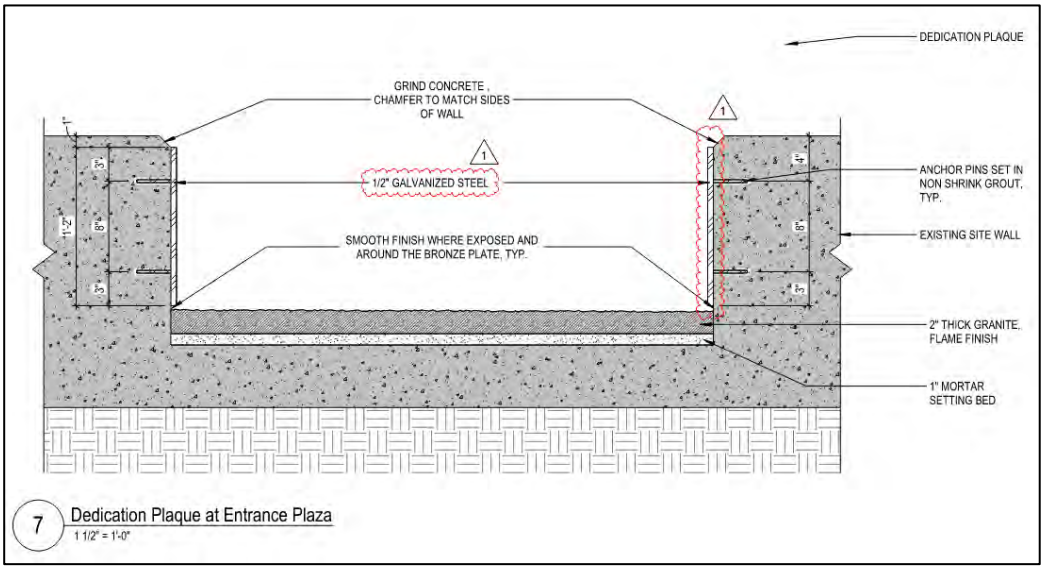


Drawing A004 Front Entry Hardscape

1. Revise Detail 2 as follows:

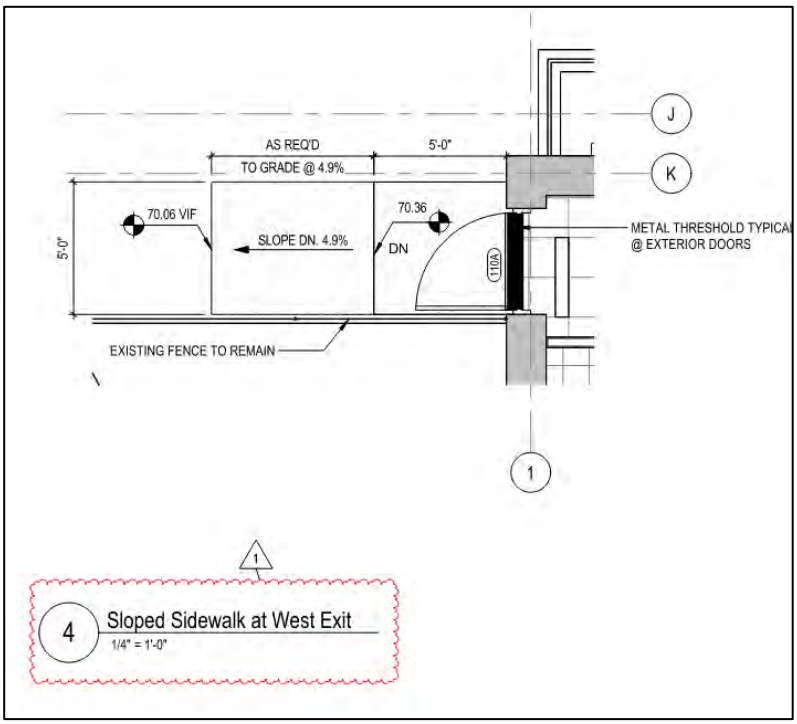


2. Revise Detail 7 as follows:



Drawing A005 Site Hardscape

1. Add Detail 4 as follows:



2.

Drawing A006 Partition and Roof Types
Delete this drawing in its entirety and insert revised A006, Rev 1

Drawing D101 First Floor Demolition Plan
Delete this drawing in its entirety and insert revised D101, Rev 1

Drawing A100 Basement Plan
Delete this drawing in its entirety and insert revised A100, Rev 1

Drawing A101 First Floor Plan
Delete this drawing in its entirety and insert revised A101, Rev 1

Drawing A102 Second Floor Plan
Delete this drawing in its entirety and insert revised A102, Rev 1

Drawing A103 Roof Plan
Delete this drawing in its entirety and insert revised A103, Rev 1

Drawing A201 Building Elevations
Delete this drawing in its entirety and insert revised A201, Rev 1

Drawing A202 Building Elevations Brickwork
Insert new drawing A202

Drawing A300 Partial Building Sections
Delete this drawing in its entirety and insert revised A300, Rev 1

Drawing A301 Partial Building Sections
Delete this drawing in its entirety and insert revised A301, Rev 1

Drawing A400 Enlarged Views Front Entrance Lobby
Delete this drawing in its entirety and insert revised A400, Rev 1

Drawing A402 Enlarged Views Multi-Purpose Room
Delete this drawing in its entirety and insert revised A402, Rev 1

Drawing A403 Enlarged Views Locker Rooms & Restrooms
Delete this drawing in its entirety and insert revised A403, Rev 1

Drawing A404 Enlarged Views Restrooms
Delete this drawing in its entirety and insert revised A404, Rev 1

Drawing A405 Enlarged Views Zoom Rooms & Misc.
Delete this drawing in its entirety and insert revised A405, Rev 1

Drawing A501 Exterior Details.
Delete this drawing in its entirety and insert revised A501, Rev 1

Drawing A510 Interior Details Typical
Delete this drawing in its entirety and insert revised A510, Rev 1

Drawing A512 Interior Details.
Delete this drawing in its entirety and insert revised A512, Rev 1

Drawing A515 Millwork Details Reception Desk
Delete this drawing in its entirety and insert revised A515, Rev 1

Drawing A516 Millwork Details Feature Wall
Delete this drawing in its entirety and insert revised A516, Rev 1

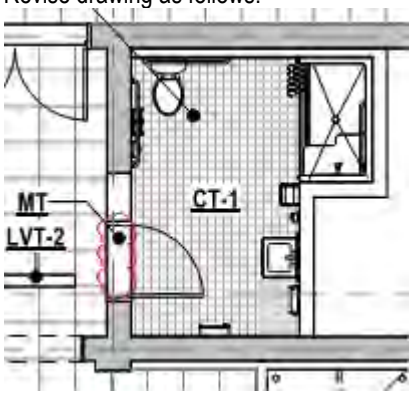
Drawing A517 Millwork Details Kitchenette
Delete this drawing in its entirety and insert revised A517, Rev 1

Drawing A600 Door Schedule & Details
Delete this drawing in its entirety and insert revised A600, Rev 1

Drawing A610 Window Schedule & Details
Delete this drawing in its entirety and insert revised A610, Rev 1

Drawing A700 Room Finish Legend & Schedule
Delete this drawing in its entirety and insert revised A700, Rev 1

Drawing A701 First Floor Finish Floor Plan
Revise drawing as follows:



Drawing A721 First Floor Reflected Ceiling Plan
Delete this drawing in its entirety and insert revised A721

Drawing C101 Civil Site Plan
Delete this sheet in its entirety and insert revised Sheet C101

Drawing C103 Construction Details
Delete this sheet in its entirety and insert revised Sheet C103

Drawing S102 Second Floor Framing
Delete this sheet in its entirety and insert revised Sheet S102

Drawing S200 Typical Details
Delete this sheet in its entirety and insert revised Sheet S200

Drawing S300 Sections
Delete this sheet in its entirety and insert revised Sheet S300

Drawing H000 HVAC Legend
Delete this sheet in its entirety and insert revised Sheet H000

Drawing HD101 HVAC Demolition First Floor Plan
Delete this sheet in its entirety and insert revised Sheet HD101

Drawing H100 HVAC Basement Plan
Delete this sheet in its entirety and insert revised Sheet H100

Drawing H101 HVAC First Floor Ductwork Plan
Delete this sheet in its entirety and insert revised Sheet H101

Drawing HP101 HVAC First Floor Piping Plan
Delete this sheet in its entirety and insert revised Sheet HP101

Drawing H102 HVAC Second Floor Plan
Delete this sheet in its entirety and insert revised Sheet H102

Drawing H103 HVAC Roof Plan
Delete this sheet in its entirety and insert revised Sheet H103

Drawing H200 HVAC Schedules
Delete this sheet in its entirety and insert revised Sheet H200

Drawing H201 HVAC Schedules
Delete this sheet in its entirety and insert revised Sheet H201

Drawing H301 HVAC Details
Delete this sheet in its entirety and insert revised Sheet H301

Drawing H400 HVAC Schematics
Delete this sheet in its entirety and insert revised Sheet H400

Drawing H401 HVAC Piping Diagrams
Delete this sheet in its entirety and insert revised Sheet H401

Drawing E100 Electrical Basement Floor Plan
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Drawing E101 Electrical First Floor Plan
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Drawing E102 Electrical Second Floor Plan
Delete this sheet in its entirety and insert revised Sheet E102

Drawing E103 Electrical Roof Floor Plan
Delete this sheet in its entirety and insert revised Sheet E103

Drawing E200 Electrical Basement & Second Floor Part Plan
Delete this sheet in its entirety and insert revised Sheet E200

Drawing E201 Electrical First Floor Plan
Delete this sheet in its entirety and insert revised Sheet E201

Drawing E300 Electrical One-Line and Schedules
Delete this sheet in its entirety and insert revised Sheet E300

Drawing E400 Electrical Panel Schedules
Delete this sheet in its entirety and insert revised Sheet E400

Drawing FP100 Fire Protection Basement Plan
Delete this sheet in its entirety and insert revised Sheet FP100

Drawing FP101 Fire Protection First Floor Plan
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Drawing PD100 Plumbing Basement Demo Plan
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Drawing PD101 Plumbing Demolition First Floor Plan
Delete this sheet in its entirety and insert revised Sheet PD101

Drawing PD103 Plumbing Demolition Roof Plan
Delete this sheet in its entirety and insert revised Sheet PD103

Drawing P100 Plumbing Underground Plan
Delete this sheet in its entirety and insert revised Sheet P100

Drawing P101A Plumbing Waste & Vent First Floor Plan
Delete this sheet in its entirety and insert revised Sheet P101A

Drawing P101B Plumbing Domestic Water First Floor Plan
Delete this sheet in its entirety and insert revised Sheet P101B

Drawing P102 Plumbing Second Floor Plan
Delete this sheet in its entirety and insert revised Sheet P102

Drawing P103 Plumbing Roof Plan
Delete this sheet in its entirety and insert revised Sheet P103

Drawing P200 Plumbing Details
Delete this sheet in its entirety and insert revised Sheet P200

REQUESTS FOR INFORMATION
The following is a summary of requests for information, questions, and inquiries by Plan Holders. Clarification with no change to the Documents are answered below. Responses that require a change to the Contract Documents have been included in the Addendum Changes

Collins Construction RFI No. 1 dated May 15, 2025

3. Will there be Liquidated Damages on this project, and if so how much will that be?
4. What is the Substantial Completion Date on this project?

Answer: Refer to language added in this Addendum.

END OF ADDENDUM NO. 01

PROJECT: **General Contractor Services For Davey Lopes Rec Center CPF Improvements**

Date: 5/13/2025

Time: 10AM

Mandatory pre-bid conference

Address, Providence RI

ATTENDEES:

Name	Company	Email	Phone
Taylor Erkkinen	City of Providence, Public Property	terkkinen@providenceri.gov	401-580-5099
Ben Lobaugh	City of Providence, Public Property	blobaugh@providenceri.gov	401-749-6320
Chance Batalon	Maron Construction	estimating@maronco.com	401-272-4930
Brian Petsch	Maron Construction	bpetsch@maronco.com	401-272-4930
Chris Reynolds	Dubon Masonry	ESTIMATING@DUBONMASONRY.com	401-500-5062
John Warner	Ahlborg	jwarner@ahlborg.com	401-2550410
Jim Hills	BENTLEY	jhills@bentleycompanies.com	
Orlando DiFiuscio	ANJ Electric EYE	ODiFiuscio@electricEYEllc.com	401-541-0992
Anthony Turcicone	Nexgen Electric	anthonyt@nexgenelectricri.com	401-714-7834

PROJECT: **General Contractor Services For Davey Lopes Rec Center CPF Improvements**

Date: 5/13/2025

Time: 10AM

Mandatory pre-bid conference

Address, Providence RI

ATTENDEES:

Name	Company	Email	Phone
Erik Guerrero	American Electrical LLC	Stephen Blair @AmericanelectricRI.com	401-385-9132
Vaughan Gaither	News LLC	INFO@NewsLLC.NET	860 571-3800
Brendan Croce	A+M Roofing	AMroofing8705@gmail.com	401-864-8705
Joe DeAngelis	Collins Construction	joe@collinsconst.net	508-678-5201
JP Morales	EW Burman	estimating@ewburman.com	401 738 5400
Colin Bonfield	BH+A	cbonfield@bhplus.com	415 722 8149
Chris Smith	Deslandes Construction	CSmith@deslandesconstruction.com	401-467-7600
CHRIS SEGER	MILL CITY CONSTRUCTION	CSEGER@MILL-CITY.com	401-766-3100
Dave Steeb	Martone Inc.	david@martoneinc.com	401 690 4703

PROJECT: **General Contractor Services For Davey Lopes Rec Center CPF Improvements**

Date: 5/13/2025

Time: 10AM

Mandatory pre-bid conference

Address, Providence RI

ATTENDEES:

Name	Company	Email	Phone
D. PAPA	TOWER	estimating@towerconstructionarp.com	~~401.944~~ 401.943.0110

SECTION 044013 – ARCHITECTURAL GRANITE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Fabricated granite components, including the following:
   1. Step treads.
   2. Slabs
   3. Curbing

1.3 REFERENCES

A. ASTM International (ASTM):
   1. ASTM C 119 - Standard Terminology Relating to Dimension Stone.
   2. ASTM C 170 - Standard Test Method for Compressive Strength of Dimension Stone.
   3. ASTM C 615 - Standard Specification for Granite Dimension Stone.
   4. ASTM C 880 - Standard Test Method for Flexural Strength of Dimension Stone.

1.4 DEFINITIONS

A. Definitions: Definitions of terms used in these specifications shall be those published by the National Building Granite Quarries Association, Inc.

B. Split Face Finish: Surface resulting from breaking stone along a natural cleavage plane. Surface has projections and depressions; edges are not true.

C. Sawn Finish: A rough and uneven surface resulting from splitting, pointing, and/or rough sawing the granite.

D. Thermal Finish: Finish produced by application of high temperature flame to the surface. Large surfaces may have shadow lines caused by overlapping of the torch.

E. Honed Finish: Dull sheen, without reflections.

1.5 SUBMITTALS

A. Submit under provisions of the general requirements.

B. Samples: Submit sufficient samples of granite:

1. Each sample set shall include three samples.
2. Sample set shall show anticipated range of color to be expected in the final installation. Natural variations in grain structure, inclusions or any other visual characteristic should also be included in the samples, or depicted in an accompanying photograph. In addition, a dated photograph may be issued to illustrate current quarry conditions.
3. Approved sample sets and/or mock up photographs with meeting minutes shall establish the standard by which stonework will be judged.

C. Shop Drawings: Show all bedding, bonding, jointing and anchoring details, and the dimensions of each piece of granite:
   1. No final sizing or finishing shall be done until the shop drawings for that part of the work have been approved.

1.6 QUALITY ASSURANCE

A. Supplier Qualifications: All granite shall be obtained from quarries having adequate capacity and facilities to meet the specified requirements. Fabrication shall be by a firm equipped to process the material promptly in accordance with specifications.

B. Any piece of granite showing manufacturing flaws upon receipt shall be referred to the design professional for determination as to whether it shall be rejected, patched, or redressed for use.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store granite on timber or platforms at least 3 inches (76 mm) above the ground.

B. Take care to prevent staining during storage.

C. Prevent excessive mud, fluid concrete, or other deleterious materials from coming in contact with and affixing to stone materials.

D. If storage is to be for a prolonged period, place polyethylene or other suitable plastic film between any wood and finished surfaces, and use also as an overall protective covering.

E. Plug all holes during freezing weather to prevent accumulation of water.

F. Do not use salt for melting of ice formed in Lewis holes or on pieces, or for any purpose involving its contact with the granite.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN MANUFACTURER

A. Basis of Design Manufacturer: Swenson Granite Co LLC, 369 N. State St, Concord, NH 03301; ASD. Phone: 603-225-4322; Fax: 603-228-2915; Web: www.swensongranite.com.

B. This shall not limit use of Granite companies provide granite and products meeting the requirements of the Work.

2.2 GRANITE

A. Granite shall comply with ASTM C 615 for material characteristics, physical requirements, and sampling for selection of granite.
   1. All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function.
   2. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling phases will be accepted provided they do not compromise the structural or durability capabilities of the material
   3. Texture and finish shall be within the range of samples approved by the design professional.
      a. Color: Concord Gray.
         1) Application: Stair treads.
         2) Application: Custom outdoor stone.
         3) Application: Curbing.
   4. Finish:
      a. Tread Face: Thermal
      b. Tread edge: cushion edge
      c. Horizontal Surfaces: Thermal (flamed)
      d. Curbing Vertical Face: Split or Rock Face
      e. Curbing Top Surface: Sawn with minimal trails

2.3 FABRICATION

A. General Requirements:
   1. Dress joints straight and at 90 degree angle to face. Shape beds to fit supports.
   2. Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone in place.
   3. Allow room for expansion of the anchoring devices where necessary.
   4. Finish exposed faces and edges of stone, except sawed reveals, to comply with requirements indicated for finish and to match final samples and mockups.
   5. Joint Width: Cut stone to produce uniform joints 3/8 inch (10 mm) or as shown on drawings.
   6. Provide chases, reveals, reglets, openings, and similar features as required to accommodate adjacent work.
   7. Grade and mark stone to achieve uniform appearance when installed. Inspect finished stone units at fabrication plant. Replace defective units.

B. Beds and Joints:
   1. Pieces shall be bedded and jointed as shown on the approved shop drawings, and bed and joint surfaces shall be cut as follows:
      a. Bed and joint surfaces shall be sawn through the full thickness of the granite piece. Bed and joint surfaces shall be 90 degrees to the face of the piece unless otherwise specified.

C. Backs of Pieces:
   1. Backs of all pieces shall be sawn to approximately true planes.

D. Incidental Cutting and Drilling:

1. Panels in excess of 100 pounds (45 kg) may include, at Installer's option, lifting clamp dimples, lewis holes, or other provisions as required to accommodate the lifting device(s) utilized by the installing contractor. Lifting holes in the top beds of panels or other locations where moisture collection is likely to occur shall be filled with non-expanding grout or high-modulus elastomeric sealant after installation and final alignment.

E. Dimensional Tolerances:
1. Variation from Rectangular Maximum out of square): +/- 1/16 inch (1.5 mm).
2. Location of Holes for anchors: +/- 1/4 inch (6 mm).
3. Hole Depth for Anchors: +/- 1/16 inch (1.5 mm).

F. Flatness Tolerances: Variation from true plane, or flat surface, shall be determined by a 4 foot dimension in any direction on the surface. Such variations on polished and honed surfaces shall not exceed the tolerances listed below or 1/3 of the specified joint width, whichever is greater. On surfaces having other finishes, the maximum variation from true plane shall not exceed the tolerance listed below or 1/2 of the specified joint width, whichever is greater.
1. Sawn finishes: 1/8 inch (3 mm).
2. Thermal finishes: 3/16 inch (5 mm).
3. Rough cut finishes: 1 inch (25 mm).

G. Packing and Loading: Finished granite shall be carefully packed and loaded for shipment using all reasonable and customary precautions against damage in transit. No material which may cause staining or discoloration shall be used for blocking or packing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify substrate is level, smooth, and capable of supporting stone imposed loads.

C. Verify grades, contours and elevations of substrate are correct.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges.

C. Set stone with joints uniform in appearance and stone edges and faces aligned to tolerances indicated.

D. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water.

3.3 PROTECTION

A. Protect installed products until completion of project.

B. Protect granite work in progress at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

3.4 CLEANING

A. Granite shall be shop cleaned at the time of final fabrication.

B. After installation and pointing or caulking are completed, carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements.

C. Stainless steel wire brushes or wool may be used, but the use of other wire brushes or of acid or other solutions which may cause discoloration is expressly prohibited.

D. Contact fabricator before using cleaners other than detergents.

END OF SECTION 044013

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SECTION 087100 - DOOR HARDWARE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Door hardware for wood doors, steel doors, aluminum framed entrance doors, all glass entrance doors, and miscellaneous hardware items.

B. Provide hardware not described herein but otherwise required for proper completion of the project, conforming to size, function, quality, and finish of other specified hardware.

C. Related Requirements: Refer to the following related specification sections (and sub-sections) for further information and proper coordination with door hardware.

	SECTION	TITLE
1.	042000	"Unit Masonry" – *for door frame anchors.*
2.	051000	"Structural Metal Framing" – *for door frame anchors.*
3.	061000	"Rough Carpentry" – *for door frame anchors.*
4.	062000	"Finish Carpentry" – *for door frame casing.*
5.	081113	"Hollow Metal Doors and Frames"
6.	081123	"Bronze Doors and Frames"
7.	081416	"Flush Wood Doors"
8.	08 8000	"Glazing" – *for door lite kits and sidelites.*
9.	089000	"Louvers and Vents" – *for door louvers.*
10.	102213	"Wire Mesh Partitions" – *for pedestrian doors with hardware.*
11.	102600	"Wall and Door Protection"
12.	210000	"Fire Protection" – *for fail safe doors tied to fire alarm system.*
13.	260000	"Electrical" – *for door hardware requiring power.*
14.	280000	"Electronic Safety and Security" – *for interface of access control devices with access control system and fire alarm system.*
15.	323100	"Fences and Gates" – *for pedestrian doors with hardware.*

1.2 REFERENCED STANDARDS

A. American Association of Automatic Door Manufacturers (AAADM).

B. American National Standards Institute (ANSI):

1. A117.1 Accessible and Usable Buildings and Facilities

C. Americans with Disabilities Act (ADA) Standards for Accessible Design.

D. Builders Hardware Manufacturers Association (BHMA):

1. A156 Door Hardware Series of Standards *(See Section 2.3)*

E. Door and Hardware Institute (DHI):
   1. ANSI/DHI/A115.IG Installation Guide for Doors and Hardware
   2. DHI Keying Systems and Nomenclature.
   3. DHI Sequence and Format for the Hardware Schedule.

F. International Building Code (IBC)

G. Massachusetts Architectural Access Board (AAB, 521 CMR)

H. National Fire Protection Association (NFPA):
   1. 70 National Electrical Code
   2. 80 Fire Doors and Fire Windows
   3. 252 Fire Tests of Door Assemblies.

I. Underwriters Laboratories Inc. (UL):
   1. 10C Positive Pressure Fire Tests of Door Assemblies
   2. 3.5 Panic Hardware
   3. 1034 Burglary-Resistant Electric Locking Mechanisms

1.3 SUBMITTALS

A. Products other than those designated herein must be approved as substitutions prior to submittal of Door Hardware.

B. Door Hardware Schedule: Vertical format conforming to DHI "Sequence and Format for the Hardware Schedule." Horizontal format schedules will be rejected without review. Format shall be ANSI Letter (8-1/2" x 11") page size. Organize Schedule into headings, grouping doors to receive same hardware items, indicating quantity and complete designations of every item required for each door opening. The schedule shall include:
   1. Cover sheet indicating name and location of Project; name of Architect; name of Contractor; name, address and phone of Hardware Supplier, name of Hardware Consultant preparing the schedule; date of submittal or revised submittal.
   2. A list of abbreviations used in schedule.
   3. An index of door openings, listed in numerical order, with hardware heading identification cross-referenced to Architect's set identification.
   4. Hardware headings shall be listed in numerical order corresponding, as closely as possible, with numerical order of Architect's set numbers.
   5. Each hardware heading shall have each door listed in numerical order according to door numbers in the Architect's door schedule, and denoting: location, configuration (single, pair, etc.), type (elevation, etc.), door and frame size(s), door and frame material(s), handing, fire rating, and key set identification.
   6. Type, complete model number, style, function, size, hand, and finish of each door hardware item.
   7. Manufacturer of each item.
   8. Fastenings and other pertinent information.

C. Manufacturer's Technical Product Data / Catalog Cut Sheets: Clearly marked for each hardware item, including installation details, material descriptions, dimensions of individual components and profiles, and finishes. Format shall be ANSI Letter (8-1/2” x 11”) page size.

D. Wiring Diagrams: No later than 14 days after receipt of reviewed hardware schedule submittal, submit detailed wiring diagrams for power, signaling, monitoring, and control of the access control system electrified hardware or other system electrified components such as sensors, switches, or indicator/ strobe lights; identified by door number(s), and detailed specifically for each type and function of electrified door opening. Format shall be ANSI Letter (8-1/2” x 11”) page size. Include the following:

1. System Description of Operation. Include description of component functions including, but not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.
2. Elevation single-line diagram, showing interface between electrified door hardware and fire alarm, power, access control, and security systems as applicable.
3. Point-to-point wiring diagram for field-installed wiring.

E. Keying Schedule: In accordance with Owner's final keying instructions for locks. Conform to DHI “Keying Systems and Nomenclature.” Format shall be ANSI Letter (8-1/2” x 11”) page size.

F. Operation and Maintenance Data: Provide complete operating and maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides.

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

H. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

B. Manufacturers, Hardware Suppliers, and Installers shall be licensed and certified with no less than five years of experience installing, commissioning, and maintaining door hardware, access control devices, and related accessories (including all of those specified herein); for projects similar in size, complexity and type.

C. Hardware Schedule and Keying Schedule submittals shall be prepared by a Hardware Consultant holding the credentials of Architectural Hardware Consultant (AHC) issued by the Door and Hardware Institute. Hardware Consultant shall have no less than five years experience in the scheduling of Door Hardware for projects similar in size, complexity and type to this Project; and shall be available, at no additional cost, during the course of the Work to consult with Contractor, Architect, and Owner regarding door hardware and keying.

D. Supplier shall submit samples indicative of door hardware to be supplied, as required by Architect and/or Owner. Samples to be advised by Architect shall include metal finishes, lever styles, door pulls, mounted locksets, accessories finishes, gasketing colors, etc.

1.5 REGULATORY REQUIREMENTS

A. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with all applicable regulations, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. At rated doors with panic exit devices, provide devices labeled as “Fire Exit Device.”

B. Comply with all applicable accessibility regulations as set forth in current/applicable versions of Americans with Disabilities Act (ADA); Accessibility Guidelines for Buildings and Facilities (ADAAG); and ANSI A117.1. 2010 Standards for Accessible Design, as applicable.

C. Latching and locking doors that are hand-activated and that are in a path of travel shall be operable with a single effort by lever-type hardware, panic bars, push-pull activating bars, or other hardware designed to be easy to grasp with one hand, not requiring tight grasping, tight pinching or twisting of the wrist; from egress side shall not require the use of a key, tool, or special knowledge for operation.

1. All hand-activated hardware shall be mounted between 34” and 48” above finished floor.

D. Door closing devices shall comply with the following maximum opening-force requirements:

	DOOR TYPES	MAXIMUM OPENING FORCE REQUIREMENTS
1.	Interior Swinging	5 lbf applied perpendicular to door at latch.
2.	Exterior Swinging	5 lbf applied perpendicular to door at latch.
3.	Fire-rated	5 lbf applied perpendicular to door at latch. To ensure latching, may be increased to the minimum force allowable by the appropriate administrative authority, not to exceed 15 lbf.

E. Where door closers are provided, adjust sweep speed so that from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.

F. Thresholds shall be maximum 1/2” in height above floor and landing on both sides of openings. Bevel raised thresholds with a slope of not more than 1:2.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Each article of hardware shall be delivered individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule.

B. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

C. Hardware shall be stored in a dry, secure locked area, complete with shelving for unpacking and sorting of the door hardware.

D. Deliver all master keys by restricted, receipted delivery directly from the manufacturer to the Owner.

1.7 COORDINATION

A. Provide hardware templates to the parties involved for doors, frames, and other work specified to be factory prepared for door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. When required by door or frame fabricator, furnish physical samples of each mortised and recessed hardware item required.

C. Coordinate layout and installation of recessed pivots and closers with floor construction.

D. Electrical System Rough-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, and security system as applicable.

E. Pre-Installation Conference: Arrange conference at job site to coordinate door, frame, hardware and electronic security hardware installation; to be attended by the Architect, Owner, Contractor and representative personnel of firms involved in the provision and installation of said items.

F. Keying Conference: Arrange conference with Owner, or designated representative, and Manufacturer’s/ Hardware Supplier’s Architectural Hardware Consultant to establish keying requirements. Incorporate keying conference decisions into Keying Schedule.

1.8 WARRANTY

A. In addition to, and not precluding, other warranty requirements in the Contract Documents, the following hardware items shall carry extended minimum warranties as indicated:

1. Hinges: 10 years from date of Substantial Completion.
2. Locks: 5 years from date of Substantial Completion.
3. Exit Devices: 3 years from date of Substantial Completion.
4. Door Closers: 10 years from date of Substantial Completion.

1.9 MAINTENANCE

A. Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. All door hardware specified is subject to compliance with local jurisdictional requirements and regulations, including those described herein.

B. Equal and/or substitute products must meet the aesthetics, features, and functions of items specified as the basis-of-design in the Hardware Sets (Part 3).

C. Provide products by one of the following Acceptable Manufacturers listed below for each Hardware Type (sorted in order of standard door hardware scheduling sequence).

NOTE : Refer also to "ANNOTATIONS" Legend (symbols) in Section 3.12.

	PRODUCT TYPE (CLASSIFICATION):	**ACCEPTABLE MANUFACTURERS (SERIES):**
HANG	Butt Hinges	Best, Ives, McKinney
	Concealed Hinges	McKinney, SOSS, Tectus
	Continuous (Geared)	ABH, Best, Ives, NGP, Pemko
	Electrical Power Transfers	ABH, Securitron, Von Duprin
LOCK	Keying (Cylinders / Cores)	Best SFIC *per Owner/Facility Key System*
	Key Storage System	Key Control Systems, Lund, Telkee
	Mortise Locks (Grade 1)	Dorma (M9000), Sargent (8200), Schlage (L)
	Auxiliary Locks (e.g., deadbolts)	Arrow, Best, Schlage
PANIC	Pushpad Exit Devices (Grade 1)	Dorma (9000), Sargent (80), Von Duprin (98/99)
	Pushpad Narrow Stile Exit Devices (Grade 1)	Sargent (8400/8500), Precision (Apex 2400/2600), Von Duprin (35A)
CLOSE	Surface Door Closers (Grade 1 Heavy Duty)	Dorma (8900), LCN (4010), Norton (7500), Sargent (351)
	Surface Door Closers (Grade 1 Medium/Standard Duty)	Dorma (8600), LCN (4030), Norton (8000), Sargent (1431)
	Cam Action / Track Arm Door Closers	Dorma (TS93), LCN (4040XPT), Norton (2800ST), Sargent (422)
AUTOMAT	Low Energy Automatic Operators (Surface, Low Profile)	Besam (SW150 Slim), Dorma (ED100/250), Nabco (GT20), Norton (6300)
	Actuators / Sensors / Bollards	All Manufacturers specified above; *plus* Alarm Controls, BEA, Securitron, Wikk Industries
STOP	Door Bolts and Coordinators (Automatic, Flush, Surface)	ABH, Ives, Rockwood, Trimco
	Mechanical Door Holders / Stops (Overhead, Concealed)	ABH, Glynn-Johnson, Rockwood, Rixson

PROTECT	Auxiliary Hardware	ABH, Ives, Rockwood
	Architectural Door Trim	ABH, Ives, Rockwood
	Door Bottoms, Metal Thresholds, Weatherstripping and Gaskets	NGP, Pemko, Zero
SECURE	☼ Electric Strikes (Frame/Jamb)	HES, RCI, Von Duprin
	☼ Electric Strikes (Overhead)	CRL, Folger Adams
	ⓘ Motion Sensors	Alarm Controls, Securitron, SDC *by Security Vendor (per spec section 280000)*
	ⓘ Card Readers and Credentials	*Compatible with Base Building Card Readers* *by Security Vendor (per spec section 280000)*
	ⓘ Door Position Switches	G.E. Security, Securitron, SDC *by Security Vendor (per spec section 280000)*
	ⓘ Access Control Accessories (e.g., buttons, switches, relays)	Alarm Controls, Securitron, SDC
	☼ Power Supplies for Electrified Door Hardware (Unsecured Doors)	Alarm Controls, Dormakaba, Securitron, SDC, Von Duprin.

2.2 MATERIALS AND FABRICATION

A. Requirements for grade, materials, size, and other distinctive qualities of each type of door hardware are indicated herein. Furnish items in types, sizes or weight, in accordance with manufacturer's standards, appropriate for the conditions of installation and service, unless otherwise indicated.

B. Products named or identified by make or model number, or other designation and described herein are base products. Base products establish the standards of type, in-service performance, physical properties, appearance, warranty, cost, and other characteristics required by the Project.

2.3 DOOR HARDWARE REQUIREMENTS AND GUIDELINES

A. Door hardware shall meet and conform to the following requirements (items listed in order of door scheduling sequence):

	HARDWARE ITEM	**ANSI/BHMA REQUIREMENT(S)**
1.	Materials and Finishes: *(See Section 2.4)*	ANSI/BHMA A156.18
2.	Butts and Hinges (e.g., sizes, templates):	A156.1, A156.7
3.	Continuous Hinges (e.g., geared, pinned):	A156.26
4.	Cylinders and Input Devices for Locks:	A156.5
5.	Mechanical Keying Systems:	A156.28
6.	Mortise Locks:	A156.13 (Grade 1)
7.	Auxiliary Locks (e.g., deadbolts):	A156.36
8.	Electrified Locks (hard-wired):	A156.25 (Grade 1)
9.	Exit Devices and Accessories:	A156.3 (Grade 1)

10.	Electrified Exit Devices:	A156.25, UL 305
11.	Panic Exit Devices:	UL305
12.	Fire Exit Devices and Mullions:	NFPA 80, UL305, NFPA 252
13.	Electric Strikes:	A156.31 (Grade 1), UL 1034
14.	Automatic / Manual Flush Bolts:	A156.3 / A156.16
15.	Auxiliary Hardware (e.g., door stops, dust proof strikes, silencers):	A156.16
16.	Door Coordinators:	A156.3
17.	Surface Door Closers:	A156.4 (Grade 1)
18.	Overhead Stops and Holders:	A156.8
19.	Power Assist & Low Energy Power Operators (incl. safety sensors, features):	A156.19; A156.31
20.	Actuators (frame-mounted):	A156.31
21.	Release Devices: Closer Holders, Electromagnetic and Electromechanical.	A156.15
22.	Architectural Door Trim: (e.g., protection, edging, astragals)	A156.6 (UL labeled as scheduled)
23.	Gasketing and Edge Seal Systems (e.g., astragals, perimeter seals, door bottoms, weatherstripping):	A156.22
24.	Thresholds:	A156.21
25.	Electrical Power Transfers, Door Position Switches:	(listed and labeled by testing agency acceptable to authorities having jurisdiction.
26.	Power Supplies:	UL listed, Class 1 and 2 outputs.

B. FASTENERS:

1. Provide concealed fasteners for hardware items on exterior doors which are exposed when door is closed.
2. Combination machine screws and expansion shields shall be used for attaching hardware to concrete or masonry.
3. Fasteners exposed to the weather in the finished work shall be of brass, bronze, or stainless steel.

C. BUTT HINGES:

1. Base Metal shall be steel plated for fire-rated doors; bronze or stainless steel for exterior out-swinging doors; bronze or plated steel elsewhere as scheduled.
2. Provide hinges with antifriction bearings for doors with closers.
3. Provide hinge weights/ gauges for doors as follows:
   a. Doors to 1-3/4” thick and 36” wide: Standard Weight.

b. Doors over 36” wide: Heavy Weight

c. Doors over 1-3/4” thick: Heavy Weight.

4. Unless otherwise indicated, provide hinges in heights as follows:

a. Doors over 1-3/4” thick shall be per hinge manufacturers published listings and recommendations, and as follows:

b. Doors to 36” wide: 4-1/2”.

c. Doors over 36” to 48” wide: 5”.

d. Doors over 48” wide: 6”.

5. Provide in minimum width sufficient to clear trim when door swings 180 degrees, whether or not shown on Drawings to swing 180 degrees.

6. Number of hinges per leaf shall be as follows:

a. Doors up to 60” in height: 2 hinges

b. Doors over 60” to 90” in height: 3 hinges

c. Doors over 90” to 120” in height = 4 hinges

d. For doors over 120” in height: 4 hinges plus 1 hinge for every 30”, or fraction thereof, door height greater than 120”.

7. Screws: Flat head wood screws not less than 1-1/2” long for hinges for wood doors; flat head machine screws elsewhere.

8. Hinges for reverse bevel doors with locks shall have pins that are made non-removable when the door is in the closed position by means of a set screw in the hinge pin barrel.

9. Electrified hinges:

a. Coordinate number and size of wires for electrified hardware served.

b. Provide junction box/ mortar shield for each electrified hinge.

D. CONTINUOUS GEARED HINGES:

1. Type: Heavy duty assembly of 3 interlocking aluminum extrusions. Door leaf and jamb leaf shall be continuously geared together the full hinge length; secured together with full length cover channel permitting 180 degree operation. Vertical door loads carried on integrated thrust bearings spaced no more than 3” apart.

2. Hinges shall have non-removable cap at hinge top to prevent foreign material from becoming lodged in hinge gear mechanism.

3. Unless otherwise noted, provide factory finished to match door and frame finish.

4. Hole pattern for fasteners shall be symmetrical and located to template dimensions.

E. CONCEALED HINGES

1. A. Concealed Hinges: Hinges mortised into door and frame so that they are concealed when the door is closed.

2. Hinges shall be adjustable three ways:

a. Vertically

b. Horizontally

c. Compression (in/out) (i.e., capable of a 180-degree swing).

3. Hinges are to be non-handed.
4. Provide fastener type, size, and quantity as recommended by hinge manufacturer for properly installing concealed hinges in the door and frame type application.
5. Provide steel receiver for metal door and frame cutouts for receiving concealed hinges.

F. CYLINDERS, KEYING AND KEY STORAGE:

1. All cylinders shall be interchangeable core type, unless otherwise directed by Owner.
2. A new great grand master keying system shall be provided unless otherwise instructed by the Owner.
3. Cylinders shall be keyed according to approved Keying Schedule.
4. Contractor to provide a temporary keying system for interim use during construction.
5. Upon close of project, City Locksmith shall change out temporary cores for City Master Key System.
6. ~~Provide change keys in individual envelopes for each cylinder delivered. Envelopes shall be marked with respective door identification numbers.~~
7. ~~Key set symbol, and inscription "Do Not Duplicate" shall be stamped on all keys.~~
8. ~~Key set symbol shall be concealed stamped on all cylinders/ removable/ Interchangeable cores unless otherwise directed by the Owner.~~
9. ~~Keys shall be supplied as follows:~~
   a. ~~Locks: 3 change keys each lock.~~
   b. ~~Master keyed sets: 2 keys each set.~~
   c. ~~Grand master keys: 5 total.~~
   d. ~~Great Grand master keys: 5 total.~~
   e. ~~Interchangeable Core control keys: 2 total.~~
   f. ~~Construction keys: 10 total.~~
   g. ~~Blank keys: 100 total.~~
10. Provide Key Storage / Control System conforming to ANSI/BHMA A156.5, including key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers. Contain system in metal cabinet with baked-enamel finish and key locking door.
    a. Key tags and holders shall be inscribed with key-change number and key-control to conform with approved hardware schedule for identification.
    b. Key Storage System shall be large enough to accommodate 150 percent of the facility.
11. Subject to compliance with requirements, provide emergency entrance key vault(s); Knox Company 3200 Series, or equal.
    a. Finish Color - Black, Dark Bronze or Aluminum as selected by Architect.
    b. Where indicated provide security key override switches for electrically activated openings.
    c. Coordinate and provide keying and type per fire/police department, and other jurisdictional agency requirements.

G. LOCKSETS AND LATCHSETS:

1. Operating trim style(s) shall match across all latching hardware (unless specified otherwise); and shall be as follows:

MANUFACTURER	ROSE	LEVER	THUMB-TURN
Dorma	A	L118	ADA
Sargent Manuf.	LN	MD	130LB
Schlage	A	LAT	09-509

2. Provide Vandal Resistant Trim as directed by Owner.
3. Lock functions which include thumb turn trim shall be provided with thumb turns compliant with accessibility code requirements.
4. Lock Throw: Comply with requirements for length of latch bolts on single and pair of doors to comply with labeled fire door requirement.
5. Lock backset shall be 2-3/4” unless otherwise indicated.
6. Provide curved-lip strike with dust box for each latch or lock bolt, with lip extended to protect frame, finished to match door hardware set, unless otherwise indicated.
7. Electromechanical locksets utilized at fire-rated openings shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction and shall maintain door in positive latched position when power is off.

H. FLUSH BOLTS:

1. Bottom bolt shall have 12” long operating rod. Top bolt operating rod shall be determined by door height, assuring the operator is located less than 72” above the floor.
2. Manual Flush Bolts are not to be utilized except where a pair of non-rated doors serving a room not normally occupied is needed for the movement of equipment.

I. EXIT DEVICES:

1. Operating trim lever style(es) shall match across all latching hardware; unless specified otherwise. Lever style shall be as follows:

MANUFACTURER	DOOR PULL	ESCUTCHEON	LEVER
Dorma	Y	L118	OP
Sargent Manuf.	ET	MD	862
Von Duprin	996	LAT	392-7

2. Provide Vandal Resistant Trim as directed by Owner.
3. Actuating portion of exit device bars shall extend across not less than one-half the width of the door leaf.
4. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
5. Adjustable strikes shall be provided for rim type and vertical rod devices.
6. Exit Devices at exterior and/or secured door openings shall be supplied without dogging.

7. Fire Exit Devices: Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
8. Electromechanical exit devices utilized at fire-rated openings shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction, and shall maintain door(s) in positive latched position when power is off.

J. ELECTRIC STRIKES:

1. Electric strikes for fire-rated openings shall be listed and labeled for such use by a testing agency acceptable to authorities having jurisdiction. Fail Secure (fail locked) strikes shall be used at all fire-rated openings.

K. SURFACE DOOR CLOSERS:

1. Surface closers shall be fully adjustable with sweep speed, latch speed and back check position valves.
2. Provide closers size adjusted in accordance with ANSI/BHMA A156.4; sized as required to ensure closing and latching of doors.
3. Arm selection shall follow the requirements of the manufacturer's recommendations with brackets, drop plates and miscellaneous accessories provided as necessary.
4. Provide closers with arms designed to permit openings of doors as far as job conditions will permit; unless otherwise indicated closers with arms restricting opening of door will not be acceptable.
5. Provide heavy-duty dead stop arm closers when door closer is on the push/ parallel arm side of the door and if conditions do not permit installation of floor or wall stop per PART 2, Auxiliary Hardware and PART 3, Door Closing Devices.
6. Provide opening force as required per Specification PART 1, Regulatory Requirements.

L. DOOR COORDINATORS:

1. Door coordinator mounting brackets to accommodate required hardware.
2. Provide carry bar at each pair of doors equipped with an overlapping astragal, except when automatic or self-latching bolts are used.

M. OVERHEAD HOLDERS AND STOPS:

1. Overhead door holders and stops shall be adjustable from 90 to 110 degrees dead stop or hold open position, as applicable.
2. Overhead door stops shall have shock absorbers providing 5 to 7 degrees compression before dead stop.
3. Overhead stops shall not be provided with hold open function when used at fire-rated doors.

N. AUTOMATIC AND LOW ENERGY DOOR OPERATORS:

1. Surface Applied Operator: The operator header shall be mounted to the surface of the door frame or wall. Connecting hardware shall be a double arm arrangement that can either push the door or pull the door open to suit the job condition. Provide parallel arm when operator mounting is on the pull side, and adjacent wall is within 4” of the door frame. Provide fire labeled unit for use at rated doors.

2. Overhead Concealed Operator: The operator header shall be mounted directly over the door and serve as the door frame header. The operator output shaft shall connect to an arm that transmits power to the door via a slide block which moves in track that is recess mounted in the top of the door.
3. In-Floor Operator Converter: Manufacturer's specialized unit to adapt specified automatic swing door operator to in-floor use. The converter shall be mounted beneath the door leaf and jamb area utilizing a standard pivot setback. Heavy-duty pivot shall incorporate 1200 pound rated, sealed thrust bearings in 1” steel bearing plate.
4. Automatic Operators to be installed and field adjusted by an AAADM Certified Professional.
5. Power operation shall be activated by actuator or sensor as scheduled.
    a. Actuators shall be wall-mounted and labeled with “Push to Open”, unless noted otherwise.
6. Operation and Functionality:
    a. Door shall not open to back check faster than 3 seconds, and shall require no more than 15 lbf applied 1” from latch edge to stop door movement.
    b. Door shall remain in fully open position for no less than 5 seconds (6 per MAAB).
    c. Door shall close from 90 degrees to 10 degrees no faster than 3 seconds, and 10 degrees to fully close no faster than 1-1/2 seconds (or from 90 degrees to fully closed is 6 seconds, per MAAB).
    d. Power operation shall be activated by push plate switch, or other actuators as indicated.
7. Provide UL labeled operators at fire-rated openings. Provide power-disconnect interface to Fire Alarm; doors to be self-closing and latching, in full compliance with Code requirements for "Fire Assembly, Self-Closing" doors.
8. Provide UL labeled operators at smoke barrier openings. Provide hold-open circuitry and power-disconnect interface to Fire Alarm; doors to be automatic closing and latching, in full compliance with Code requirements for "Fire Assembly, Automatic Closing" doors.
9. Provide opening force as required per Specification PART 1, Regulatory Requirements.
10. Control Features
    a. Power-hold Close
    b. Built in Lock Delay
    c. On-Off-Hold Open switch control to control door function, (Automatic-Hold Open- Exit Only)
    d. On-Off Power Switch
    e. Fire Alarm Integration
    f. Field Adjustable Handing
    g. Push and Go
    h. Power Assist Opening Activation
    i. Intergraded Connections for Monitored Safety Sensors and other accessories.

j. Integrated access control

11. Door Control Features
    a. Wind Load and Stack Pressure microprocessor monitored with power boost to ensure secure opening and closing in changing conditions.
    b. Door Weight Max. ED 250 - 600 lbs.
12. Header Size: Fine header height at 2 ¾" by 5" 1/8" depth.
13. Safety Devices
    a. Provide door controls in accordance with ANSI/BHMA standards A 156.19 and complying with cited BHMA standard for condition of exposure and for long-term, maintenance-free operation under normal traffic load. When presence sensors are used, they shall be monitored in accordance with ANSI/BHMA A 156.10. Coordinate controls with door operation and door operators.
    b. Adaptive Door Mounted Sensor System (Basis of Design):
        1) Adaptive Door Mounted Safety Systems (ADMSS): Door mounted presence sensor, where the sensor shall be mounted on both the swing (pull) side and the approach (push) side of the door. No header mounted sensor is required.
        2) The sensor shall provide a full detection pattern that covers the entire swing path of the door and provides detection in the fully open and full close position. While the door is in motion, the pattern shall be capable of providing door panels from 24" to 48"
        3) The sensor will provide secondary activation as required for "knowing act" doorways.
        4) Sensors to be field installed and adjusted in accordance with applicable safety standards.
    c. System will reactivate a closing door, stop/stall an opening door, keep a closed door closed and keep an open-door open if a person is within the detection zone of the sensors.
14. Electrical
    a. Electrical 115 V AC +/- 10% 50/60 Hz 6.6 A max.
15. Bollards to meet basis-of-design products specified, fabricated from 7 gauge formed stainless steel per metal finish specified, with welded flat top, cutouts and hood/flange for electrified devices, surface/concealed base plate with standard mounting bolts, coordinated with ground material to prevent water infiltration. Refer to Architectural Drawings for more locations and details.

O. ELECTROMAGNETIC HOLDERS/RELEASES:
1. Size and configuration shall provide degree of swing and hold open position as indicated on the drawings.

P. ARCHITECTURAL DOOR TRIM:
1. Door Protection Plates: Kick, mop, and armor plates shall be 0.050” thick brass, bronze, or stainless steel depending on finish indicated. Plates shall have beveled edges and shall be provided with countersunk mounting holes and No. 6 oval head screw fasteners.
    a. Width of kick and armor plates shall be 2” less than door width for single doors and 1” less for pairs of doors.

b. Width of mop plates shall be 1” less than door width.

c. Unless otherwise indicated, height shall be 10” for kick and mop plates, and 34” for armor plates.

d. When door protection items are not indicated in Hardware Sets, then refer to Door Schedule and/or Drawings for required locations.

e. At fire-rated doors, provide UL labeled protection plates in sizes, types, fasteners and materials only in accordance with door manufacturer's listings for respective ratings.

2. Door Edging and Astragals: Fabricated from 18 gauge cold-rolled steel or 304 stainless steel as indicated; factory prepared for all mortise hardware; countersunk screw mounting.

a. At fire-rated doors, provide UL labeled edge protection in sizes, types, fasteners and materials only in accordance with door manufacturer's listings for respective ratings.

3. Push and pull plates shall be 0.050” thick brass, bronze, or stainless steel depending on finish indicated.

a. Plates shall have beveled edges, and shall be furnished with countersunk mounting holes and No. 6 oval head screw fasteners.

b. Pull plates shall also be furnished with flat-head through bolts for pull grip.

4. Push and pull bars and grip handles shall be brass, bronze, or stainless steel depending on BHMA finish indicated.

5. If architectural door trim is not scheduled in the hardware sets; then refer to Architectural Drawings and/or Door Schedule for required locations.

Q. AUXILIARY HARDWARE:

1. Door Stops: Stops shall be of heavy-duty construction, provided in finish indicated. Wall bumpers shall have no visible fasteners. Floor stops shall be of height required by floor conditions. Unless otherwise indicated, provide stops at all doors as follows:

a. Supplier shall only provide one Door Stop per door leaf. When multiple options are specified, the preferred type shall be supplied *in lieu of* any others.

b. At exterior, out-swinging doors provide overhead stop or heavy-duty stop function on door closer arm. At all other doors provide wall bumpers if conditions permit, or otherwise floor stops. Where it is not possible to properly place a floor stop due to tripping hazard or any other condition, or wall type stop due to device on door not striking wall or any other condition, provide heavy duty concealed overhead type stop, or heavy-duty stop dead stop arm in door closer when door closer when installed parallel arm/ push side of door per Specification PART 3, Door Closing Devices.

2. Silencers: Gray rubber, non-marring configured for metal or wood frames as scheduled. Provide 3 per single door and 2 per pair of doors.

a. Silencers shall be tamper resistant once installed in door frame.

b. Silencers may be omitted at openings where door frames are provided with integral seals if integral seals satisfy all applicable Codes and Regulations.

R. DOOR BOTTOMS:

1. Door bottoms shall be of aluminum or extruded bronze of the type and finish indicated and shall provide proper clearance and an effective seal with specified thresholds.
2. Door bottom shall have a vinyl, neoprene, silicone rubber, polyurethane or brush seal as indicated.
3. The door bottom shall exclude light when the door is in the closed position and shall inhibit the flow of air through the unit.
4. Coordinate door bottom/sweep with full width of door leaf, perimeter gasketing, pivots, continuous hinges, and any other door hardware occupying the same space.

S. METAL THRESHOLDS:

1. Thresholds shall be heavy-gauge aluminum or bronze of the configuration and finish indicated, and shall provide an effective seal with door bottom.
2. Where required, thresholds shall be prepared to accommodate floor closers, pivots, and projecting bolts of latching hardware.
3. Thresholds at floor closers shall have mitered returns and removable access portion for floor closer maintenance.
4. Provide thresholds at doors where indicated. Refer to Door Schedule and Drawing details for type and configuration required. Additionally, where combustible flooring passes under doors, provide fire door thresholds in accordance with applicable regulatory requirements.

T. METAL HOUSED TYPE WEATHERSTRIPPING:

1. Metal Housed Type Weatherstripping shall be aluminum or bronze of the type and finish indicated, comprised of metal retainers with vinyl, neoprene, silicone rubber, polyurethane or brush inserts as indicated.

U. GASKETING:

1. Shall be a compression type product for use with wood or steel doors; labeled for use on smoke-control and fire-rated doors where required.
2. Gasketing may be omitted at openings where door frames are provided with integral seals if integral seals satisfy all applicable Codes and Regulations.

V. ELECTRICAL POWER TRANSFERS:

1. Electrical power transfers shall be capable of transferring sufficient electrical current to properly operate electrified hardware in door.
2. Electrical power transfers used on fire-rated doors shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

W. DOOR POSITION SWITCHES:

1. Door position switches used on fire-rated doors shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
2. Security Drawings and Specifications (Section #280000) supersede this specification for locations of all Electronic Access Control components, accessories, and wiring.

X. POWER SUPPLIES FOR ELECTRIFIED HARDWARE:

1. Output shall be filtered and regulated. Relay, timer, and logic modules shall be provided as required for interface to related security components; and shall be assembled, connected, and fully contained within the power supply enclosure. A fire alarm emergency release input terminal shall be provided for connection to fire / life safety system at fire-rated openings.
2. Power supplies shall provide sufficient power capacity for the worst-case condition that could occur in the operating environment without any loss or degradation of operation.

2.4 FINISHES

A. Metal finish(es) shall match at each door opening as scheduled; unless specified otherwise.

B. Comply with base material and finish requirements indicated by the following:

BHMA	U.S.	DESCRIPTION	BASE MATERIAL
(612)	US10	Satin Bronze, Clear Coated	Bronze
(626)	US26D	Satin Chromium Plated	Brass, Bronze
(630)	US32D	Satin Stainless Steel (300 Series)	Stainless Steel
(639)	US10	Satin Bronze Plated, Clear Coated	Steel
(689)	SP28	Aluminum Painted	Brass
(691)	SP10	Light Bronze Painted	Brass
(716)		Satin Bronze Plated, Clear Coated	Steel
(719)		Mill Finish Aluminum, Uncoated	Aluminum
(BLK)		Black Color (Match EACH Frame's Finish)	Polymer
(CLR)		Clear (Match EACH Frame's Finish)	Polymer
(DRK)		Dark Brown (Match EACH Frame's Finish)	Polymer
(GRY)		Gray Color (Match EACH Frame's Finish)	Polymer
(TAN)		Tan Color (Match EACH Frame's Finish)	Polymer

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine doors and frames for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine rough-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Steel doors shall be factory prepared for hardware per ANSI/BHMA A156.115.

B. Wood doors shall be factory prepared for hardware per ANSI/BHMA A156.115W.

C. Installation shall be in accordance with DHI A115.IG.

D. Hardware for fire door assemblies shall be installed conforming with NFPA 80, and all other applicable building codes and regulations.

E. Hardware for smoke door assemblies shall be installed conforming with NFPA 105, and all other applicable building codes and regulations.

F. Install each door hardware item according to manufacturer's printed instructions, utilizing templates and proper fasteners provided by manufacturer.

G. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

H. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in other Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

3.3 PUSH-PULL PLATES

A. Pull plate grip handles shall be through bolted through the door. When push plate is indicated on opposite door side, through bolts shall be countersunk with push plate mounted to conceal through bolts.

3.4 KEY CONTROL STORAGE SYSTEMS

A. Key control storage system shall be installed where directed by the Owner.

B. Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.

3.5 DOOR CLOSING DEVICES

A. Surface closers on doors opening to or from halls and corridors shall be mounted on the room side of the door.

B. Surface closers on doors opening into stairs or stair vestibules shall be mounted on the stair or stair vestibule side of the door.

C. Surface closers on exterior doors shall be mounted on the interior side of building utilizing regular arm, or parallel arm mounting as required.

D. Door closing devices with adjustable spring power shall be adjusted for proper door operation, and compliance with all applicable codes and regulations.

E. Cutting of gasketing or weatherstripping to accommodate closer installation is not acceptable.

3.6 ASTRAGALS

A. Unless otherwise indicated install overlapping astragals as follows:

1. At out-swing pairs of doors, mount astragal on active leaf.
2. At in-swing pairs of doors, mount astragal on inactive leaf.

3.7 THRESHOLDS

A. Thresholds shall be secured with a minimum of 3 fasteners per single door width and 6 fasteners per double door width with a maximum spacing of 12”; with a minimum of 1” thread engagement into the floor or anchoring device used. Thresholds over 6” in width shall be secured with a double row of fasteners.

B. Exterior thresholds shall be installed in a bed of sealant with combination expansion anchors and stainless-steel machine screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws.

3.8 HARDWARE LOCATIONS

A. Unless otherwise indicated install hardware as follows:

	COMPONENT(S)	REQUIRED MEASUREMENT(S)
1.	Bottom Hinge:	10” from door bottom to bottom of hinge.
2.	Top Hinge:	5” from door top to top of hinge.
3.	Center Hinge(s) or Pivot(s):	Spaced equidistantly between top and bottom hinges/ pivots.
4.	Lockset / Latchset:	38” from finished floor to center of lever.
5.	Exit Device:	38” from finished floor to device centerline.
6.	Deadlock:	32” from finished floor to center key cylinder / thumb turn.
7.	Push Plate/ Pull Plate:	42” from finished floor to center of pull.
8.	Wall Bumper:	Centered at point on wall where lever, or other operating trim, first makes contact with wall.
9.	Floor Stop:	Adjacent to wall; not to exceed 4” from face of wall; located 3” from latch edge of door; in any case never more than 50 percent of door width from latch edge of door.

3.9 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended.

B. Engage a factory-authorized service representative to adjust door closing devices, compensating for final operation of heating and ventilating equipment, and to comply with referenced accessibility requirements.

C. Follow-up Adjustment: Approximately 6 months after date of Substantial Completion, Installer shall perform the following:

1. Examine and readjust each item of door hardware as necessary to ensure function of door hardware.
2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

D. Adjust door closers, operators, and controls for smooth and safe operation.

3.10 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant:

1. Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
2. Independent Architectural Hardware Consultant shall inspect door hardware and prepare written report whether installed work complies with or deviates from requirements, whether door hardware is properly installed and adjusted, and prepare a specific list of any deficiencies, a copy of which shall be provided to Architect.
3. Contractor shall correct all deficiencies noted in above report.
4. Independent Architectural Hardware Consultant shall re-inspect door hardware and prepare a report certifying correction of deficiencies and compliance with requirements.

3.11 COMPLETION

A. When complete all hardware shall be properly secured in place and all exposed surfaces shall be clean and free from scratches, paint, and other defects and damages.

B. Contractor shall demonstrate that all keys properly operate the locks as identified in the approved Keying Schedule.

3.12 DOOR HARDWARE SETS

A. Door Hardware Sets are a general listing of hardware requirements. The Contactor and Door Hardware Supplier are required to convert these condensed citations into complete and current manufacturer product numbers; and are also required to supply hardware items that are required by established standards and practices to meet state and local codes, even if not cited herein.

B. Hardware Set Line Items are “basis-of-design” products, per Owner Facility Standards and/or Architect Aesthetic Preferences. Refer to Part 2 for approved equal manufacturers.

C. Refer to Architectural Drawings for “Door Schedule”, which supersedes ALL citations and descriptions specified herein; especially Hardware Sets assigned to each Door Number (including “Suffixes” from the “Hardware Set Numbering Legend” below, if applicable).

D. Hardware Sets may exclude Lever Styles and/or Metal Finishes, which are specified above in Part 2.3 and Part 2.4, respectively.

E. Contractor and/or Door Hardware Supplier to coordinate ( ) “metal finish” and/or “color” (e.g., white, tan, gray, black, etc.) of Door Trim, Gasketing, and Accessories. These finishes are intentionally omitted from the hardware sets due to further/future field coordination required with finishes for doors, frames, walls, and floors.

F. Operational Narratives are specified for coordination and educational purposes only. Requirements conveyed in Security Drawings, Door Elevations, and/or Riser Diagrams (by Others) shall supersede all Electrified hardware ( ) and descriptions specified herein.

HARDWARE SET NUMBERING LEGEND

SUFFIX	DESCRIPTION	
• ___ **No**	SATIN CHROME (e.g., 626, 630, 689, 719, GRY)	*…Refer to Spec Section 2.4*
• ___**.1**	SATIN BRONZE (e.g., 612, 639, 691, 716, TAN)	*…Refer to Spec Section 2.4*

MANUFACTURER'S ABBREVIATIONS *~ parent company/group*

**hyperlinks to websites embedded below*

ALC	Alarm Controls	*~ assa abloy*
BEA	BEA Sensors	*~ halma*
CRL	CR Laurence	
DOR	Dorma	*~ dormakaba*
MCK	McKinney	*~ assa abloy architectural door accessories*
PEM	Pemko	*~ assa abloy architectural door accessories*
RIX	Rixson Door Controls	*~ assa abloy*
ROC	Rockwood Manufacturing	*~ assa abloy architectural door accessories*
SAR	Sargent Manufacturing	*~ assa abloy*
SEC	Securitron	*~ assa abloy electronic security hardware*
SOS	SOSS Door Hardware	
VON	Von Duprin	*~ allegion*

ANNOTATIONS LEGEND		***Specified and Supplied under Specification Section:***
⚠	**Special/Vital Note**	***(Pertinent to ALL Spec Sections)***
	Coordinate as Noted	*(087100) "Door Hardware"*
	Mechanical Key	*(087100) "Door Hardware"*
	Key Storage (cabinet)	*(087100) "Door Hardware"*
	Electric (wired)	*(087100) "Door Hardware"*
	Tied to Fire Alarm	*(087100) "Door Hardware"*
	Automatic Opening	*(087100) "Door Hardware"*
	Items by Others	*(081123) "Bronze Doors and Frames"*
		(102213) "Wire Mesh Partitions"
		(323100) "Fences and Gates"
	Wiring Harness(es)	*(280000) "Electronic Safety and Security"*

HARDWARE SET 1.1

*Exterior Bronze **Pair** ~ Egress, Automatic, Secured, Remote Activation*

Location: Lobby

	2	Electrified Hinge (continuous)	_FM-HD-SER (match door/frame finish/color)	PEM
	1	Exit Device (narrow conc. rods)	PA-QEL-RX-3547A-NLOP (nightlatch, primary)	VON
	1	Exit Device (narrow conc. rods)	PA-RX-3547A-EO (exit only, secondary)	VON
	2	Door Pull (straight)	RM302 (1 ¼" ∅, 18" length, beneath keyway)	ROC
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Automatic Operator (active door leaf)	ED250-FC (narrow profile, full power)	DOR
	2	Touchless Actuator (narrow size)	10MS31J	BEA
	1	Door Closer (secondary door leaf)	TS93 (low profile, coord. w/glass)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	2	Astragal / Gasketing (integral)	*by Door Assembly Manufacturer*	
	1	Weatherstripping (integral)	*by Door Assembly Manufacturer*	
	1	Perimeter Seals (head/jambs)	*by Door Assembly Manufacturer*	
	1	Threshold (thermal)	*by Door Assembly Manufacturer*	
	1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
	2	Door Position Switch (per door leaf)	*by Security Vendor*	
	1	Card Reader (narrow size)	*by Security Vendor*	
	1	Intercom (outside)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

NOTE : Balance of door hardware by door assembly manufacturer.

NOTE : Automatic Operator must be installed and field adjusted by AAADM Certified Professional.

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Doors normally closed (Auto Operator, Door Closer), latched and secured (Electrified Exit Device); unless programmed/scheduled unlocked via Access Control System.*
  - *Door Position Switches monitor door positions.*
  - *Upon reclosure of doors, conditions return to normal status.*
  - *Upon loss of power, Exit Device remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily retracts Exit Device vertical rods and shunts door position switces, allowing manual ingress (either door leaf).*
  - *Authorized credential to Card Reader then motion detected by Touchless Actuator (outside), momentarily retracts Exit Device vertical rods and shunts door position switches; then activates Automatic Operator, allowing accessible ingress (primary door leaf).*
  - *Key override retracts Exit Device vertical rods (by authorized personnel or emergency responders only), bypasses access control, allowing emergency ingress (primary door leaf).*

- *EGRESS:*
  - *Motion detected by Touchless Actuator (inside) momentarily retracts Exit Device vertical rods and shunts door position switches; then activates Automatic Operator, allowing accessible egress (primary door leaf).*
  - *Exit Device pushbar (inside) built-in request to exit switch shunts Door Position Switch, and always allows egress (either door leaf).*

HARDWARE SET 2.1

*Exterior Metal / Glass **Pair** ~ Egress, Secured*

Location: Multipurpose Room

	2	Electrified Hinge (continuous)	_FM-HD-SER (match door/frame finish/color)	PEM
	1	Exit Device (rim, primary)	PA-QEL-RX-98-LNL (nightlatch, rigid lever)	VON
	1	Exit Device (rim, secondary)	PA-RX-98-EO (exit only)	VON
	1	Mullion (removable, keyed)	KR	VON
	2	Cylinder / Core (key override, mullion)	*per Owner / Facility Key System*	
	2	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	2	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	1	Astragal Set (split)	351_PK (match door finish/color)	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
	2	Door Position Switch (per door leaf)	*by Security Vendor*	
	1	Card Reader (narrow size)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Door normally closed (Door Closer), latched and secured (Electrified Exit Device).*
  - *Door Position Switch monitors door position.*
  - *Upon reclosure of door, conditions return to normal status.*
  - *Upon loss of power, Exit Device remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily unlocks Electric Exit Device and shunts built-in door position switch, allowing manual ingress (primary door leaf).*
  - *Key override to Exit Device (by authorized personnel or emergency responders only) bypasses access control, allowing emergency ingress (primary door leaf).*

- *EGRESS:*
  - *Exit Device pushbar (inside) built-in request to exit switch shunts Door Position Switch, and always allows egress (either door leaf).*

HARDWARE SET 3.1

Exterior Metal ~ Egress, Secured

Location(s): Corridor / Exterior

	1	Electrified Hinge (continuous)	_FM-HD-SER (match door/frame finish/color)	PEM
	1	Electric Exit Device (rim, fail secure)	RX-QEL-PA-98-LNL (latch retract, rigid lever)	VON
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	1	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Door Top Weatherstrip (if required)	346 (match outside frame color)	PEM
	1	Door Position Switch (per door leaf)	*by Security Vendor*	
	1	Card Reader (narrow size)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Door normally closed (Door Closer), latched and secured (Electric Exit Device).*
  - *Door Position Switch monitors door position.*
  - *Upon reclosure of door, conditions return to normal status.*
  - *Upon loss of power, Exit Device remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily unlocks Electric Exit Device and shunts built-in door position switch, allowing manual ingress.*
  - *Key override to Electric Exit Device (by authorized personnel or emergency responders only) bypasses access control, allowing emergency ingress.*
- *EGRESS:*
  - *Electric Exit Device pushbar (inside) built-in request to exit switch shunts Door Position Switch, and always allows egress.*

HARDWARE SET 4.1

Exterior Metal ~ Egress, Monitored

Location(s): Corridor / Exterior

1	Hinge (continuous)	_FM-HD (match door/frame finish/color)	PEM
1	Exit Device (rim, night-latch)	PA-98-LNL (rigid lever)	VON
1	Cylinder / Core	*per Owner / Facility Key System*	
1	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
1	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
2	Weatherstrip (adjustable, jambs)	379_PK	PEM
1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
1	Door Top Weatherstrip (if required)	346 (match outside frame color)	PEM
1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
2	Door Position Switch (per door leaf)	*by Security Vendor*	

NOTE : Motion detected by Request to Exit (within narrow activation zone) shunts Door Position Switches upon egress.

HARDWARE SET 5.1

Exterior Metal ~ Locked, Monitored

Location(s): Service Catwalk, Storage

1	Hinge (continuous)	_FM-HD (match door/frame finish/color)	PEM
1	Lock (mortise, storeroom)	8204	SAR
1	Cylinder / Core	*per Owner / Facility Key System*	
1	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
1	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
2	Weatherstrip (adjustable, jambs)	379_PK	PEM
1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
1	Door Top Weatherstrip (if required)	346 (match outside frame color)	PEM
1	Door Position Switch (per door leaf)	*by Security Vendor*	

NOTE: Roof Egress Doors to be keyed inside, always allowing free egress from rooftop/exterior.

HARDWARE SET 6

*Metal / Glass **Pair** ~ Egress, Lockable, Hold Open*

Location: Gymnasium, Multipurpose

	2	Hinge (continuous)	_FM-HD (match door/frame finish/color)	PEM
	2	Exit Device (conc. rods, lockable)	PA-9847-L	VON
	2	Cylinder / Core	*per Owner / Facility Key System*	
	2	Door Closer (inside, high traffic)	8900 T / SPA (FC, 180° as required)	DOR
	2	Electromechanical (EM) Holder	997M / 998M (coord. w/lever/closer)	RIX
	2	Door Stop (wall-mounted)	400	ROC
	2	Protection Plate (kick, push side)	K1050-CSK (10” high)	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 7

Metal / Glass ~ Egress, Lockable

Location: Gymnasium

		Hinge (hvy-duty, qty/size as req’d)	T4A3386 (1NRP@outswing)	MCK
	1	Exit Device (rim)	PA-98-L	VON
	1	Cylinder / Core (key override)	*per Owner / Facility Key System*	
	1	Door Closer (inside, track arm)	TS93 (FC, built-in hold open)	DOR
	1	Door Stop (wall-mounted)	400	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10” high)	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 8

*Exterior Metal **Pair** ~ Locked*

Location(s): Mechanical Room

		Hinge (hvy-duty, qty/size as req'd)	T4A3386 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom, active)	8204 (keyway faces indoors)	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Flush Bolt Set (manual, inactive leaf)	2845 / 2945	ROC
	1	Dust Proof Strike (inactive door leaf)	570 (match floor finish)	ROC
	2	Door Closer (inside, track arm)	TS93 (FC, built-in hold open)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Bottom (automatic, underneath)	411_PKL / 420_PKL	PEM
	1	Door Bottom (rain drip)	3452_PK (match door finish/color)	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM

HARDWARE SET 9.1

*Exterior Metal / Glass **Pair** ~ Egress, Locked, Monitored*

Location: Rear Corridor

	2	Hinge (continuous)	_FM-HD (match door/frame finish/color)	PEM
	1	Exit Device (conc. rods, primary)	PA-9847-LNL (night latch)	VON
	1	Exit Device (conc. rods, secondary)	PA-9847-EO (exit only)	VON
	1	Cylinder / Core	*per Owner / Facility Key System*	
	2	Door Closer (inside, high traffic)	8900 T / SPA (FC)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	2	Door Bottom (rain drip)	215_PK / 2221_PK	PEM
	1	Astragal Set (split)	351_PK (match door finish/color)	PEM
	2	Weatherstrip (adjustable, jambs)	379_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (thermal, as required)	2705_T (per sill conditions)	PEM
	1	Request to Exit (motion sensor)	SREX-100 (narrow activation zone)	ALC
	2	Door Position Switch (per door leaf)	*by Security Vendor*	

NOTE : Motion detected by Request to Exit (within narrow activation zone) shunts Door Position Switches upon egress.

HARDWARE SET 10

Metal / Wood ~ Secured

Location(s): Zoom

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Power Transfer	EPT10	VON
	1	Electric Lock (mortise, fail secure)	NAC-82271 (key override, request to exit)	SAR
	1	Door Closer (low profile, inside)	TS93 (coordinate w/glass)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted)	400	ROC
	1	Door Bottom (automatic, underneath)	411_PKL / 420_PKL	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM
	1	Card Reader (narrow size)	*by Security Vendor*	
		Power Supply (as needed)	*by Security Vendor*	
		Wiring Harness (as needed)	*by Security Vendor*	

OPERATIONAL NARRATIVE:

- *STATUS:*
  - *Door normally closed (Door Closer), latched and secured (Electric Lock).*
  - *Electric Lock built-in door position switch monitors door position.*
  - *Upon reclosure of door, conditions return to normal status.*
  - *Upon loss of power, Electric Lock remains locked (fail secure), preventing ingress.*
- *INGRESS:*
  - *Authorized credential to Card Reader (outside) momentarily unlocks Electric Lock and shunts built-in door position switch, allowing manual ingress.*
  - *Key override to Electric Lock (by authorized personnel or emergency responders only) bypasses access control, allowing emergency ingress.*
- *EGRESS:*
  - *Electric Lock lever (inside) built-in request to exit switch, shunts built-in door position switch; and always allows egress.*

HARDWARE SET 11

*Metal / Wood **Pair** ~ Hidden, Lockable, Latching*

Location(s): Multipurpose Storage

		Hinge (concealed, qty/size as req'd)	218 / 418	SOS
	1	Deadbolt (lockable)	4877 (match door finish/color)	SAR
	1	Cylinder Pull	90 (match door finish/color)	ROC
	1	Cylinder / Core	*per Owner / Facility Key System*	
	2	Roller Latch (overhead, heavy-duty)	592 (coord. w/frame/header)	ROC
	2	Overhead Stop (hvy-duty, inside)	OH100S / OH900S	ROC
	2	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
	1	Threshold (only if required)	2715_ / 2716_ (match floor finish)	PEM

NOTE: Deadbolt thumb-turn inside retracts bolt (but will not project it), as required for egress.

HARDWARE SET 12

Metal ~ Locked, Gasketing (odors)

Location(s): Janitor

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom)	8204	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, med. traffic)	8600 T / SPA (FC)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Protection Plate (kick, push side)	K1050-CSK (10" high)	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 13

Metal / Wood ~ Locked

Location(s): Mezzanine Mechanical, Storage

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom, active)	8204 (keyway faces indoors)	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Door Closer (inside, med. traffic)	8600 T/SPA (FC) (180° as req'd)	DOR
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted preferred)	400	ROC
	3	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
	1	Threshold (only if required)	2715_ / 2716_ (match floor finish)	PEM

HARDWARE SET 14

*Metal / Wood **Pair** ~ Locked*

Location(s): Storage

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, storeroom, active)	8204 (keyway faces indoors)	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Flush Bolt Set (manual, inactive leaf)	2845 / 2945	ROC
	1	Dust Proof Strike (inactive door leaf)	570 (match floor finish)	ROC
	2	Door Closer (inside, med. traffic)	8600 T/SPA (FC) (180° as req'd)	DOR
	2	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	2	Door Stop (wall-mounted preferred)	400	ROC
	2	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
	1	Threshold (only if required)	2715_ / 2716_ (match floor finish)	PEM

HARDWARE SET 15

Metal ~ Lockable, Gasketing (noise)

Location(s): Computer Room, Kitchenette, Lounge

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, classroom)	8237	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted preferred)	400	ROC
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 16

Metal / Wood ~ Lockable, Gasketing (privacy)

Location(s): Rec. Manager

		Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
	1	Lock (mortise, office)	8256-130LB	SAR
	1	Cylinder / Core	*per Owner / Facility Key System*	
	1	Overhead Stop (hvy-duty, only if req'd)	OH100S / OH900S (in lieu of wall-mtd)	ROC
	1	Door Stop (wall-mounted preferred)	400	ROC
	1	Door Bottom (acoustic)	234_PK / 222_PK	PEM
	1	Perimeter Seal (head/jambs)	S88 (match frame color)	PEM
	1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 17

Metal / Wood ~ Locked, Gasketing (odors)

Location(s): Restroom

	Hinge (std-duty, qty/size as req'd)	TA2714 (1NRP@outswing)	MCK
1	Lock (mortise, privacy)	8265 V21 130LB (emergency release)	SAR
	Outside: Vacant (Green) / Occupied (Red) // Inside: Unlocked (Green) / Locked (Red)		
1	Door Closer (inside, med. traffic)	8600 T / SPA (FC)	DOR
1	Door Stop (wall-mounted preferred)	400	ROC
2	Protection Plate (kick/mop, each side)	K1050-CSK (10" high)	ROC
3	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 18

Metal / Wood ~ Push / Pull

Location(s): Locker Room, Restroom

	Hinge (hvy-duty, qty/size as req'd)	T4A3386 (1NRP@outswing)	MCK
1	Door Pull (straight)	RM301 (1 ¼" ∅, 12" length)	ROC
1	Push Plate (engraved "PUSH")	RM1010H (4" x 22" radius corners)	ROC
1	Pull Plate (engraved "PULL")	RM1010L (4" x 22" radius corners)	ROC
1	Door Closer (low profile, inside)	TS93 (coord. w/glass, secondary leaf)	DOR
1	Door Stop (wall-mounted preferred)	400	ROC
2	Protection Plate (kick/mop, each side)	K1050-CSK (10" high)	ROC
3	Silencer (non-rated doors only)	608-RKW / 609 / 608CA (as req'd)	ROC
1	Threshold (as required)	2715_ / 2716_ (per sill conditions)	PEM

HARDWARE SET 19

Steel Gate / Wire Mesh ~ Locked

Description: Mezzanine Access, Basement Access

	Pivots (qty as needed, spring-loaded)	*by Gate Fabricator*	
1	Lock (mortise, storeroom, tactile)	8204	SAR
1	Core	*per Owner/Facility Key System*	

NOTES :

- *Gate Fabricator to provide blocking to receive basis-of-design door hardware and coordinate with Door Hardware Supplier, as needed.*
- *Gate Fabricator to provide fine mesh to prevent tampering from outside and/or intrusion.*
- *Door hardware metal finishes to match gate finish.*

END OF SECTION

SECTION 220000
PLUMBING

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PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Examine all other Sections of the Specifications for requirements, which affect work under this Section whether or not such work is specifically mentioned in this Section.

C. The Plumbing Drawings shall not limit the Subcontractors responsibility to determine the full extent of his work as required by all Contract Drawings.

1.2 SCOPE OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this section and, without limiting the generality thereof, including:

1. Complete interior storm and sanitary drainage system, including soil, waste, and vent piping within the building to ten (10'-0") outside the inside surface of the exterior foundation wall of the building.
2. Complete interior water systems, including cold, hot, and re-circulated hot water piping. Cold water to commence from new service entrance location.
3. Complete hot water generation systems.
4. Drainage specialties such as drains, cleanouts, vacuum breakers, shock absorbers, wall hydrants, hose bibs, etc.
5. Backflow prevention devices on all equipment requiring same.
6. Plumbing fixtures and all trim.
7. All drilling of holes for piping, including but not limited to steel, concrete, and wood coring. Patching to be performed by others.

B. Items to be Furnished Only: Furnish access panels to the General Contractor for distribution by him to the various trade sections in whose work the panels occur.

C. Related work in Other Sections:

1. Cutting and patching.
2. Excavation, trenching and backfill.
3. All electric power wiring, except as specified herein.
4. Building heating, ventilating and air conditioning.
5. Flashing of floor drains and vents through the roof.
6. Toilet room accessories.
7. Installation of access panels.
8. Painting.
9. Sprinkler system.

D. The Plumbing Contractor shall coordinate their scope of work with requirements as noted on architectural drawings.

1.3 CODES, ORDINANCES AND PERMITS

A. All work shall be installed in accordance with the laws, ordinances, rules and regulations of all local and state authorities having jurisdiction, and the rules and regulations of the State Plumbing and Gas Codes. In case of conflict, the higher standard shall prevail. Extra payment will not be allowed for work or changes required by code enforcement authorities.

B. Apply and pay for inspection permits, certificates of inspection, and license fees in connection with this work, and deliver to the Owner at the completion of the work. All diagrams or drawings required by local or state authorities shall be supplied by This Contractor.

C. All equipment, fixtures, and valves shall be compliant with Lead Reduction NSF 61 2014 standard.

1.4 JURISDICTIONAL DISPUTES

A. Subcontract all portions of this work as necessary to avoid jurisdictional disputes and work stoppages that could arise during the installation of this work.

1.5 INTENT

A. It is the intention of these specifications and drawings to require the equipment to be furnished complete in every respect, and this Contractor shall furnish all equipment needed and usually supplied in connection with such systems. Equipment, materials and articles incorporated in the work shall be new, and of the best grade of their respective kinds for the type of work involved.

1.6 DRAWINGS

A. The drawings show the extent and general arrangement of piping, and locations of the equipment. Piping, fixtures, and equipment are shown diagrammatically. This Contractor shall be responsible for the locations in the most practical manner, free from interference with other piping or structural features. If any changes from the drawings are deemed advisable, details of such proposed changes shall be submitted for approval. No changes shall be made without such approval. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with the installation.

1.7 SHOP DRAWINGS AND SUBMITTALS

A. Within thirty days after award of the contract, provide six copies of schedule of materials proposed to be submitted for approval, prior to submission of any detailed drawings. The Architect will review this schedule and may supplement it with additional items or eliminate some items.

B. Supply manufacturers' drawings of all materials, equipment and apparatus remaining on the list, giving full information as to dimensions, construction, capacity and other pertinent facts, which shall be submitted to the Architect, and approval secured, before apparatus is ordered, built or installed. Samples shall be submitted, if required.

C. Approval by the Architect of shop drawings for any materials, apparatus, devices and layouts shall not relieve the responsibility of furnishing same of proper dimensions, size, quantity, quality and all performance characteristics to efficiently perform the requirements and intent of the contract documents. Such approval shall not relieve This Contractor from responsibility of errors of any sort on the shop drawings. If the shop drawings deviate from the contract documents, advise the Architect of the deviations in writing accompanying the shop drawings, including the reasons for the deviations. Shop drawings without specific notations or without schedules as described herein, may be returned not approved. Each shop drawing for any item shall be clearly identified with codings used on the drawings complete with name and/or locations of equipment. Shop drawings covering more than one item shall be accompanied by a suitable location schedule.

D. Shop drawings are required for:
   1. Plumbing fixtures and equipment.
   2. Pipe and fittings.
   3. Valves.
   4. Pipe insulation.
   5. Drains and appurtenances.
   6. Pipe hangers, supports and special equipment.
   7. Water heaters and associated equipment.

1.8 SUBSTITUTIONS

A. Substitutions of equipment or materials other than those shown on the drawings or named in the specifications may be made only with the written approval of the Engineer, who reserves the right to require adequate proof of the quality of the substitute before permitting its use.

B. Where this Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring, or of any other part of the mechanical, electrical or architectural layout, all such redesign, and all new drawings and detailing required therefore shall, with the approval of the Architect, be prepared by This Contractor at his expense.

C. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit and equipment from that specified or indicated on the drawings, with the approval of the Architect, This Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

1.9 COORDINATION

A. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed or interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

B. Any core or hole drilling required for the installation of the plumbing systems shall be brought to the structural engineer and architect’s attention prior to performance of this work.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other sections. Any conflicts shall be referred immediately to the Owner’s Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner’s Representative’s satisfaction at no expense to the Owner.

D. Refer to Architectural Drawings prior to installation of visible material and equipment, including access panels. Where items are not indicated, request the information from the Architect.

E. If any plumbing work has been installed before coordination with other trades so as to cause interference with the work of such trades, all necessary adjustments and corrections shall be made by the plumbing trades involved without extra cost to the Owner.

1.10 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun, prepare coordination drawings showing the size and location of equipment, piping, etc., in the manner described under SUPPLEMENTARY CONDITIONS.

B. Plumbing Contractor shall show on coordination drawings prepared by the General Contractor all of the plumbing work to be installed as part of this section of the specifications.

C. Coordination drawings are for the General Contractor's and the Architect's use during construction and shall not be construed as replacing any shop, "as-built" or record drawings required elsewhere in these contract documents.

1.11 RECORD DRAWINGS

A. The Architect will furnish the Plumbing Sub-Contractor AutoCAD 2014 files of the plumbing drawings as issued for this contract. The Contractor shall change these drawings to indicate accurately and neatly the actual pipe routing and pipe sizes, as well as the actual locations of all equipment. At the end of the project the Contractor shall deliver to the Architect one set of reproducible "as built" drawings and a compact disc or DVD with electronic files of the drawings in AutoCAD 2014 format for the owner's permanent record.

B. The "as built" drawings shall show the actual location and valve tag number of all valves.

C. The Architect will not certify the accuracy of the Record Drawings. This is the sole responsibility of the Plumbing Sub-Contractor.

D. Record Drawings shall show record condition of details, sections, riser diagrams and corrections to schedules. Schedules shall show actual manufacturer, make and model numbers of final equipment selection.

1.12 WORKMANSHIP

A. The entire work provided in this division shall be constructed and finished in a workmanlike and substantial manner. It is not intended that the drawings show every pipe, fitting and appliance, but This Contractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best practice and to the satisfaction of the Architect.

B. Keep other contractors fully informed as to the shape, size and position of all openings required for apparatus and give full information to the General Contractor and other subcontractors sufficiently in advance of the work so that all openings may be built in advance. Furnish and install all sleeves, supports, etc., specified herein, or required.

C. In case of failure to give proper and timely information, provide cutting and patching or have same done by the General Contractor, but in any case, without extra expense to the Owner.

D. Obtain detailed information from the manufacturers of apparatus as to the proper method of installing and connecting same. Obtain all information from the General Contractor and other subcontractors which may be necessary to facilitate the work and the completion of the whole project.

1.13 ACCESSIBILITY

A. All work shall be installed so that all parts required are readily accessible for inspection, operation, maintenance and repair. Minor deviations from the drawings may be made to accomplish this end, but changes of magnitude shall not be made without prior written approval from the Architect.

1.14 PROTECTION

A. Be responsible for work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery to the site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

B. Protect work and material of other trades from damage that might be caused by work or workmen and make good any damage thus caused.

1.15 EXAMINATION OF SITE

A. Before submitting proposal, visit the site, examine its condition, and become acquainted with the obstacles and advantages for performing the work. Study the drawings and

specifications explanatory of the work to be performed and compare them with the information gathered by the examination of the site.

B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of the site conditions and contract documents prior to executing the contract would have revealed.

1.16 TEMPORARY OPENINGS

A. Ascertain from examination of the architectural drawings, whether any special temporary openings in the building will be required for the admission of apparatus furnished under this contract, and notify the Architect accordingly. In the event of failure to give sufficient notice to the Architect in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.

1.17 TESTS

A. Furnish all labor, material, instruments, supplies and services, and bear all costs for the accomplishment of the tests specified herein. Correct all defects appearing under test, and repeat the tests until no defects are disclosed. Leave the equipment clean and ready for use.

B. Perform all tests, other than specified herein, which may be required by legal authorities or by agencies to whose requirements this work is to conform.

1.18 GUARANTEE

A. Attention is directed to the provisions of the GENERAL CONDITIONS and SUPPLEMENTARY CONDITIONS regarding guarantees and warranties for work under this contract.

B. Manufacturers shall provide their standard guarantees for work under this section. However, such guarantees shall be in addition to, and not in lieu of, all other liabilities which the manufacturer and contractor may have by law or by other provisions of the Contract Documents.

C. All materials, items of equipment and workmanship furnished under this section shall carry the standard warranty against all defects in material and workmanship. Any fault due to design which may develop shall be made good by and at the expense of This Contractor, including all other damage done to areas, materials and other systems resulting from this failure.

D. This Contractor shall guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced.

F. Any apparatus that requires excessive service during the guarantee period will be considered defective and shall be replaced.

G. Furnish, before the final payment is made, a written guarantee covering the above requirements.

1.19 COMMISSIONING OF PLUMBING EQUIPMENT AND SYSTEMS

A. RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, including Section 018100 – General Commissioning Requirements, apply to this Section.

B. SUMMARY

1. Section includes commissioning process requirements for water heaters.
2. During Functional Testing, it is anticipated that the equipment will function as intended. Failure of an item includes excessive noise, failure to perform the intended function, or a deviation of more than 10 percent from the intended performance.
3. First-round testing is included in the CxA's budget. Any testing necessitated by above-described failures shall be at extra cost, and may be borne by the contractor.

C. DEFINITIONS

1. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
2. CxA: Commissioning Authority.
3. EOR: Engineer of Record
4. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

D. CONTRACTOR'S RESPONSIBILITIES

1. Allow sufficient time in the construction schedule, presented as a task in all project schedules, for on-site Functional Testing of equipment that is within the scope of work. CxA shall be consulted as early as possible to determine the appropriate amount of time necessary for testing. This time shall commence after all work is complete and equipment start-up sheets have been submitted and approved by the EOR. It will end prior to occupancy of the space. The time allotted for Commissioning SHALL NOT coincide with building flushing, balancing, or other testing or operations without the specific approval of the CxA.
2. Allow sufficient time in the schedule for repair of any faulty systems or components revealed during Functional Testing. One week is recommended.
3. Allow 5 working days minimum, prior to occupancy of the building, and after any repairs or reprogramming as per the previous item, for follow-up Functional Testing to prove that equipment and systems are operating and reporting properly
4. Perform all equipment inspections and testing prior to commissioning. Submit a complete manufacturer-recommended start-up checklist for all major equipment at least 2 weeks prior to commissioning.
5. Participate in plumbing system, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
6. Provide information requested by the CxA for final commissioning documentation.
7. Provide a technician that is thoroughly familiar with the programming and operation of the system controls for assistance during functional testing.
8. Provide personnel as necessary to assist in the Functional Testing of the plumbing equipment.
9. Repair, reprogram, or otherwise correct any deficiencies that are revealed during functional testing, and report the corrections in the forma agreed to with the CxA and Project Management.
10. Assist as necessary in any retesting that is necessitated by failure of equipment or systems to perform as per the design intent.
11. Provide material for inclusion in the commissioning report. For example, as-built drawings, start-up reports, and submittals for major equipment.

E. CxA'S RESPONSIBILITIES

1. Include CxA responsibilities in this article that have an impact on Contractor's activities and responsibilities.
2. Provide Project-specific commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
3. Approved start-up reports, balancing reports, and control system point-to-point checklists and calibration reports shall serve as pre-functional testing. The CxA may

choose to participate in this work.
4. Direct commissioning testing.
5. Verify testing, adjusting, and balancing of Work are complete.
6. The CxA shall judge whether equipment or systems function in a manner consistent with the design intent. A report shall be produced that lists any discrepancies.
7. Testing of any systems or equipment that fails the initial functional test will be repeated until all systems perform in accordance with the design intent and the intended operating sequences. Retesting may be additional to the contract value, and the cost may be passed through to the contractor responsible for the non-performing system.
8. A final commissioning report will be generated after all functional testing is complete. This report will contain as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

F. COMMISSIONING DOCUMENTATION
1. Provide the following information to the CxA for inclusion in the commissioning plan:
a. Plan for delivery and review of submittals, system manuals, and other documents and reports.
b. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
c. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for plumbing systems, assemblies, equipment, and components to be verified and tested.
d. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
e. Certificate of readiness certifying that plumbing systems, subsystems, equipment, and associated controls are ready for testing.
f. Test and inspection reports and certificates.
g. As-built drawings
h. Corrective action documents.
i. Verification of testing reports.
j. Maintenance requirements or recommendations for all equipment provided by the Contractor.
k. Recommended spare parts list
l. Contact names and phone number for warranty or maintenance during the warranty period, as well as a 24-hour emergency contact.

G. SUBMITTALS
1. Paragraphs below are "Informational Submittals." See Division 01 Section "Submittal Procedures" for definition of "Informational Submittals."
2. Certificates of completion of installation, prestart, and startup activities.
3. Start-up/checkout checklists and reports
4. As-built drawings

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Sanitary waste, storm, and vent piping systems above grade, within the building foundation walls:
1. Drainage piping 2" and larger shall be no hub cast iron with rubber gaskets and mechanical couplings. Vent piping 2” and larger may be DWV type copper with wrought copper drainage fittings, 95/5 lead free solder joints.
2. Drainage piping 1 1/2" and smaller shall be DWV type copper with wrought copper drainage fittings, 95/5 lead free solder joints.

B. Storm, Sanitary waste and vent drainage piping below grade:

1. Storm drainage, sanitary waste, and sanitary vent piping: cast iron, bell and spigot, rubber gasket joints, service weight, coated on exterior.

C. Water piping:
1. Underground domestic water: Type K copper tubing conforming to ASTM B88 with cast brass fittings conforming to ANSI B16.22.
2. Above ground: Copper tubing, Type L, conforming to ASTM B 88 with solder joint wrought copper fittings conforming to ANSI B16.18 or B16.22, lead free solder joints.

2.2 VALVES

A. Each valve type shall be of same manufacturer and appropriate for service in which used; valves shall be Milwaukee, Watts, Apollo, or approved equal. Type proposed for each service shall be submitted for approval. In general, shut- off valves, except for exposed stops at fixtures, shall be ball valves.

B. Each system shall be provided with valves as required by Code and as specified. Valves shall be installed for isolation and to facilitate operation, replacement and repair. Provide access panels where valves are concealed behind non- removable ceilings or walls. Provide shut off valves for gas and water supply piping to individual fixtures and appliances.

C. Valves shall be:
1. Ball valves - 2 inches and smaller, bronze, 400 lb., 1/4 turn solder ends for copper tubing.
2. Ball valves - 3 inches and larger - 400 lb., 1/4 turn, bronze. IPS thread ends.
3. Check valves - 2 inches and smaller - brass, 125 lb., spring check, IPS thread ends, Nibco or equal.
4. Check valves - 2-1/2 inches and larger - bronze, 125 lb., spring check, flanged ends, Nibco or equal.
5. Drain valves - cast bronze, 1/2" and 3/4", threaded outlet for garden type hose connection, Nibco #72.

2.3 BACKFLOW PREVENTERS

A. Backflow preventer: Backflow preventers shall be installed to prevent backflow of contaminated water in the potable water supply:
1. On all hose end faucets such as hose bibs, wall hydrants, service sink faucets, etc. - Watts #8A, non-removable type or equal.
2. On any and all equipment: Watts #009, reduced pressure type, unless otherwise noted.

2.4 MISCELLANEOUS PIPING MATERIALS

A. Nipples: Nipples shall conform to WW-N-351 and shall be the same material as the piping in which installed.

B. Unions: Unions shall be brass or bronze, 125 lb., either threaded or with solder joint ends, conforming to WW-U-516 for use in copper tubing. For use in steel piping unions shall conform to WW-U-531.

C. Insulating bushings and Unions: hard rubber threaded bushing inserted between two dissimilar metals.

D. Flanges on copper tube or pipe: cast bronze, 150 lb., solder joint connection.

E. Flanges on steel piping: carbon steel, 150 lb., welding neck or slip-on ASTM A181, Grade 1, ANSI B16.5

F. Floor and ceiling escutcheon plates: Floor and ceiling escutcheon plates shall be split hinged, locked type. Plates shall be of pressed steel with a heavy coating of copper, nickel and chromium.

G. Copper: Copper for flashing shall be soft temper or light cold rolled, minimum weight 16 ounces per square foot.

H. Sheet lead: Sheet lead for flashing shall be at least four pounds per square foot.

I. End cleanout: Threaded brass tapered plug fitted with raised head for cast iron piping with plug fitted with raised head.

J. Wall cleanouts: Chrome plated steel access panels, complete with frame and anchor straps, concealed hinges, slotted actuated cylinder lock installed flush with wall to gain access to valves and cleanouts. Access panels shall have general characteristics of Zurn, Josam, Smith #4761 or #4766 or equal.

K. Floor cleanouts: Cast iron, raised head caulking plug, brass cleanout cover flush mounted with flanged ring having anchor lugs, nickel-bronze scoriated hinged cover plate with "CO" cast in the cover, vandal-proof screws, similar to Zurn, Josam, Smith #4021, or equal. Access covers in all finished areas shall be similar to Zurn, Smith #4160 or 4200 or equal, with identical inlay of adjacent materials and vandal-proof screws.

L. Shock or water hammer arrestors: Shock or water hammer arrestors shall conform to the requirements of PDI-WH-201, ASSE 1010, or ANSI A112.26.1, size as required. Units shall be the standard factory prefabricated products as manufactured by Jay R. Smith, Amtrol, or equal. Provide at the last fixture on all pipe runs exceeding twenty feet in length and at all fixtures with automatic solenoid or cylinder operated valves, automatic flush valves, quick-closing valves or solenoid valves and where indicated on the drawings. Fixtures and equipment in battery installation may use a single water hammer arrester properly sized for the connected load.

2.5 HANGERS, SUPPORTS AND INSERTS

A. Pipe - 2 inches and smaller - 1A band type complete with threaded rod hanger nut, lock nut and sized to encompass insulation and pipe supported, similar to Carpenter-Patterson Fig. 1A or 122 CT or equal.

B. Piping - 2-1/2 inches and larger - clevis hanger type complete with threaded rod, locking and adjusting nuts and sized to encompass insulation and pipe supported, similar to Carpenter-Patterson Fig. 100 or equal.

C. Where due to space requirements, pipe must run close to structure above, a roll hanger with two threaded rods and nuts shall be used similar to Carpenter-Patterson Fig. 142 or Fig. 109.

D. Supports for piping from below shall be Carpenter-Patterson Fig. 333 or equal.

E. Insulation protective saddles shall be provided at all hanger locations for insulated piping.

F. Extension pipe or friction deck clamp shall be used on all piping except water piping passing through floors, similar to Carpenter-Patterson Fig. 126.

G. Pipe hangers and supports shall be installed for all piping systems as follows:

PIPE SIZE	MINIMUM ROD DIAMETER
to 1 inch	3/8 inch
to 2 inch	3/8 inch
to 3 inch	1/2 inch
to 6 inch & larger	5/8 inch

H. Hangers and supports shall be acoustically protected by means of resilient type clamps and isolation. They shall be furnished complete with all appurtenances and shall be Hold-Rite, Grinnell, Carpenter-Patterson, or equal. Hangers and supports shall be hot-dipped galvanized where exposed and dip painted, where concealed. Copper tubing shall be suspended from copper plated hangers.

2.6 SLEEVES

A. Sleeves for piping passing through foundation walls shall be steel pipe, standard weight, two sizes larger than pipe.

B. Sleeves for piping passing through interior wall shall be twenty-gauge galvanized sheet metal and shall be set flush with walls.

C. Sleeves for piping passing through concrete floors shall be black steel pipe and shall extend one inch above floor and be flush below. Within chases 26-gauge galvanized sheet metal may be used.

D. All plumbing piping passing through foundation walls shall be provided with expandable wall hole closure. Closure shall be Link-Seal as manufactured by Thunderline Corp.

E. All sleeve openings around piping other than those provided with Link-seals shall be sealed with fire-retardant silicone foam as manufactured by Chase Technology Corp.

2.7 DRIP PANS

A. Examine the drawings and in cooperation with the Electrical Contractor confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping no closer than two feet from a vertical line to electric motors and controllers, switchboards, or similar equipment. Piping is not permitted in electric equipment, transformer, switch gear and telephone gear rooms.

B. Where the installation of piping does not comply with the requirements of foregoing paragraph, where feasible the piping shall be relocated.

C. Where relocation of piping is not feasible, furnish gutters as follows:
   1. Provide and erect a gutter of 16 ounce cold rolled copper or 18 gauge galvanized steel, under every pipe which is within 2 feet from a vertical line to any motor, electrical controllers, switchboards, panel boards or the like.
   2. Each gutter shall be reinforced, rimmed, soldered and made watertight, properly suspended and pitched to a point outside of the electrical room.

2.8 ACCESS PANELS

A. Furnish access panels for access to plumbing equipment. The sizes of the access panels for hidden valves, cocks and cleanouts in walls and ceilings shall be 12 x 12 inches. The panels shall be factory fabricated completely flush with heavy metal door and frame. Frames shall be welded construction of not less than 14-gauge steel, with heavy piano type hinges set flush with frame, and shall be secured in the closed position. In no case shall opening of the door require removal of nuts, bolts, screws, wing-nuts wedges or any other screwed or loose device. Access panels shall have UL rating, conforming to requirements of area in which it is installed. Access panels shall be Milcor, WayLocktor, Jay R. Smith or equal. Access panels shall be turned over to the General Contractor for installation. Access panels shall not be required in removable tile ceilings. Access panels in fire rated ceilings and/or walls shall have U.L. fire ratings comparable to that location installed.

2.9 SPECIALTIES AND ACCESSORIES

A. Vacuum breakers shall have bronze body and internal trim with high temperature resisting rubber disc and external trim, similar to Chicago, Beacon, Watts #188, or equal. Furnish at hose bibs, wall hydrants and at locations shown on the drawings and governed by code.

2.10 INSULATION

A. All insulation work shall be manufactured by Johns-Manville, Gustin-Bacon, Owens-Corning Fiberglass Corp. or equal, and be executed by a qualified Insulation Sub-contractor who is thoroughly experienced in this type of work, who has adequate facilities and equipment for erecting same; who is acceptable to the Architect. Application and finish on all pipes, fitting and valves shall be as recommended by manufacturer and approved by the Architect. Details shall be submitted for approval. All jackets and adhesives shall be flame retardant. Insulation shall be provided on all piping, valves and fittings in accordance with the International Energy Conservation Code and the requirements of this section.

B. Hot water supply and re-circulating piping:
   1. Piping – 1 inch thick for 1-½ inch piping and larger, ½ inch thick for 1-1/4 inch piping and smaller. Insulation shall be fibrous glass, 3-1/2 pound per cubic foot density minimum sectional pipe insulation with factory applied white All Service Jacket (ASJ) with butt strips and Benjamin-Foster, or equal BF85-75, or longitudinal seams.
   2. Fittings and Valves - shall be insulated with insulation cement or molded fitting insulation to thickness of adjoining insulation finished with two coats of Benjamin-Foster, or equal "Foster Sealfas" 30-36 lagging cloth.

C. Cold water piping:
   1. Piping –½ inch thick for all piping. Insulation shall be fibrous glass, 3-1/2 pound per cubic foot density minimum sectional pipe insulation with factory applied white All Service Jacket (ASJ) with butt strips and Benjamin-Foster, or equal BF85-75, or longitudinal seams. No staples shall be utilized or accepted on the installation of the insulation on cold water piping.
   2. Fittings and Valves - shall be insulated with insulation cement or molded fitting insulation to thickness of adjoining insulation finished with two coats of Benjamin-Foster, or equal "Foster Sealfas" 30-36 lagging cloth.

D. Storm Drain Piping (cast iron): 1/2 inch thick, fibrous glass, 3-1/2 pound per cubic foot density, sectional pipe insulation with a white flame retardant vapor barrier jacket covering all pipe insulation butted. All longitudinal seams and butt seams shall be sealed with Benjamin-Foster, or equal, "Foster Sealfas" 30-36 adhesive and covered with vapor barrier jacket. Storm piping shall be insulated from the roof drain body to the vertical leader to the floor below.

E. All pipe insulation shall have a flame spread rating of 25.

2.11 PIPE LABELS

A. All piping installed by this contractor shall be labeled with plastic adhesive labels. Labels shall indicate the piping system (hot water, hot water recirc, cold water, etc.), and shall indicate the direction of flow. Piping shall be labeled every 20 feet minimum on straight runs and shall be labeled within five feet of changes of direction. Labels shall be applied to the insulation jacket on insulated piping.

2.12 PLUMBING FIXTURES

A. Refer to fixture schedule on design documents for plumbing fixture selections.

B. Mounting heights shall be as shown on architectural details.

C. Fixture installation shall be in accordance with 521 CMR as required.

D. Each individual fixture shall be provided with supply stops for each water service.

2.13 HOSE BIBBS

A. Interior hose bibs shall be Woodford Model 24, Josam, Zurn, or equal, chrome plated, vacuum breaker, hose connection, loose T key.

2.14 FLOOR CLEANOUTS

A. All floor cleanouts shall be Josam model model 55000-1-SQ series or equal. Floor cleanouts in carpeted areas shall be of the carpet clamping type.

2.15 FLOOR DRAINS

A. Furnish and install all floor drains as indicated and required. Drains shall be Josam model 30000 series or equal. All floor drain strainers shall be square shaped style with square grid pattern.

2.16 TRAP PRIMERS

A. Furnish and install trap seals manufactured by SureSeal or equal for floor drains and sprinkler drain standpipes as indicated and required.

B. Alternate to trap seals will be the use of trap primers
   1. Trap primers shall be Precision Plumbing Products ULP-500LP, Jay R. Smith Prime-Eze, or equal, or Mifab M-500 or equal, pressure drop activated, brass with removable filter screen.
   2. Multiple trap distribution units shall be Mifab MI-DU or equal to serve two, three or four floor drains.
   3. Provide access panels at all trap primer locations if necessary.

2.17 WALL HYDRANT

A. Wall hydrant shall be of the non-freeze type equal to Woodford Model 67, 3/4-inch inlet, vacuum breaker, bronze construction, of wall thickness as required. Confirm exterior finishes with architect.

2.18 WATER HEATER

A. Furnish and install water heaters as indicated in the water heater schedule.

2.19 HOT WATER MIXING VALVE

A. Furnish and install mixing valves as indicated in the mixing valve schedule.

2.20 CIRCULATOR PUMP

A. Furnish and install circulator pumps as indicated in the mixing valve schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The plumbing drawings intend to show only the scope of the design, and the Plumbing Contractor shall be responsible for the correct installation of his work in a manner satisfactory to the best practices of his trade and to complete the scope of this work in all respects.

B. The contractor is responsible for field verifying all existing conditions for connections to existing systems (if any), and shall modify the connection points as necessary based on existing conditions.

C. The location of piping as indicated on the drawings is diagrammatic only, and the exact location shall be determined in the field. The run and arrangement of all pipes shall be approximately as shown on the drawings, as directed during installation, as straight and direct as possible, forming right angles or parallel lines with building wall and other pipes, and neatly spaced. All risers shall be erected true and plumb, parallel with walls and other pipes, and neatly spaced. All horizontal runs of piping except where concealed in partitions, shall be kept as high as possible and close to walls. Wherever possible, adjacent pipe lines, both heating and plumbing, shall be grouped in the same vertical or horizontal planes. All piping shall be concealed and shall have a minimum number of fittings. Piping shall not interfere with the operation or accessibility of doors, windows, access panels, or equipment and shall not encroach on aisles or passageways. All piping shall be installed to preserve access to all valves, traps and equipment.

D. This Contractor shall be responsible for the correctness of field dimensions and shall check for himself all grades, lines, measurements, and other data in any way affecting his work. He shall refer to the project, phasing schedule together with architectural, structural, and drawings of other trades for a full comprehension of the extent of the work to be performed and to avoid interference, and shall not be entitled to any extra compensation for any additional work or expense arising from his failure to do so. In case interference develops, the Architect shall decide which work is to be relocated, regardless of which was first installed. Work installed by the Contractor which is improperly located and/or interferes with or modifies either the phasing schedule or the architectural or structural design, shall be changes as directed by the Architect, and all costs incidental to such changes shall be paid by the Plumbing Contractor.

E. The Plumbing Contractor shall also provide the necessary data and supervision for the provision of all openings in the structure, including bolt hole templates, weights of equipment and manufacturer's recommendations for proper emplacement design. This shall be furnished to the General Contractor and other related trades.

F. No plumbing fixtures, devices, equipment or piping shall be installed which will provide a cross or interconnection be- between a distributing supply for drinking or domestic hot water system and a polluted supply or drainage system. Backflow preventers and vacuum breakers shall be installed where noted on the drawings, and in conjunction with all hydrants, hose bibs, water lines to equipment, water closets, service sinks, and where required to prevent polluted back siphoning.

G. All exposed run outs to equipment, materials and fixtures having chrome plated trim and/or fittings shall be chrome plated brass with chrome plated brass fittings, unless otherwise noted.

3.2 SANITARY AND RAINWATER (STORM) SYSTEMS

A. Interior sanitary and rainwater piping shall pitch in accordance with code requirements, unless otherwise noted.

B. All changes in pipe size and direction on soil and waste piping shall be made with Y's and cleanouts, reducing fittings, recessed reducers. Wyes and 45 degree fittings or 45 degree combination fittings shall be used wherever conditions permit.

C. Sanitary long sweep bends and wyes shall be used for connections to branch lines for fixtures and tee wyes on vertical runs of pipe. Long turn fittings shall be used wherever conditions permit.

D. All fittings, regardless of type, shall be furnished complete with the necessary bolts, nuts and washers, as well as brass or chrome plated nipples of the proper length and wax ring gaskets for the water closet connection.

E. Cleanouts shall be installed where indicated on the drawings, or approximately every 50 ft. along horizontal runs, at all changes in direction, and at the base of all soil, waste and leader stacks. Test tees with brass clean out plugs shall be installed at the base of all vertical piping. No projection above the floor line will be permitted. Cleanouts occurring in or back of walls shall be extended out to finished wall and finished with flush metal access panel. Cleanouts located in floor shall be extended to grade and finished with an access panel. Cleanouts located above hung ceilings are to be made accessible through metal access panels. Running cleanouts may be used where it is impractical to use end cleanouts at base of risers.

F. Each fixture, drain and piece of equipment must be separately trapped unless otherwise noted, and all traps must be vented. All main stacks of back ventilation shall run parallel and as close as possible to the soil stack, and shall connect to the vent continuation of the soil stack at least 3 feet above the highest plumbing fixture on the stack. Horizontal vent lines shall pitch toward a waste line.

G. Fittings for piping above ground shall be drainage patterns.

3.3 DOMESTIC COLD, HOT, AND RE-CIRCULATED HOT WATER PIPING

A. All interior water piping shall be installed without traps or pockets and shall pitch to draw-offs so that the whole system or individual sections can be properly drained. Piping shall have valves and be graded to allow for complete drainage of the system. All draw-off valves shall have hose end which shall be capped. Piping shall be pitched up toward risers and fixtures for proper air relief. Piping subject to expansion shall be flexible and installed to safely absorb all deflection stressed.

3.4 PIPE JOINTS

A. Joints for hub and spigot cast iron soil pipe shall be made with rubber gaskets conforming to State Plumbing Code.

B. Soldered joints on water and waste piping shall be made up using lead-free tin antimony solder, conforming to Federal Spec. QQ-S-571C, and joint shall be filled the full length of the socket. The fitting shall be heated evenly to the proper temperature to run the solder. The ends of the tubing and the inside of the fitting shall be thoroughly cleaned to a bright shining finish before applying flux. Flux shall be non-corrosive type conforming to Fed. Spec. 0-F-506.

3.5 VALVES

A. All piping systems shall be provided with valves so located that they can be operated, replaced, repaired and offer complete control to each group of fixtures, appliance, equipment, and each gas, hot and cold water branch. Each fixture, appliance or piece of equipment shall have a separate shut-off valve, furnished and installed, of approved type, for service to be connected to. Locate valves on supply and return, at each piece of equipment or fixture, each side of regulating valves, each side of pumps, each side of meter, and on main branches. Drain valves on systems containing water shall be installed at the base of each riser (after the shut-off valve), on down- fed fixtures and at equipment, also at such other locations as required to allow for complete drainage of the system. Valves shall be located as shown on the drawings or as here-in-before specified.

3.6 VALVE TAGS

A. Valve tag scheme shall be approved by the Engineer prior to installation in the field and insertion on the record drawings.

B. Contractor shall provide a valve tag chart and clearly label the valve tags on the record drawings. The valve chart shall include but not be limited to: tag #, location, valve type, size and what the valve controls.

C. Valve tags shall be securely fastened to the valve handle by heavy aluminum or brass hooks or chain.

3.7 HANGERS AND SUPPORTS

A. Sanitary piping shall have a hanger at each hub or every 5 feet, whichever is less. Water and gas piping shall be supported at all changes in direction, on branch lines regardless of length, at base and at top of risers. Piping adjacent to floor, where ceiling hangers are impractical, shall be adequately supported by a suitable hanger, as approved by the Architect, with rod to plate at floor, said plate to be secured to floor.

3.8 ACCESS PANELS

A. Access panels shall be turned over to the General Contractor for installation into structure. This Contractor shall direct the General Contractor as to location of access panels.

3.9 SLEEVES

A. Provide sleeves for all piping penetrating new walls, ceilings and floors. Where pipes run through sleeves, the annular openings shall be sealed with fire resistant materials as called for under Part 2 - MATERIALS.

3.10 FIRESTOPPING

A. The Contractor shall provide UL listed through penetration fire stopping systems for all penetrations of fire rated floor/ceiling, roof/ceiling and wall assemblies. Coordinate the required UL system with the architectural plans and the material of the piping.

B. Submit each UL listed through penetration fire stopping system to the Architect for review.

3.11 TESTING

A. The Plumbing Contractor shall notify the Architect three working days prior to day tests are to be made. Test all piping and make it gas and water tight, in accordance with the authority having jurisdiction and ordinances, and in the presence and to the satisfaction of the applicable Inspector along with the Architect and his representative.

B. No piping shall be buried, concealed or insulated before tested and approved. Partial tests shall be made as required, by the progress of the work, and the Plumbing Contractor shall accommodate the testing operations to the progress of the project. Furnish all equipment, labor, services and apparatuses, and pay for all costs for pertinent tests. All approvals shall be rendered in writing and submitted to the Architect. Remedy all defective work and replace all defective materials, equipment or fixtures with new ones of the specified grade. No caulking, peening, or wicking of screwed joints or holes will be acceptable. This Contractor shall make and remove all temporary piping and line connections required for the tests and shall dispose of test water and all wastes after tests in a satisfactory and non-damaging manner.

C. Piping Systems

1. Upon completion of the roughing in and before setting plumbing fixtures, the entire water piping system shall be tested at a hydrostatic pressure of not less than 150 percent of the maximum working pressure of the system, and shall hold tight at this pressure for 2 hours, without additional pumping. Where a portion of the work is to be concealed before completion, this portion shall be tested separately in the same manner as described for the entire system.
2. Upon roughing in and before setting fixtures, all outlets in soil, waste, rainwater and

vent systems shall be temporarily capped and made tight. The piping within the building shall then be filled with water up to the roof and must remain full, without showing any leakage of water. All parts of the system shall be subject to not less than 10 feet of hydrostatic head, above the point being tested. Test tees shall be provided as to facilitate testing.

3.12CLEANING AND STERILIZATION OF SYSTEMS

A. The Plumbing Contractor shall be responsible for the cleaning and purging of all pertinent systems after installation and before system operation. Any damage to part of the building, its finish or furnishings, due to This Contractor's failure to properly clean the system, shall be repaired or replaced, at his expense.

B. All plumbing fixtures shall be thoroughly cleaned of all plaster, sticks, rust stains and other foreign matter or discoloration, leaving every part in an acceptable condition and ready for use. Surfaces shall be cleaned, polished and left bright. The surfaces of all pumps, meters, floor drains, cleanouts, sediment buckets and other equipment shall be cleaned and each items hall be left in a first class condition.

C. All finished metal work shall be cleaned, polished and left bright. All equipment, pipe, valves, drains and fittings shall be cleaned of grease, metal cutting and sludge, which may have accumulated during construction and/or testing.

D. The Plumbing Contractor shall refinish and restore to its original condition all plumbing equipment which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

E. The entire new potable water system shall be thoroughly sterilized by the Plumbing Contractor with a solution containing not less than 50 parts per million of available chlorine. The chlorinating materials shall be either liquid chlorine conforming to the requirements of the U.S. Army Spec. No. 4-1 or sodium hypochlorite solution conforming to the requirements of Fed. Spec. O-B-441, Grade D. The sterilizing solution shall be allowed to remain in the system for a period of 8 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million. Sterilization shall be to the satisfaction of the Board of Health. Submit certification, in writing, that this work has been accomplished in conformance with the above.

END OF SECTION

SECTION 230000

HVAC

(FILED SUB-BID REQUIRED)

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PART 1 – GENERAL

1.1 GENERAL PROVISIONS

A. The BIDDING REQUIREMENTS, CONTRACT FORMS, and Contract Conditions as listed in the Table of Contents, and applicable parts of Division 1 - GENERAL REQUIREMENTS, shall be included in and made a part of this Section.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section. The listing of Contract Drawings above does not limit Filed Subcontractor's responsibility to determine full extent of work of this Section as required by all Drawings listed in the Drawing List on the Drawing Title Sheet, as modified by Addenda.

C. Refer to Section 01 23 00 - Alternates, for alternates which may affect the scope of Work of this Section.

1.2 WORK INCLUDED

A. The work included in the Heating, Ventilating and Air Conditioning specifications consists of furnishing all materials, labor, equipment and appurtenances to perform, and leave in satisfactory operating condition the new systems.

B. It is the intention of these specifications to call for finished work, fully tested and ready for continuous operation. Any apparatus, equipment, material or work not mentioned in the specifications or incidental accessories to make the work completely balanced, perfect in all respects and ready for operation, even if not specifically mentioned, shall be furnished, tested, adjusted or balanced at no additional expense to the Owner. Should there appear to be discrepancies or questions of intent, the Sub-Contractors shall refer the matter to the Architect for decision before start of any related work.

C. The drawings, where applicable, show equipment and device locations, required flows at those devices and locations of new thermostats and controls. In addition, the drawings identify routing for new ducting and new piping as well as their respective sizes. The HVAC Sub-Contractor shall field verify that the routing is free of obstacles and other trades work.

D. The Contractor shall confer and cooperate with all other building trades so that all work will be installed in the proper relationship to all other work.

E. The Contractor shall provide and maintain all staging, scaffolding, ladders and hoisting equipment required for the execution of the work by his personnel. Remove same from premises when no longer required.

1. Coordinate with Division 1 for which staging will be provided by the General Contractor.

F. The work under this section shall include furnishing all motor starters and components for installation by the electrical sub-contractor.

G. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install:

1. All pipe guides, supports, hangers and anchors.
2. All vibration isolation equipment, bases and devices.

a. Unless otherwise noted on the equipment schedule, all mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule or those required to provide 98% isolation efficiency.

3. All insulation of all parts of the condensate system including all pipe, fittings, pipe flanges, valves, expansion joints, vents, drains, etc. which may be subject to thermal losses adverse to the operation of the various systems, or which may sweat.
4. All insulation of all parts of the supply and outdoor air intake duct systems including all duct, fittings, flanges, dampers, etc. which may be subject to thermal losses adverse to the operation of the various systems, or which may sweat.
5. All refrigeration piping and insulation.
6. All filters and air cleaning equipment.
7. All ductwork.
8. All duct fittings.
9. All ductwork accessories.
10. All motorized dampers.
11. All constant volume regulators.
12. All air inlet and outlet equipment.
13. All louvers.
14. All fan coil units.
15. All variable refrigerant volume heat pump systems.
16. All energy recovery units.
17. All air handling units.
18. All fans.
19. All air curtains.
20. All electric heating devices.
21. All control system components to provide a fully operational automatic temperature control system.
22. All Testing, Adjusting and Balancing of all components of the HVAC systems.
23. All HVAC commissioning requirements in Section 019113 – General Commissioning Requirements.
24. All requirements for the project's participation in the Eversource Path 1 Net Zero Equivalent (NZE) rebate program for new buildings.
25. All firestopping.

H. The following work is not included in this section and will be provided under other sections, except as specified herein:

1. Electrical wiring for all equipment
2. Structural supports necessary to distribute loading equipment to roof or floor
3. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division I, General Conditions.
4. Excavation and backfill

5. Concrete work including concrete housekeeping pads and blocks for vibrating and rotating equipment, and cast-in-place manholes
6. Flashing roof and wall penetrations
7. Painting

I. The Contractor shall coordinate their scope of work with requirements as noted on architectural drawings.

1.3 DEFINITIONS

A. Where used in this specification, the following definitions shall apply:

1. "Test" means to determine quantitative performance of HVAC equipment.
2. "Adjust" means to produce the specified fluid at the terminal equipment.
3. "Balance" means to establish the specified air flows within the distribution systems.
4. "Procedure" is the standardized approach and execution of sequence of work operations to yield reproducible results.
5. Report forms shall be test data sheets arranged for collection of test data in logical order for submission and review. These data shall form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.
6. The testing, adjusting, and balancing Sub-Contractor shall hereinafter be referred to as "The TAB Sub-Contractor", who shall be a subcontractor to the HVAC sub-contractor.
7. Where specifications refer to SMACNA standards, the SMACNA standards shall be considered as the minimum acceptable. If local codes require other standards than the local codes shall govern.
8. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
9. "Concealed" shall mean hidden from sight in chases, furred in spaces, shafts, embedded in construction, in a crawl space, and above hung ceilings.
10. "Exposed" shall mean not installed underground or concealed as defined above.
11. "Furnish" shall mean purchase and deliver to the project site, complete with every necessary appearance and support.
12. "Install" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting, proper location and operation in the project.
13. "Provide" shall mean furnish and install.
14. "Piping" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
15. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the general contract and connected to the systems covered by this section of the specifications by the HVAC Sub-Contractor.
16. "Coordinate" shall mean all work provided under this section of the specification shall be in compliance with the work of other trades.
17. "HVAC Subcontractor," "Subcontractor," or "Installing Contractor" shall be the Subcontractor responsible for the work of this section of the specifications, and shall be responsible for coordination of the work of this section.
18. "ATC" shall mean Automatic Temperature Controls, and shall be interchangeable with Building Automation System (BAS) and Building Management System (BMS).

19. "Owner's Representative" shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.
20. The "Sheetmetal Sub-Contractor" shall herein after be responsible for the sheetmetal work of this section.
21. The "TAB Sub-Contractor" shall herein after be responsible for the balancing work of this section.
22. The "ATC Sub-Contractor" shall herein after be responsible for the ATC work of this section.

1.4 GENERAL REQUIREMENTS FOR SHEETMETAL DUCTWORK

A. Where specifications refer to SMACNA standards, the SMACNA standards shall be considered as the minimum acceptable. If local codes require other standards, then the local codes shall govern.

B. All ductwork indicated on the drawings is to be considered as shown in schematic. Changes in duct size to clear obstructions or to accommodate field conditions caused by the work of other trades, not shown on the drawings, shall be made, where necessary to conform to the actual space conditions and shall be provided at no additional cost to the owner. No duct changes shall be fabricated until after written approval of the modified or original shop drawings by the Engineer.

C. It shall be the Sub-Contractor's responsibility to field verify all dimensions and to coordinate his work with the work of other trades. Locations and placement of ducts shall be coordinated with the work of the other trades before any ductwork is fabricated or installed.

D. Each duct system shall be constructed for the specific duct pressures and/or pressure classifications shown on or required by the contract drawings. Where no specific duct pressure or class designation is shown the SMACNA 2" W.G. pressure class is the basis for compliance with these standards.

1.5 EXAMINATION OF SITE AND DOCUMENTS

A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority (Owner) will not be responsible for errors, omissions and/or charges for extra work arising from General Contractor's or Filed subcontractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that he is familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.

1.6 RELATED WORK IN OTHER SECTIONS

A. The following is a list of related work to be performed or furnished by other trades under other sections of the specifications:

1. Electrical power wiring.
2. Grillage and miscellaneous structural elements to fully support and/or suspend the HVAC equipment.

3. Access Panels (other than duct access panels) – filed sub-bid contractor to provide sizes to General Contractor. General Contractor to purchase and install.

1.7 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

A. Furnish line voltage fan speed control switches and line voltage thermostats for installation by the Electrical Subcontractor.

B. All motors for HVAC equipment shall be furnished and set under this section. All motor starters shall be provided by the HVAC Sub-Contractor for installation by the Electrical Contractor. All controls shall be provided and installed by the ATC Sub-Contractor. All control wiring shall be provided and installed by the ATC Sub-Contractor in accordance with the applicable provisions of the electrical specifications.

1.8 INSTALLED, BUT NOT FURNISHED UNDER THIS SECTION

A. N/A

1.9 CODES AND STANDARDS

A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, and any ‘other Codes-and Regulations having jurisdiction including but not limited to:

1. All applicable NFPA Standards
2. State and Local Building, Mechanical, Electrical and Energy Codes
3. American Society of Mechanical Engineers (ASME)
4. American Society of Testing and Materials (ASTM)
5. American National Standards Institute (ANSI)
6. Underwriters Laboratories, Inc. (UL)
7. Occupational Safety and Health Administration (OSHA)
8. Any other ‘local codes’ or authorities having jurisdiction

B. Heating, pumping, sheetmetal and refrigeration systems shall be installed by contractors and personnel appropriately licensed in the State (Installing Contractor).

C. Electrical and automatic temperature control wiring shall be done in accordance with applicable codes by licensed electricians.

D. All equipment shall meet the more efficient requirements:

1. As shown on bid documents, or
2. Minimum efficiencies stated in the governing Energy Code.

E. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Diffusion Council (ADC)
3. Air Movement and Control Association (AMCA)
4. American Boiler Manufacturers Association (ABMA)

5. American National Standards Institute (ANSI)
6. American Petroleum Institute (API)
7. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing and Materials (ASTM)
10. American Welding Society, Inc. (AWS)
11. Associated Air Balance Council (AABC)
12. Copper Development Association (CDA)
13. Expansion Joint Manufacturers Association, Inc. (EJMA)
14. Factory Mutual System (FM)
15. Institute of Electrical and Electronics Engineers (IEEE)
16. Manufacturer's Standardization Society of the Valve & Fitting Industry (MSS)
17. National Electric Manufacturers-Association (NEMA)
18. National Environmental Balancing Bureau (NEBS)
19. The Hydronics Institute (HI)

F. The date of the code or standard is that in effect at the Bid Date.

G. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the owner. If work is covered before inspection and approval, the HVAC Sub-Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.10 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. It is the intention of the Specifications and Drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by the HVAC Sub-Contractor or his/her Sub-subcontractors, without additional expense to the Owner.

B. The drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the site and shall have the approval of the Architect-before being installed. The HVAC Sub-Contractor and related Sub-Contractors shall follow Drawings, including shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Architect before proceeding with the installation. The HVAC Sub-Contractor and related Sub-Contractors shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with the work of other trades or for proper execution of the work.

C. Sizes of ducts and pipes and routing are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the

intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge.

1.11 SURVEY AND MEASUREMENTS

A. Base all required measurements, horizontal and vertical, from referenced points established with the Owner's Representative and be responsible for correctly laying out the Work required under this Section of the Specification.

B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

1.12 COORDINATION WITH OTHER BUILDING TRADES

A. Structural members and building openings for HVAC equipment, ducts, piping, fans, etc., for use by the HVAC Sub-Contractor shown on the architectural or structural plans are the coordination responsibility of the HVAC Sub-Contractor.

B. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed or interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other sections. Any conflicts shall be referred immediately to the Owner's Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner's Representative's satisfaction at no expense to the Owner.

D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

E. Keep fully informed as to the shape, size and position of all opening s required for all apparatus, piping, ductwork, etc., and give information in advance to build openings into the work. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the Owner's Representative for the proper setting of same.

F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not.

G. The HVAC Sub-Contractor shall, with the approval of the Architect and without extra charge, make reasonable modifications in his work as required by normal structural interferences, or by interference with work of other trades, or for proper execution of the work.

H. Keep fully informed as to the size, shape and location of all openings required for the work of this Section and give full information to all Contractors and Sub-Contractors and the Owner's Representative.

I. Structural Concrete Coordination Drawings

1. Contractor shall prepare and submit ¼" scale plan slab layout drawings clearly dimensioning all openings, sleeves, inserts, embedded pipes and conduits, embedded plates, etc. required for the mechanical, electrical and plumbing trades.
2. Where embedded items are to be placed in column or wall pours, similar elevation drawings shall also be submitted.
3. Submittals shall be made for review by both the Architect and Structural engineer and made not less than six weeks prior to the date of concrete placement for a given slab level or column wall story level.

1.13 GENERAL REQUIREMENTS

A. Nameplates

1. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, type or style, model number, catalog number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

B. Maintenance Information

1. Systems and equipment which require periodic maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

C. Equipment Guards

1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.14 FEES AND PERMITS

A. The HVAC Sub-Contractor and related Sub-Contractors shall apply for, obtain and pay for all required permits, inspections, certificates, and incidental charges required for proper performance of the work, and shall furnish the Architect with copies of applications and all correspondence.

1.15 MATERIAL AND EQUIPMENT STANDARDS

A. Where equipment or materials are specified with the name of a manufacturer, such specifications shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.

B. Substitutions (approved equals) may be offered for review provided the material, equipment or process offered for consideration, is equal in every respect to that indicated or specified. In order for requests for substitution to be considered, all must be submitted for pre-approval of manufacturer within 30 days of award of contract. All requests must be accompanied by a list of minimum 5-year-old successful installations of similar scope (with owner contact and phone number), complete specifications together with drawings or samples to properly appraise the materials, equipment or process. Allow 30 days for Owner's Representative's review.

C. If a substitution of materials or equipment in whole or in part is made, this HVAC Sub-Contractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.

D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

1.16 SHOP DRAWINGS AND SUBMITTALS

A. Conform to the requirements of Division I, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing contractors and shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the heating, piping, and refrigeration systems.

B. Provide any additional submittals not noted below that may be required for confirmation of conformance with the requirements of all applicable Energy Rebate programs.

C. Definitions:

1. Shop drawings are information prepared by the HVAC Sub-Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.
2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:
   a. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, a fan coil unit must deliver equal CFM against equal external static pressure (with the allowed pressure drop of dirty filters) using equal or less horsepower as the fan coil unit listed in the schedules.
   b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space this determination is solely the responsibility of the HVAC Sub-Contractor.
   c. For rooftop mounted equipment and equipment mounted in areas where

structural matters are a concern, the products must have a weight no greater than the product listed in the schedules or specifications.

d. Products must adhere to all architectural considerations including, but not limited to: being of the same color as the product scheduled or specified, fitting within the architectural enclosures and details, and for diffusers – being the same size and of the same physical appearance as scheduled or specified 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.

D. Submittal Procedures, Format and Requirements

1. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼" scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary. Sheet metal drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls and partitions (highlighting fire walls and smoke partitions), diffusers, registers, grilles, fire and smoke dampers, sleeves and other aspects of construction as necessary for coordination.
2. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
3. If shop drawings showing connection details are not submitted and connections are found to be installed incorrectly, the HVAC Sub-Contractor shall reinstall them within the original contract price.
4. Provide complete data for all auxiliary services and utilities required by submitted equipment. This shall include power, condenser or cooling water, condensate and compressed air requirements and points of connection.
5. Provide a complete description of all controls and instrumentation required, including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.
6. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.
7. The Owner's Representative shall approve all materials before commitment for materials is made.

E. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping and Fittings (all systems, types and joining methods)
2. Pipe Hangers and Supports
3. Fan Coil units
4. Variable refrigerant volume heat pump systems
5. Energy recovery units

6. VAV boxes
7. Ceiling exhaust fans
8. Identification
9. Sleeves
10. Firestopping materials
11. Valves and Accessories (all types)
12. Pipe Insulation
13. Electric Motors and Starters
14. Refrigerant and Oil
15. Equipment Nameplates
16. Vibration Isolation equipment
17. Complete ductwork, equipment layout, and shop drawings, construction details and construction standards
18. Motorized dampers
19. Duct Insulation
20. Diffusers, Registers and Grilles
21. Air Filters
22. Fans
23. Electric heating devices
24. Operating and maintenance instructions and manuals
25. HVAC Control Systems
    a. See additional requirements in section 3.27 - Sequences of Operation.
26. Color selection charts and samples for equipment and systems in finished areas. (Provide six (6) original hard copies from manufacturer, electronic files are not acceptable.)

F. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in an individual (combined) submittal with a screwed together post binding system. Three-ring binders shall not be accepted.

G. Substitution Requests: Submit four copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution: A submittal shall be considered a substitution when the Engineer/Architect does not accept the product or material as an “equivalent” or where one of the listed manufacturers is not submitted.
2. Substitution Requirements: Substitutions shall meet the requirements of “Comparable Products.”
3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those

of the Project scope of work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested.

f. Cost information, including a proposal of change, if any, in the Contract Sum.

g. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

h. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

i. Statement indicating why the requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations.

H. Deviations

1. Proposed deviations from the Contract Documents, other than substitutions, shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Architect.

2. Without letters flagging the deviation, it is possible that the Architect may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner's Representative, the Seller shall hold the Architect, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Architect has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.

3. Approval of proposed deviations, if any, will be made at discretion of Architect.

I. Schedule: Incorporate shop drawing review period into construction schedule so that work is not delayed. The HVAC Sub-Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule:

1. Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that 20 working days, exclusive of transmittal time are required for the following:

a. HVAC temperature control submittals

b. HVAC balancing report

c. Coordination drawings

d. If more than five shop drawings of a single trade are received in one calendar week.

2. All roof mounted equipment submittals shall be considered a critical path item for coordination with structural shop drawings.

J. Responsibility

1. Intent of submittal review is to check for capacity, rating and certain construction features. HVAC Sub-Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes' or

means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the HVAC Sub-Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.

2. Inform sub-contractors, manufacturer's suppliers, etc. Of scope and limited nature of review process and enforce compliance with contract documents.

K. In the event that the HVAC Sub-Contractor fails to provide Shop Drawings for any of the products specified herein:

1. The HVAC Sub-Contractor shall furnish and install all materials and equipment herein specified in complete accordance with these Specifications.
2. If the HVAC Sub-Contractor furnishes and installs material and/or equipment that are not in complete accordance with these Specifications, he shall be responsible for the removal of this material and/or equipment. He shall also be responsible for the replacement of this material and/or equipment with material and/or equipment that is in complete accordance with these Specifications, at the direction of the Owner's Representative.
3. Removal and replacement of materials and/or equipment that are not in complete compliance with these Specifications shall be done at no extra cost to the Owner.
4. Removal and replacement of materials and/or equipment that are not in complete compliance with these Specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

L. Mark dimensions and values in units to match those specified.

M. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.17 APPROVAL OF SUBMITTALS

A. The Architect will return signed and approved or disapproved submittals to the Contractor within the time allowed by other sections of the specifications. Any submittals, which have been disapproved, shall be resubmitted by the Contractor within the time allowed by other sections of the specifications.

1.18 RESPONSIBILITY FOR ACCURACY OF SUBMITTALS

A. The HVAC Sub-Contractor is solely responsible for the accuracy and completeness of all submittals, regardless of corrections made in, or approval given to, such submittals. When the Architect makes comments and returns the submittals, it is incumbent upon the HVAC Sub-Contractor to thoroughly review the comments and notations made by the Architect. When, in the HVAC Sub-Contractor's opinion, the notes made by the Architect are in error or in conflict with other elements of the system, it is incumbent upon the HVAC Sub-Contractor to promptly notify the Architect of his findings or opinion along with substantiating data, in writing to preclude misunderstanding or expensive alterations caused by a review error or oversight. The submittals are intended to provide detailed documentation of the system design and its components. The responsibility for their correctness rests completely, totally and solely with the HVAC Sub-Contractor.

1.19 SUBSTITUTION OF MATERIALS OR EQUIPMENT

A. Named manufacturers for any equipment specified herein or identified on the drawings are identified for the purpose of identifying quality standards, performance information or type. Any substitution as “or equal” shall be considered. The Architect shall determine whether or not the offered equipment is equal to the specified. Where dimensional constraints exist the HVAC Sub-Contractor shall be responsible for any extra costs associated with extra work required to make the “or equal” equipment fit.

B. After approval of the submittals, substitution of materials or equipment of makes other than those specifically named in the submittals will be approved by the Architect only if the material or equipment proposed for substitution is equal to and/or superior to material or equipment named in construction, efficiency, utility and accuracy; and further that the material or equipment named in the submittals cannot be delivered to the job in proper sequence due to conditions beyond the control of the HVAC Sub-Contractor.

C. To receive consideration, requests for substitution shall be accompanied by documentary proof of equality or difference of both proposed equipment to be substituted and equipment named in the approved submittals. Substitution by the HVAC Sub-Contractor of other materials or processes than those named in the approved submittals shall be done only upon written authorization from the Architect.

D. Substitutions of fans shall have noise ratings that are equal to or better than the specified units. The substituted equipment shall be provided with the sound power data for both the substituted and specified equipment graphed on an NC curve chart for review with the submittal.

E. The requirements of Sections 013300 & 013301 shall be followed.

1.20 PRODUCT INTEROPERABILITY REQUIREMENTS

A. Interoperability Coordination Meeting: Attend coordination meetings to coordinate interoperability between all systems and equipment. Meetings shall be scheduled by the construction manager.

B. General Networking and Protocol Interoperability Requirements: Provide products that are fully BACNet interoperable.

1. All systems and equipment shall interface with the primary building management network provided under "Instrumentation and Controls for HVAC” using Ethernet standards and BACNet protocol.
2. Equipment that is native BACNet may connect directly to a BACNet MS/TP subnet that is provided by "Instrumentation and Controls for HVAC” when coordinated with that Section Contractor.
3. Communication involving control components (i.e., all types of controllers and operator interfaces) shall conform to the most current ANSI/ASHRAE Standard 135, BACnet.
4. The MS/TP trunks support all of the ASHRAE 135 approved baud rates.
5. All MS/TP devices support all baud rates of the ASHRAE 135.
6. All MS/TP devices shall be BTL approved (BACnet Testing Lab).
7. All BACnet routers must support B-BC (BIBB) and support BBMD routing.

8. Lonworks and Modbus subnets may be utilized where no BACNet protocol is available provided full 2-way compatibility is provided through a gateway.
    a. Exception: Fire alarm systems shall be 1-way, read only communication.
9. Each individual system and/or equipment manufacturer/installer shall provide all necessary gateways/translators Provide Gateway with all products as required facilitating full BACNet interoperability with BACNet Protocol.
10. It must be possible to read and display the value of any property, including all required properties, supported optional properties, and proprietary extensions of very object of every networked device.
11. Operating setpoints and parameters must be available for modification via BACnet services via a graphical user interface (GUI).
12. An operator shall be able to display at any time the operational status of any device on the BACnet internetwork. An operator shall be able to display at any time any property of any BACnet object. An operator shall also be able to display property values of objects grouped by object type, object location, building system, and by user defined parameters.
13. An operator shall have the ability to issue re-initialization commands to any device that supports remote re-initialization.
14. An operator shall have the ability to backup and restore all BACnet devices on the network.
15. It shall be each contractor's responsibility to configure each router using the network numbering scheme for the project. Each router shall be configured such that all network layer error messages shall be directed to a specific workstation using the BACnet Confirmed Text Message service. It shall be the contractor's responsibility to initially configure each router with routing tables containing all network numbers that are part of the project's internet. The router shall be able to receive messages at each port of any length that is valid for the LAN technology connected to that port, and to forward the message to any directly-connected network that can convey a message of that size.
16. Legacy Systems: Bi-directional gateways shall be provided for systems and equipment operating on a legacy/proprietary system. The operator workstation shall display information from both the BACnet and non-BACnet devices. Any information specified or required for system functionality shall be made readable and modifiable. Gateways shall have 10% expansion capacity. Gateways shall support archiving, uploading, trending, scheduling, and alarm/event detection, notification and acknowledgement.
17. Systems and equipment shall have full 2- way communications and interoperability.
    a. Exception: Fire safety systems and equipment shall have only read access to outside systems:
        1 Fire alarm.
18. Coordinate with "Instrumentation and Controls for HVAC" and other building operational systems for specific interoperability requirements.

C. Communications Standard: Coordinate communications standards requirements with other Sections and Divisions.

1. MS/TP LAN: RS 485

2. Systems with dedicated network(s) shall connect on the BACNet Ethernet LAN: utilizing a switch and shall meet standard Ethernet requirements.
   a. Utilize RJ-45 terminations.
   b. Utilize CAT 6 cabling.
   c. Meet IEEE Standard 802.3 standards and requirements.
   d. Speed: 100 Mbps.
3. Equipment without dedicated networks shall connect to the BACNet MS/TP LAN.
   a. RS 485 communications standard.
   b. Speed: 1 Mbps.

D. Information Availability: Make all product information, points, variables, setpoints, etc., available for access of building operational systems upon request.
   1. Provide bi-directional point mapping/addressing instructions.
   2. Provide on-site technicians as required to ensure proper information exchange.

E. Factory Provided Equipment Controllers: Provide all information, points, variables, setpoints, etc., indicated and referenced in all documentation, including "Instrumentation and Controls for HVAC." Products shall have full interoperability as indicated in this Section, in BACNet standards and elsewhere.

1.21 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun, prepare coordination drawings showing the size and location of equipment, piping, etc., in the manner described under SUPPLEMENTARY CONDITIONS.

B. Coordination drawings are for the General Contractor's and the Architect's use during construction and shall not be construed as replacing any shop, "as-built" or record drawings required elsewhere in these contract documents.

C. The HVAC Sub-Contractor shall be responsible for initiating the preparation of the coordination drawings and passing the drawings to other trades through the General Contractor for addition of the other trade’s work.
   1. Coordinated reflected ceiling plans showing ceiling mounted fan coil locations shall be included.

D. HVAC Coordination drawings shall show the following:
   1. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   2. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   3. Fire-rated enclosures around ductwork.

E. Before work progresses, and in addition to the shop drawings listed herein, submit coordination drawings at a suitable scale of not less than 3/8 inches equals one foot.

F. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:

1. File Preparation Format: Autodesk Revit .rvt file format in Microsoft Windows operating system and Autodesk AutoCAD .dwg file format in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination digital data files in the file preparation format and in Adobe .pdf format.
3. Upon receipt of a signed release form, Engineer/Architect will furnish to the Contractor one set of digital data files for use in preparing coordination digital data files.
   a. Engineer/Architect makes no representations as to the accuracy or completeness of digital data files as they relate to the drawings.
   b. Contractor shall execute a data licensing agreement

G. Provide composite systems coordination drawings showing HVAC duct, piping and equipment, fire protection piping and equipment, plumbing pipe and equipment and electrical conduit, cable, lights and other equipment.

H. All trades are required to coordinate with the other trades and revise the composite systems coordination drawings to eliminate interferences.

1.22 RECORD DRAWINGS

A. The Architect will furnish the HVAC Sub-Contractor electronic files of the mechanical drawings as issued for this contract in AutoCAD format and current Revit model file (if available). The HVAC Sub-Contractor shall change these drawings to indicate accurately and neatly the actual duct routing and duct sizes. At the end of the project the HVAC Sub-Contractor shall deliver to the Architect one set of reproducible As-built drawings and two (2) Compact Disks or USB flash drives with As-Built drawing files in the current AutoCAD version format and the current Revit version for the owner's permanent record.

B. The “As-Built” drawings shall show:
   1. The actual location of all air volume dampers and actuators.
   2. The actual location of all control valves and isolation valves with valve tag numbers
   3. Valve tag charts
   4. The actual location of all thermostats and control sensors.
   5. The actual location of all access panels
   6. Equipment schedules of the installed equipment.

1.23 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Commence preparation of the Operating and Maintenance manuals immediately upon receipt of “Approved” or “Approved as Noted” shop drawings and submit each section within one month. The last submission shall be no later than two months prior to the date of Substantial Completion of the project.

B. The manual shall consist of (3) sets of manuals and include (3) CDs, which shall contain the scanned content of the entire manual. The manual shall be submitted for review prior to creation of the CDs.

C. The manual shall contain the following:
   1. Operations Manual
      a. Systems description including all-relevant information needed for day-to-day

operations and management including start-up and shut-down instructions.

b. Wiring diagrams, schematics, logic diagrams and sequence of operations that accurately depict the controls system.

c. Depiction of each interface screen where programmable logic and visual displays are provided. Descriptors shall be provided to define displayed data; alarms, etc.

d. A single sheet (for ease of removal) of all access codes and passwords necessary to access all levels of control and programming.

e. Trouble shooting guide defining common alarms/problems with possible cause and effect.

2. Maintenance Manual

a. Define all maintenance activities required to ensure system operation within manufacturers' specified parameters. Provide table of all required activities plotted vs. interval with adequate fill-in-space for "activity completion date" and "comments". Where multiple instrument readings are required, provide data sheet formatted to accommodate activity.

b. Provide as part of each package, lubricating charts indicating equipment tag number, location, equipment service, greasing and lubricating requirements, lubricants, and intervals.

c. Provide as part of each package, a valve and system chart that corresponds to the valve tags. Provide directions for normal positions and positions for equipment failure modes.

d. The HVAC Sub-Contractor shall furnish spare-parts data for each different item of equipment furnished. The data shall include a complete list of: parts and supplies, with current unit prices, lead time, and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified herein after to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 360 days at the particular installation. The foregoing shall not relieve the HVAC Sub-Contractor of any responsibilities under the guarantees specified herein.

e. Provide copy of all warranty information with associated date of substantial completion (commencement of warranty) and end date of coverage. Define all components/subsystems specifically included and excluded.

D. Provide O&M manuals for each of the following as a minimum:

1. Electric Motors and Starters
2. Energy recovery units
3. Fan coil units
4. Variable refrigerant volume systems
5. VAV Boxes
6. Constant volume regulators
7. Vibration Isolation
8. Air Filters
9. Fans
10. Electric heating devices

11. Equipment support stands
12. Vibration isolation devices
13. Control Systems and components

1.24 WARRANTIES

A. Submit manufacturers standard replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the HVAC Sub-Contractor and related Sub-Contractors may have by law or by provisions of the Contract Documents.

B. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Drawings.

C. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.25 SYSTEM TRAINING

A. The HVAC Sub-Contractor shall provide on-site training on the mechanical systems for the building. The amount of time provided shall be as indicated below. Training times and dates shall be coordinated with the Owner. The training shall be video recorded by the HVAC Sub-Contractor and a DVD shall be provided to the Owner with each of the O&M Manuals.

B. Training shall include but not be limited to:

1. A general overview of the operation of each system (provide 4 hours)
2. The Variable refrigerant volume heat pump system and controls (provide 4 hours)
3. The energy recovery ventilators and fresh air system (provide 4 hours)
4. The ATC system and scheduling. (provide 4 hours)
5. Any other topics related to the mechanical system as requested by the Owner (provide 4 hours).

C. The variable refrigerant volume heat pump system shall include training by a manufacturer approved representative, a minimum of four hours and 4 hours of standard structured off-site training at the manufacturer's or manufacturer's representative's facility. The training shall be as is typically provided for Contractor certification in maintenance of the systems and shall include any information requested by the Owner.

D. Training time is exclusive of travel time, breaks, lunch, etc.

1.26 TESTING AND CHECKOUT

A. After completion of any work installed under this section, field tests shall be performed and checkout of the system accomplished. The tests shall include functional and operational tests where applicable on all equipment under all conditions that exist at the time. All defects of new equipment disclosed by tests shall be rectified without additional cost to the Owner. The installing Sub-Contractor shall be required to make all adjustments to equipment and accessory material to provide a thoroughly functional installation. All new equipment shall be installed, tested and checked before the HVAC Sub-Contractor tests, adjusts or balances the system as a whole.

B. The TAB Sub-Contractor shall perform the services of testing, adjusting, and balancing of the heating, ventilating, and air conditioning systems. The TAB Sub-Contractor shall check and adjust all HVAC systems to produce the performance specified by the construction documents and to achieve total system balance. The Tab Sub-Contractor shall be certified by an appropriate air balance council, such as the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or other approved agency, or shall employ technicians certified by an appropriate air balance council, such as the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or other approved agency to perform the air balancing procedures. All work done by the TAB Sub-Contractor shall be by qualified technicians under the direct supervision of a certified test and balance engineer. The TAB Sub-Contractor shall furnish all certified engineers, instruments, and provide personnel, trained and experienced, to test, adjust and balance all airside systems and related automatic temperature control systems, and shall submit system performance reports.

C. The work to be performed by the TAB Sub-Contractor shall include, but not be limited to:

1. Adjustment of the airside performance of the HVAC systems to provide design air quantities and temperatures.
2. Electrical measurement.
3. The balance of all air and water distribution systems.
4. Verification of performance of all equipment, thermostats and controls.

D. The TAB Sub-Contractor shall accomplish these objectives by:

1. Checking installations for conformity to design.
2. Measurement and establishment of the air distribution quantities of the systems as required to meet the design specifications.
3. Adjusting and balancing all HVAC systems to meet the design specifications.
4. Recording and reporting all results in a format approved by the Architect.

E. All work shall be completed in accordance with the standards set by AABC, NEBB, or other approved testing and balancing organizations. In general, all equipment, materials, and balancing procedures shall comply with all applicable standards.

F. The qualifications of the TAB Sub-Contractor shall include current membership in AABC, or certification by NEBB, or the TAB Sub-Contractor shall submit proof to the satisfaction of the Architect that the TAB Sub-Contractor meets the certification requirements of the AABC or NEBB.

G. Submit for approval samples, shop drawings, certificates, literature and data with information sufficient to evaluate the submission in compliance with the requirements of a completely adjusted and balanced system. Testing, adjusting and balancing procedures shall equal those of approved submittals and shall not be completed or incorporated in the work until approved. Approval or acceptance of submittal items will not preclude rejection of these items upon discovery of defects in them prior to final acceptance of completed work.

H. All work shall be performed in compliance with the approved submittals. The work schedule shall include the proposed procedures, proposed forms, diagrams, and reports for documenting the work. The TAB Sub-Contractor shall establish an approved systematic and uniform set of procedures in compliance with the AABC or NEBB.

I. All test instruments shall be accurately calibrated and maintained in good working order. If requested, calibration tests of equipment to be used shall be performed in the presence of the Owner.

J. The equipment and systems shall be tested, adjusted and balanced in accordance with the approved submittals. Wherever the TAB Sub-Contractor deviates from the original procedures, he shall be responsible for the new procedures being a better method. Any changes made necessary by the above shall be brought to the attention of the Architect and shall be subject to his approval prior to making such change. The procedural changes shall not be made a basis for additional compensation by the Owner, but shall be made at the TAB Sub-Contractor's own expense.

1.27 DUCT CLEANLINESS

A. The Sheetmetal Sub-Contractor shall be responsible for the requirements of this section.

B. All ductwork shall be protected from dust and debris with plastic wrap on each end until installation. After installation, unfinished ends or grilles shall be covered until the system is in operation.

C. Any equipment connected to ductwork shall not be operated until construction progress has reached a point where minimal dust is being created as determined by the Architect.

D. If any equipment is to be used prior to the point of minimal dust creation, all return or exhaust intakes shall be covered with filter material and all filters in the equipment shall be changed on a daily basis.

1.28 IDENTIFICATION OF MECHANICAL SERVICES

A. Ductwork: Identify all ductwork with plastic adhesive labels identifying the system, supply, exhaust or return, and flow arrows.

B. Volume damper location flags

1. Flags: Yellow one-inch wide tape, minimum 18 inches long.

C. Piping: Identify all piping with plastic adhesive labels identifying the system, supply or return, and flow arrows.

1. Labels shall be located at all changes of direction, wall and floor penetrations, every 20 feet on long pipe runs, at valves and close to points of branch takeoffs.
2. Refrigerant piping shall identify fan coil unit served.

D. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Owner.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain

E. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
3. Frame: Extruded aluminum.
4. Glazing: ASTM C 1036, Class 1, glazing quality B, 2.5 mm, single thickness glass.

F. Valve Schedule on Electronic Media:

1. In addition to the framed paper schedule, provide valve schedule on electronic media, type specified by Owner.
2. All valve tag locations shall be identified points on as-built drawings.

G. Equipment: Identify all energy recovery units, make up air units, controls, starters and similar equipment with white lamacoid engraved nameplates with black letters. Firmly secure with self-tapping screws.

1. Energy Recovery Unit identification shall be 6”x4” and shall indicate the following information:
   a. Tag number
   b. Design exhaust and supply airflow
   c. Design exhaust and supply external static pressure
   d. DX heating and cooling coil capacities
   e. Electric heat capacity
   f. Motor horsepower
   g. Power (volts/phase/hz)
2. Fan coil unit identification shall be 3”x2” and shall include the following information:
   a. Tag number
   b. Nominal cooling capacity (Btu/h)
   c. Nominal heating capacity (Btu/h)
   d. Rooms Served (ducted units only)
   e. Power (volts/phase/hz)
3. Variable refrigerant volume heat pump system identification shall be 6”x4” and shall include the following information:
   a. Tag number
   b. Nominal cooling capacity (Btu/h)
   c. Nominal heating capacity (Btu/h)
   d. Power (volts/phase/hz)
4. Fan identification shall be 3”x2” and shall include the following information:
   a. Tag number.
   b. Design airflow (CFM)
   c. Design external static pressure (IN WC)
   d. Motor horsepower
   e. Power (volts/phase/hz)

1.29 DELIVERY, STORAGE AND HANDLING

A. No materials shall be delivered or stored on site until Shop Drawings have been approved.

B. All manufactured material shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.

D. Inspect all equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

1.30 PROTECTION OF WORK AND PROPERTY

A. The HVAC Sub-Contractor shall be responsible for the care and protection of all work included under this section until the completion and final acceptance of this Contract.

B. Protect all equipment and materials from damage from all causes; including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this section and make good damage thus caused.

D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

1.31 SAFETY PRECAUTIONS

A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the owner and OSHA throughout the entire construction period of the project.

1.32 SCHEDULE

A. Construct work in sequence under provisions of Division I and as coordinated with the Owner's Representative.

1.33 HAZARDOUS MATERIALS

A. Dispose of all hazardous materials in accordance with Federal and State laws. All handling shall conform to EPA requirements. A uniform hazardous waste manifest shall be prepared for all, disposals and returned with all applicable signoffs, prior to application for final payment. Provide breakout cost for this scope.

B. Recovered refrigerant shall be recycled by a licensed facility approved by the Owner's Representative.

C. Removed equipment or fluids containing any hazardous materials such as ethylene glycol, oil or chromate shall be recycled by a licensed facility approved by the Owner's Representative.

1.34 ACCESSIBILITY

A. All work provided under this section of the specification shall be installed so that parts requiring periodic inspection, maintenance and repair are readily accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

1.35 ELECTRICAL WORK

A. All electrical apparatus and controls furnished, and the installation thereof, as a part of the HVAC work, equipment and controls shall conform to applicable requirements under specification 260000 – Electrical.

1.36 PROJECT CLOSEOUT

A. Certificates of Approval

1. Upon completion of all work, provide certificates of inspections from the following equipment manufacturers stating that the authorized factory representatives have inspected and tested the operation of their respective equipment and found the equipment to be in satisfactory operating condition and installed per the manufacturer's installation instructions and requirements.
   a. Automatic Temperature Controls
   b. Variable Refrigerant Volume Heat Pump System

B. Construction Observations by the Engineer

1. The engineer is contracted to make progress site visits during construction, one substantial completion (punch list) site visit for determining substantial completion and one Final inspection visit to determine if all work is complete.
2. The HVAC Sub-Contractor and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.
3. Progress Site Visits
   a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.
   b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.

C. Substantial Completion

1. When the HVAC Sub-Contractor considers the work under this Section is substantially complete, the HVAC Sub-Contractor shall submit written notice, through the General Contractor, with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion, the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.

2. The following items shall be submitted and approved by the Engineer prior to the written request for substantial completion inspection:
   a. Certification of successful operation of all systems
   b. Training of the Owner's personnel in the operation of the systems.
   c. Record Drawings in accordance with the contract specifications.
   d. Operation and Maintenance Manuals
   e. Testing reports
   f. Balancing reports
   g. Manufacturers certificates of approvals
   h. Emergency contact list for reporting of malfunctioning equipment during the warrantee period
   i. Contractors project completion certificate in accordance with the building code requirements.
3. Should the engineer, during the substantial completion visit, observe that the work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punch List will provide for a place for the HVAC Sub-Contractor and general contractor to sign off and date each item and individually indicating that the observed deficiency item has been corrected.
4. Should the Engineer, during the substantial completion site visit, observe that the work is not substantially complete, s/he will provide a written list of the major deficiencies and a reason for the work not being considered substantially complete.
5. If the work is found not to be substantially complete, then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the Subcontractor through the Contractual Agreement for any further observations by the engineer.
6. The HVAC Sub-Contractor shall remedy all deficiencies listed in the punch list within the time frame required by the contract.

D. Engineers Construction Completion Certificate

1. Where required by the applicable code, the Engineers Construction Completion Certification will be issued by the Engineer when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:
   a. Air Balancing
   b. Variable Refrigerant Volume Heat Pump System Start up
   c. Pipe Pressure Test
   d. Ductwork
2. There shall be NO outstanding items identified on the punch list for scope within any of these categories.

E. Final Completion

1. The following items shall be submitted prior to the written request for Final completion:
   a. Revised substantial completion items to be resubmitted in accordance with the review process comments

b. Warranties commencing the date of substantial completion

c. Individual signed and dated punch list acknowledging completion of all punch list items

2. When the HVAC Sub-Contractor considers all of the punch list work items complete, the HVAC Sub-Contractor shall submit written notice through the General Contractor that all punch list items are complete and resolved and the work is ready for final inspection. The signature lines for completion of each punch list item shall be signed by the HVAC Sub-Contractor indicating the work is complete and signed by the General contractor indicating site has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punch list items are complete, the engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punch list work to be incomplete during the final inspection, a written listing of the observed deficiencies will be prepared by the Engineer.

3. If the work is not fully complete then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the HVAC Sub-Contractor through the contractual agreement for any re-observations by the engineer.

F. Re-Observation Fees

1. The re-observation fee shall be $1,800 per visit.

G. HVAC Sub-Contractor's Project Completion Certificate

1. Upon completion of work and prior to request for Certificate of Occupancy, the HVAC Sub-Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. The certificate shall certify:

a. Execution of all work has been installed in accordance with the approved construction documents.

b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.

2. The certificate shall include the following information:

a. Project

b. Permit Number

c. Location

d. Construction Documents

e. Date on Plans and Specifications submitted for approval and issuance of the Building Permit

f. Addendum(a) and Revision Dates

3. The certificate shall be signed by the HVAC Sub-Contractor and include the following:

a. Signature

b. Date

c. Company

d. License Number

e. License Expiration Date

1.37 SEQUENCING

A. Phasing: Refer to Section 01 10 00 - Summary, and Drawings for phasing and milestone completion requirements which affect the Construction Manager's Work and the Work of the HVAC Sub-Contractor and related Sub-Contractors.

B. Coordinate work of this Filed Subcontract with that of other trades, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

C. Do not order or deliver any materials until all submittals, required in the listed Specification Sections included as part of this Filed Subcontract, have been received and approved by the Architect.

D. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

1.38 COMMISSIONING OF HVAC EQUIPMENT AND SYSTEMS

A. RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections.
2. An outside commissioning authority will commission the building at the completion of construction. Refer to SECTION 01 81 00 commissioning specifications for systems affected and contractor interface required.

B. SUMMARY

1. Section includes commissioning process requirements for HVAC&R systems, lighting control systems, and hot water heaters.
2. During Functional Testing, it is anticipated that the equipment will function as intended. Failure of an item includes excessive noise, failure to perform the intended function, or a deviation of more than 10 percent from the intended performance.
3. The CxA will choose specific pieces of equipment at random for testing.
4. A representative sample of large-volume equipment items of a similar nature (such as VAV terminals or heat pumps) may be chosen for testing. Failure of 10 percent (or 1, whichever is greater) of selected items shall result in stopping the Functional testing. The contractor shall remedy the deficiency and notify the CxA so that re-testing of failed portions can be performed.
5. Failure during retesting of any of the previously-failed items, or 10 percent (or 1, whichever is greater) of an additional sample roughly equal in size to the original sample, shall constitute failure, and shall necessitate testing of 100% of the installed equipment.
6. For small-volume or critical equipment (such as chillers or air handlers), every unit will be functionally tested.
7. At the CxA's sole discretion, many or all units of a similar nature (for example, heat pumps or fan coils) may be tested simultaneously in order to apply a thermal or electrical load on major contributing systems, such as chillers, boilers, cooling towers, or air handlers.

8. First-round testing is included in the CxA's budget. Any testing necessitated by above-described failures shall be at extra cost, and may be borne by the contractor.

C. DEFINITIONS

1. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
2. CxA: Commissioning Authority.
3. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
4. BMS: Building Management System, a computer-based system intended to monitor and control the operation of the HVAC equipment
5. TAB: Testing and Balancing
6. EOR: Engineer of Record
7. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

D. CONTRACTOR'S RESPONSIBILITIES

1. Allow sufficient time in the construction schedule, presented as a task in all project schedules, for on-site Functional Testing of equipment that is within the scope of work. CxA shall be consulted as early as possible to determine the appropriate amount of time necessary for testing. This time shall commence after all work is complete, TAB reports have been submitted, reviewed, and approved by the EOR, and equipment start-up sheets have been submitted and approved by the EOR. It will end prior to occupancy of the space. The time allotted for Commissioning SHALL NOT coincide with building flushing, balancing, or other testing or operations without the specific approval of the CxA.
2. Allow sufficient time in the schedule for repair of any faulty systems or components revealed during Functional Testing. One week is recommended.
3. Allow 5 working days minimum, prior to occupancy of the building, and after any repairs or reprogramming as per the previous item, for follow-up Functional Testing to prove that equipment and systems are operating and reporting properly
4. Perform all equipment inspections and testing prior to commissioning. Submit a complete manufacturer-recommended start-up checklist for all major equipment at least 2 weeks prior to commissioning.
5. Assure that the Testing and balancing work (TAB) work is complete, and that the TAB report is sent to the Engineer of Record for approval no later than 2 weeks prior to commissioning. A draft of the report is to be sent simultaneously to the CxA.
6. The Building Controls Contractor shall submit a complete controls submittal for review by the CxA, which shall include at a minimum operating sequences and sample graphics. This must be submitted with enough lead time to consider any recommendations by the CxA.
7. The Building Controls Contractor shall submit point-to-point checklists and calibration sheets at least two weeks prior to functional testing.
8. Submittals for any controls that are provided with equipment, such as proprietary boiler or air handler controls, must be provided to the CxA at least 2 weeks prior to functional testing

9. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
10. Provide information requested by the CxA for final commissioning documentation.
11. Provide a technician that is thoroughly familiar with the programming and operation of the BMS and other controls for assistance during functional testing.
12. Provide personnel as necessary to assist in the Functional Testing of the HVAC equipment.
13. Repair, reprogram, or otherwise correct any deficiencies that are revealed during functional testing, and report the corrections in the forma agreed to with the CxA and Project Management.
14. Assist as necessary in any retesting that is necessitated by failure of equipment or systems to perform as per the design intent.
15. Provide material for inclusion in the commissioning report. For example, as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

E. CxA'S RESPONSIBILITIES

1. Include CxA responsibilities in this article that have an impact on Contractor's activities and responsibilities.
2. Provide Project-specific commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
3. Approved start-up reports, balancing reports, and control system point-to-point checklists and calibration reports shall serve as pre-functional testing. The CxA may choose to participate in this work.
4. Direct commissioning testing.
5. Verify testing, adjusting, and balancing of Work are complete.
6. The CxA shall judge whether equipment or systems function in a manner consistent with the design intent. A report shall be produced that lists any discrepancies.
7. Testing of any systems or equipment that fails the initial functional test will be repeated until all systems perform in accordance with the design intent and the intended operating sequences. Retesting may be additional to the contract value, and the cost may be passed through to the contractor responsible for the non-performing system.
8. A final commissioning report will be generated after all functional testing is complete. This report will contain as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

F. COMMISSIONING DOCUMENTATION

1. Provide the following information to the CxA for inclusion in the commissioning plan:
   a. Plan for delivery and review of submittals, systems manuals, and other documents and reports, including BMS, lighting control devices and systems, leak detection submittals.
   b. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

c. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
d. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
e. TAB reports for both air and hydronic systems.
f. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
g. Test and inspection reports and certificates.
h. As-built drawings
i. Corrective action documents.
j. Verification of testing, adjusting, and balancing reports.
k. Maintenance requirements or recommendations for all equipment provided by the Contractor.
l. Recommended spare parts list
m. Contact names and phone number for warranty or maintenance during the warranty period, as well as a 24-hour emergency contact.

G. SUBMITTALS

1. Paragraphs below are "Informational Submittals." See Division 01 Section "Submittal Procedures" for definition of "Informational Submittals."
2. Certificates of completion of installation, prestart, and startup activities.
3. Control system submittals
4. Point-to-point checklists and instrument calibration records.
5. TAB Report
6. Start-up/checkout checklists and reports
7. As-built drawings

2 PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials, except as otherwise specified, shall be new, of current production, first quality and the best of each class specified.

B. Required materials not covered by detailed specifications shall be of a suitable class, grade, quality and type and shall be subject to the approval of the Architect. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer.

C. All equipment shall be installed and constructed to operate safely, as designed, without leakage, undue wear, noise, vibration or corrosion.

2.2 ELECTRIC MOTORS AND RELAYS

A. Design, type and ratings of electric motors shall comply with the National Electrical Code, NEMA and Underwriter's Laboratory.

B. Unless otherwise noted or required for special applications, motors shall be open drip-proof with sealed ball bearings.

C. All electric motors shall be of the voltage, type and frame as specified in the electrical portion of the specifications.

2.3 ACROSS-THE-LINE STARTERS

A. All motor starters shall be across-the-line start with magnetic contactors and thermal overloads properly sized for the motor nameplate data.

B. All motor starters shall be furnished with a Hand-Off-Auto (HOA) switch mounted on the cover of the enclosure.

C. All motor starters shall be furnished with a fused 120 volt control power transformer rated at a minimum of 2 amps.

D. All motor starters shall be furnished mounted in a NEMA 1 enclosure suitable for the mounting location.

E. All motor starters shall be provided with magnetic contactors having one normally open and one normally closed auxiliary contactor.

2.4 HANGERS AND SUPPORTS

A. Pipe hanger or stanchion support assemblies shall include turnbuckles or other means of vertical adjustment.

B. Trapeze hangers may be used in lieu of separate hangers for closely spaced, parallel lines. Pipe hanger components shall be as per MSS SP-58.

C. Hangers shall have steel rods with two nuts and shall be suspended from suitable beam clamps or concrete inserts. Rod sizes shall be as recommended by the hanger manufacturer and at least the following:

Pipe to 2".....3/8" diameter
2½" - 3".....1/2" diameter
4- 5" .....5/8" diameter

D. Maximum hanger or stanchion support spacing for copper or steel pipe shall be as follows:

PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING
3/4” or less	5 feet	2 ½"	9 feet	6"	14 feet
1”	6 feet	3"	10 feet	8"	16 feet
1¼"	7 feet	3 ½"	11 feet	10"	18 feet
1½"	8 feet	4"	12 feet	12"	19 feet
2”	8 feet	5"	13 feet	14"	25 feet

E. Hangers or stanchion supports for copper tubing shall be copper plated where they contact the copper tubing.

F. Hangers or stanchion supports for insulated pipe shall have insulation shields.

G. All rigid piping attached to the building and serving equipment subject to vibration shall be hung or supported on vibration isolators for the first 20 feet.

H. Vertical rises shall be supported from stands at the bottom of the rise or hangers at the top of the rise as shown on the drawings per the HVAC Sub-Contractor's option.

I. All hangers on insulated piping to be sized to fit around the insulation.

2.5 ANCHORS

A. Anchor points as shown on the drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

2.6 VIBRATION ISOLATORS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for these areas where bolting is required.

B. Spring type isolators shall be free standing and laterally stable without any housing and complete with ½" neoprene acoustical friction pads between the baseboard and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

C. Vibration hangers for piping and mechanical equipment shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bussing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability. For locations requiring precise elevation during installation the hanger shall be precompressed to the rated deflection and the released after completion of the installation.

D. Vibration hangers for duct systems shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability.

E. Horizontal thrust restraints shall be provided on equipment subject to excessive displacement. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad. The spring element shall be contained within a steel frame and designed so that it can be preset for thrust and adjusted to allow for a maximum of ¼" movement when the equipment starts or stops. The assembly shall

be furnished with one rod and angle brackets for attachment to the equipment and the ductwork. Horizontal thrust restraints shall be attached at the centerline of the thrust and symmetrically on each side of the unit.

2.7 CONDENSATE PIPING

A. Condensate piping shall be type-L copper with soldered joints. All 90° changes in direction shall be made with 45° elbows and tee-wyes with cleanouts, not with straight tees.

B. Solder shall be 95/5 non-lead solder.

2.8 REFRIGERANT PIPING

A. All refrigeration system piping shall be as follows:

Construction	Hard brazed joints
Piping	Copper tubing type ACR, hard drawn, cleaned, dehydrated and capped for refrigeration service, ANSI B70.1 ASTM A-280
Fittings	Wrought copper, Brazed joint type, ANSI B16.22
Coupling	Same as above
Brazing Alloy	Easy Flo, Silfos, Phos Co., Minimum 1100 °F melting temperature, ASTM 280

B. Soft drawn copper tubing may be used in sizes acceptable to the refrigeration equipment manufacturer.

2.9 PIPING INSULATION MATERIALS

A. Insulation for pipe shall be glass fiber with a K factor of .24 at 100° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a factory applied double pressure sensitive adhesive sealing system.

B. Insulation for concealed fittings and valves shall be glass fiber blanket with a K factor of .24 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket.

C. Exposed fittings, valves and flanges shall be insulated with molded fitting covers or fabricated segments of pipe insulation.

D. Insulation, jacket, covers and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

E. Insulation shall be Owens-Corning Fiberglass ASJ/SSL-II or approved equal.

F. All refrigerant piping (suction and liquid lines) shall be insulated with flexible foamed plastic, minimum 5.0 lb. per cubic foot density, thermal conductivity not greater than 0.27 Btu-in/sq. ft/°F/hour at mean temperature difference of 75°F.

G. Multiple layers of refrigerant piping insulation shall be provided to achieve the overall required thickness.

H. All outdoor exposed refrigerant piping shall be encased in Zeston PVC Jacketing as manufactured by Johns Mansville or pre-approved equal. All seams shall be located

on the lower half of the pipe. Fittings shall be covered using PVC fitting supplied by the manufacturer.

1. All refrigerant support and mounting clips shall be installed on the outside of the insulation and/or jacketing.

I. Insulation thickness shall be as follows:

SYSTEM	**PIPE SIZE**	**THICKNESS or R-value**
Refrigerant Piping (suction and liquid)	7/8” and smaller 1” and up	½” 1”
Condensate Drain Piping	1¼” and smaller 1½” and up	½” 1”

2.10 PVC INSULATION JACKET

A. High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; 25/50 flame-spread/smoke developed rating; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Johns Manville; Zeston.
2. P.I.C. Plastics, Inc.; FG Series.
3. Proto Corporation; LoSmoke.

C. Adhesive: As recommended by jacket material manufacturer.

1. Color: White.

D. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

E. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville: Z-Tape
   b. ABI, Ideal Tape Division; 370 White PVC tape.
   c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

F. The following piping shall be jacketed:

1. All refrigerant piping located outdoors.

2.11 VALVES

A. All valves shall be first quality of an approved manufacturer, shall be installed with the proper clearances and shall be tight at the specified pressures.

B. Valves shall be of minimum working pressure and materials as fittings specified for the service, however, in no case shall valves be designed for less than 125 PSI working pressure.

C. Where a specific manufacturer, brand and/or figure number is specified, an equivalent figure from an approved manufacturer shall be acceptable.

D. For shut off service the HVAC Sub-Contractor shall use ball valves with full open ID.

E. For throttling or modulating service the HVAC Sub-Contractor shall use a butterfly valve or another type of valve if a specific valve is specified on the drawings.

F. Check Valves

1. Check valves shall be bronze 2." and smaller; Cast iron or cast steel with bronze trim for 3" and larger.
2. All check valves shall have removable caps and regrindable disc and seat ring.
3. Bronze check valves shall be rated 125 PSI SWP, 200 PSI WOG as NIBCO figure T-413 or S-413.
4. Iron Check valves shall be 125 PSI SWP, 200 PSI WOG as NIBCO figure F-918.

G. Ball Valves.

1. Ball valves shall be bronze 2½" and smaller equal to Apollo Ball Valves 70 series.
2. Ball valves shall be rated for 200 PSI @ 250°F.

2.12 PIPE LABELS

A. All refrigerant piping shall be labeled with plastic adhesive labels. Labels shall indicate the piping system (refrigerant suction, refrigerant liquid, etc.), and shall indicate the direction of flow. Piping shall be labeled every 20 feet minimum on straight runs, within 2 feet of access panels and shall be labeled within five feet of changes of direction. Labels shall be applied to the insulation jacket.

1. All refrigerant branch circuits shall be labelled with the fan coil tag number served.

2.13 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves for each pipe passing through a wall, floor, partition or roof.

2.14 FIRE-STOPPING

A. Seal annular spaces between sleeves and penetrating materials in fire-rated floors, ceilings, and walls with fireproof and waterproof silicone elastomer applied in accordance with the manufacturers published instructions. Multiple penetrations

shall be sealed with silicone foam; single penetrations may be sealed with silicone caulking. Seal material shall be UL classified for use in fire-rated penetration seals, and shall be applied in the manufacturer's recommended thickness for the fire rating of the penetrated structure in accordance with ASTM-E-814 requirements.

B. Acceptable Manufacturers: Dow Corning, General Electric, 3M.

2.15 WATERPROOFING

A. Seal penetrations of wet or potentially wet structures, floors, exterior walls, etc., other than those requiring fire stopping, with sealant to prevent moisture leakage. Apply sealing material (caulking) in accordance with manufacturer's published instructions.

B. Product Research and Chemical Co. "Poly-Sulphide Sealant" PRC-5000.

2.16 FILTERS

A. Refer to equipment schedules and specifications for filter requirements.

B. Unless otherwise noted panel filters shall be 1" MERV 8 filters.

C. Provide one (1) set of spare filters for each piece of equipment.

2.17 RECTANGULAR DUCTS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

B. Duct sizes shown on the drawings are the clear inside dimensions, after any lining has been applied.

C. Ductwork for ERV-1, RTU-1 & 2, exhaust fan and fan coils shall be constructed to 2” static pressure class requirements.

2.18 RECTANGULAR DUCT FITTINGS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.19 ROUND DUCTS

A. All round ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

B. All round spiral duct and fittings shall be manufactured from G-90 galvanized steel, conforming to ASTM and SMACNA standards. Standard elbows will have 1.5 centerline radius. Other radii and vaned elbows are available as needed. Elbows through 12” shall be die formed, with stitch welded joints. Elbows 14” through 30” shall be gore-locked construction. All elbows above 32” shall also be gored, but with tack weld and sealed construction for use to 4” w.g., or solid welded for use to 10” w.g.

2.20 FLEXIBLE DUCTS

A. All flexible ducts shall be constructed of a trilaminate of aluminum foil, fiberglass and aluminized polyester mechanically locked to a galvanized steel helix. No adhesives shall be used to lock the fabric to the helix.

B. All flexible ducts must conform to NFPA 90A and 90B requirements and be tested in accordance with UL-181 and bear a UL label and be installed in accordance with their listing by UL. Flexible ducts shall have a flame spread rating or 25 or less and a smoke developed rating or 50 or less per UL 723.

C. Insulated flexible duct shall have a block fire retardant polyethylene outer jacket with a ½ lb. density 1-1/2” thick fiberglass insulation jacket.

D. Flexible ducts 12” diameter and smaller shall be rated at 12” positive pressure and 10” negative pressure. Flexible ducts 14” and 16” diameter shall be rated at 5” positive and negative pressure and flexible ducts 18” diameter and larger shall be rated at 1” positive and negative pressure.

E. Flexible ducts shall not exceed 5 feet in length.

2.21 FLEXIBLE CONNECTORS

A. All connections between vibrating or rotating equipment and ductwork shall be made with a flexible connection consisting of a heavy fiberglass fabric, double coated with neoprene and shall be fireproof conforming to NFPA 90A, waterproof and airtight. The flexible connection shall be a minimum of 6" long and held in place with heavy metal bands.

2.22 DUCT INSULATION MATERIALS - DUCT WRAP

A. Insulation for ducts and fittings shall be glass fiber with a K factor of .25 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a 2" stapling flange.

B. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

C. Insulation for concealed ductwork shall be Owens-Corning Fiberglass Type 150 or approved equal.

D. Exposed exterior ductwork insulation shall be protected with a waterproof EPDM membrane with all seams sealed water tight and all longitudinal seams located on the bottom of the duct.

E. The following ducts shall be insulated:

1. All exterior ERV-200 system supply and return ducts.

2.23 SPIRAL DUCT LINING

A. Basis of design is Johns Manville Spiracoustic Plus fiberglass spiral duct liner. Alternate manufacturers are Owens Corning and CertainTeed.

B. Materials: All supply ducts, return ducts, and fittings insulated with Spiracoustic Plus System round duct liners, meeting the following requirements:

1. Minimum thermal conductance of 0.23 at 75°F based on 1" material thickness.
2. Noise reduction coefficient of 0.75 for 1" board, 0.85 for 1.5" board, and 0.95 for 2" board when tested in accordance with ASTM C423 when using a type "A" mounting.
3. Maximum rated velocity of 6000 FPM when tested in accordance with UL 181.
4. Fiber shed shall not be detectable as determined by electron microscopy analysis of isokinetic sampling at maximum rated velocity.
5. Duct liner shall have a FHC rating of 25/50 and be classified as meeting the requirements of limited combustibility.
6. The air stream surface shall have a 100% coverage coating of acrylic polymer formulated with an immobilized EPA registered anti-microbial agent proven resistant to microbial growth as determined by ASTM G21.
7. Material shall be certified by GreenGuard.
8. Shall not contain asbestos, lead, mercury, or mercury compounds.

C. Accessories

1. Joint closure tape meeting the requirements of UL 181A, as identified by imprinting on the tape foil surface.
2. SuperSeal® coating products for coating exposed edges, connections or minor surface damage not requiring replacement of insulation.
3. Duct liner adhesive, when required, meeting the requirements of ASTM C9l6.
4. Duct liner pins, when required, meeting the requirements of Johns Manville Spiracoustic Plus Installation Guide, Sections 5 and 6.

D. The following ducts shall be lined:

1. All exposed supply and return ductwork in the Gymnasium shall be lined with 1" in its entirety.

E. Duct dimensions shown on the drawings are the clear inside dimensions, after the lining has been applied.

2.24 ACOUSTICAL DUCT LINING

A. Acoustical duct lining shall be constructed of a semi-rigid board of glass fiber with a black-pigmented, fire resistant coating on the side toward the airstream. The duct lining shall comply with the requirements of NFPA 90 and ASTM C 1071.

B. Duct lining shall have a thermal conductivity of 0.25 Btu*in/hr*ft^2*°F.

C. The following ducts shall be lined:

1. All ERV supply and return/exhaust duct connections to the unit shall have 1" lining for the first 10 feet or past the second elbow, whichever is further.

D. Duct dimensions shown on the drawings are the clear inside dimensions, after the lining has been applied.

2.25 VOLUME DAMPERS

A. Furnish and install, where indicated on the drawings or where required for balancing, air splitter dampers, butterfly dampers, or opposed blade dampers with indicating and locking quadrants or push rods and pillow blocks.

B. Opposed blade dampers shall be manually operated multi-blade type with sleeve bearings, galvanized steel interlocking blades and a galvanized steel frame. In ducts over 19" in depth and 12" in height, use multiple opposed blade type, gang operated dampers with a maximum blade width of 8". Fabricate the damper blades of 10-gauge steel with hemmed edges, and a maximum length of 48". Damper operating rods shall be the full blade length and shall extend through the duct to externally mounted bearing plates. On insulated ductwork, bearing plates shall be flush with insulation finish and fastened to the duct. The operating lever shall be of the indicating type with locking quadrant. Splitter dampers shall be sufficiently long to extend the full width of the branch duct to which they are attached. Where necessary they shall curve to scoop branch duct air out of the main duct air stream. The dampers shall be constructed in accordance with the latest SMACNA standards and shall be at least two gauges heavier than the ducts in which they are installed.

2.26 CONTROL DAMPERS & ACTUATORS

A. Control dampers based on Greenheck series VCD-34 low leakage insulated blade or approved equal.

B. General:

1. Blade action shall be opposed.
2. Dampers shall meet or exceed the IECC (International Energy Conservation Code) requirements for damper leakage ratings of 3 cfm/ sq. ft @ 1 in. wg or 8 cfm/sq. ft. @ 4in. wg or less when integral to the building envelope.
3. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.04 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3.
4. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance in accordance with AMCA 511 (VCD-20, VCD-23, VCD-33, VCD-34, SEVCD-23 and SEVCD-33).
5. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance Air Leakage in accordance with AMCA 511 (VCD-23, VCD-33, VCD-34, SEVCD-23 and SEVCD-33).

C. Construction:

1. Damper frame shall be 16 ga. galvanized steel formed into a 5” x 1” structural hat channel. Top and bottom frame members on dampers less than 17” high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 ½” (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking. Stainless steel frame is optional.
2. Damper blades shall be airfoil shape, galvanized steel double skin construction (14 ga. equivalence) filled with ½ in. polystyrene on each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide

symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal. Stainless steel blade is optional.

3. Linkage shall be plated steel.
4. Axles shall be plated steel.
5. Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame.
6. Mill galvanized finish is standard.

D. Actuator

1. Electric, 24V DC, 2-position
2. External (outside of duct)

2.27 DRIP PANS

A. Examine the drawings and in cooperation with the Electrical Contractor confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping no closer than two feet from a vertical line to electric motors and controllers, switchboards, or similar equipment. Piping is not permitted in electric equipment, transformer, switch gear and telephone gear rooms.

B. Where the installation of piping does not comply with the requirements of foregoing paragraph, where feasible the piping shall be relocated.

C. Where relocation of piping is not feasible, furnish gutters as follows:

1. Provide and erect a gutter of 16 ounce cold rolled copper or 18 gauge galvanized steel, under every pipe which is within 2 feet from a vertical line to any motor, electrical controllers, switchboards, panelboards or the like.
2. Each gutter shall be reinforced, rimmed, soldered and made watertight, properly suspended and pitched to a point outside of the electrical room.

2.28 ACCESS PANELS

A. Hinged access panels shall be provided at locations of volume dampers, control dampers, and elsewhere as required to service the duct systems. Access doors shall be fully gasketed for airtight seal at the rated working pressures of the systems in which they are installed. Access doors shall be adequately sized for their intended purpose and equipped with a minimum of two sash locks. Access doors in insulated ducts shall be double wall and insulated.

B. Access panels shall be provided at locations of the variable refrigerant volume systems if located above hard ceilings.

C. Coordinate with requirements of Specifications Section 083110.

2.29 REGISTERS, GRILLES AND DIFFUSERS

A. The types, sizes and airflow patterns of the registers, grilles and diffusers as specified and as shown on the plans have been selected to accomplish the intent and purpose of the system. Any substitutions proposed for items scheduled, shown or specified must provide the same air flow patterns, at the same air volumes and must have the same acoustical characteristics as the specified elements.

B. All interiors of all ducts in back of all registers, grilles and diffusers shall be painted with one coat of flat black nonflammable paint.

C. Duct connections to supply devices shall be made inside the collars, if any, and, duct connections to return or exhaust devices shall be made outside the collars, if any.

D. All registers, grilles and diffusers shall have a baked enamel, white, semi-gloss finish.

E. Square and rectangular diffusers shall have removable cores with opposed blade dampers, gasketed borders and concealed fastenings.

F. Frame types of diffusers shall be as appropriate for the type of ceiling in which they are to be installed.

G. Supply, return and exhaust air registers shall have opposed blade dampers and gasketed borders.

2.30 CONSTANT AIRFLOW REGULATOR

A. Constant airflow regulators basis of design is American Aldes.

B. Refer to plans and schedules for models, accessories and quantities.

C. Model CAR3 Constant Airflow Regulator

1. Airflow regulator shall be capable of maintaining constant airflow within +/-10% of the scheduled flow rates, within the operating range of 0.12 to 1.2 in. w.g. differential pressure for low-pressure models (CAR3-L), or 0.4 to 2.8 in. w.g. with high-pressure models (CAR3-H).
2. CAR3 solely operate on duct pressure and require no external power supply or sensors, and shall be rated for use in air temperatures ranging from -25°F to 140°F (-32°C to 60°C).
3. CAR3 must be equipped with double lip gasket to provide a secure, leak free installation into rigid round duct, take-offs, collars, etc.
4. Each regulator shall feature dual-side adjustment dial to allow changes in airflow setpoint while installed in either the supply or exhaust direction without removing the regulator from the duct.
5. Each CAR3 must be calibrated to match the airflows indicated on the schedule or drawings.
6. Regulator must be classified per UL 2043 and carry the UL mark indicating compliance.
7. Constant Airflow Regulator shall be enhanced with antimicrobial, anti-static, and flame retardant additives for increased durability and safety, and covered under warranty for a period of no less than seven years.
8. Constant Airflow Regulator shall be installed in accordance with local code and manufacturer's instructions.

D. Model ZRT-PDIL Parallel Damper In-Line Zone Terminals

1. The terminal casing shall be minimum 24-gauge G90 galvanized steel with duct flange that allows attachment of rectangular rigid ducting in a slip-type duct connection.

2. Each terminal shall include integral, pressure-independent Constant Airflow Regulators (CAR) that provide the capability of automatically regulating airflow in both a continuous and boost setting. Each regulator shall automatically respond to changes in duct pressure to maintain specified flow rates at a constant level.
3. The low-volume continuous and on-demand boost Constant Airflow Regulators (CAR) shall be factory calibrated to the specified set points. Both regulators shall be capable of being adjusted in the field to any desired airflow within their noted minimum and maximum setpoints.
4. The continuous CAR will automatically control the amount of air any time the central fan is operating.
5. The boost CAR shall be located in series with a motorized single-blade damper operated by a long-life synchronous-drive motor with normally closed spring-return closure. When the ZRT-PDIL is powered, the motorized damper will open allowing air through the boost regulator, automatically adding the prescribed boost rate to the continuous rate during central fan operation. The damper blade shall rotate on a solid one-piece damper that pivots on permanently lubricated bearings. A permanently fixed perimeter gasket seal shall be provided to prevent air noise and leakage at the closed position.
6. The entire damper assembly and all operable parts shall be capable of being removed from the terminal housing from below without disconnecting duct or removing the housing. Access to all regulator and damper components shall be through an integral screw-on access plate.
7. All terminals and/or pertinent components must be listed per UL standards and carry the UL, UR or ETL mark indicating compliance.
8. Each ZRT-PDIL shall include all necessary mounting brackets and hardware.
9. Installation shall be per all applicable codes and manufacturer’s instructions.

2.31 CEILING MOUNTED EXHAUST FANS

A. General:

1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Ceiling mounted applications
3. Maximum operating temperature is 130 Fahrenheit (54.4 Celsius)
4. Sound levels as low as 0.7 AMCA sones
5. UL/cUL listed for above bathtub exhaust
6. Fans are UL/cUL listed 507 - Electric Fans
7. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number
8. Fans shall be manufactured by Greenheck (basis of design) or approved equal.

B. Wheel:

1. Forward curved centrifugal wheel
2. Constructed of galvanized steel or calcium carbonate filled polypropylene
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05

C. Motors:

1. AC Induction Motor
    a. Motor enclosures: Totally enclosed air over: (TEAO)- designed to be used solely in the airstream, constructed with a dust tight cover and an aerodynamic body which relies upon the strong airflow of the fan to cool the motor, not suitable for hazardous environments.
    b. Motors shall be permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase.
    c. Motor shall be mounted on vibration isolators and be accessible for maintenance
    d. Thermal overload Protection

D. Housing:
1. Constructed of heavy gauge galvanized steel
2. Interior shall be lined with 0.5 inches of acoustical insulation
3. Profile as low as 10 1/2 inches

E. Spring Loaded Aluminum Backdraft Damper:
1. Prevents air from entering back into the building when fan is off
2. Eliminates rattling or unwanted backdrafts

F. Outlet:
1. Type of outlet: Round
2. Field rotatable from horizontal to vertical discharge
3. Shall include an aluminum backdraft damper

G. Mounting Brackets:
1. Fully adjustable for multiple installation conditions

H. Options/Accessories:
1. Thermostat:
    a. Type: Cooling
    b. Control the fan based on temperature of the space
    c. Contacts close on temperature change
2. Transformer:
    a. Type: T-2.0 - UL listed, Rated for 230/277v to 115, 2.0 amps max at 120 volts
    b. Available for applications requiring voltage reduction
    c. All transformers are shipped loose
3. Vibration Isolation:
    a. Available for suspended installations
    b. Includes pre-punched hole for ease of installation and shall have all hardware to mount one unit

2.32 DESTRATIFICATION FANS

A. Destratification fans basis of design is Airius, ONYX series.

B. General

1. Performance: Coordinated design of housing, stator and motor shall provide columnar laminar airflow to produce a minimum of 100 fpm at center of column at grade level when installed within 2'-0" of ceiling. Refer to manufacturer's airflow velocity profiles for jet pattern and throw data.
2. Housing: The fan housing shall be made of PC/ABS resin, rated 5VA for flame resistance.
3. Housing color:
   a. PMS Cool Gray 2C (off white)
   b. Black
   c. As scheduled
4. Safety Cable: Supplied with 6'-0" steel cable fastened to seismic restraint point integrated into the fan housing. Safety restraint attached to primary mounting handle will not be accepted.
5. Motor Mounting: Enclosed in housing, above stator.
6. Stator: The fan shall be equipped with a patented curved multiple-vane stator coordinated with fan design for maximizing columnar laminar flow.
7. Bypass Technology: The fan shall be equipped with multiple bypass vents within the outer housing to maximize air entrainment through the housing to maximize volume output.
8. Certification: UL Standard 507 for Safety Electric Fans, CAN//CSA-C22.2 No. 1113 and UL 94 5VA as certified by nationally recognized testing laboratory. Acceptable laboratories include ETL, UL or other nationally recognized testing laboratories.
9. Identification: Permanently affixed manufacturer's nameplate including the following: Model Number, Serial Number, Motor Power Specifications, Country of Manufacture and Safety Marks: ETL (US & CA) & CE (EU).
10. Power Cord: 6 foot, 300-volt AC, UL rated. Motors within the range of 100-130VAC are provided with a standard 3-prong plug. Motors within the range of 200-277VAC are not provided with a plug.
11. Motor:
    a. Electrically commutated motor, up to 92% efficient. Plastic blades bolted to steel hub. Ball bearings shall be permanently lubricated and shielded. Up to 1422 cfm, 1732 rpm,. Thermally protected motor with an operating range of -40° F (-40° C) to +176° F (80° C).
    b. Recommended ceiling height up to 50 feet (15.2 m) and area coverage up to 2000 sq. ft (185.8 sq. m); 25 feet (7.6 m) from the fan's center in all directions.
12. Electrical Requirements:
    a. 100-130V AC, single phase, 50/60 Hz.; 1.32 Amps; 90 watts
    b. 200-240V AC, single phase, 50/60 Hz.; 0.8 Amps; 98 watts
13. Controls shall be coordinated with motor electrical requirements.
    a. Shall be controlled directly by 0-10VDC control signal from BAS. Uses low voltage control circuit separate from mains power. See wiring diagram.
    b. Provide with BACnet MS/TP card for individual fan control and status integration with BAS.

2.33 DIRECT DRIVE INLINE FANS

A. Inline fans basis of design is Greenheck.

B. General

1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Performance capabilities up to 27,800 cubic feet per minute (cfm) and static pressure to 3.0 inches of water gauge
3. Fans are available in twenty-four sizes with nominal wheel diameters ranging from 7 inches through 33 inches
4. Continuous operating temperature range of -10º Fahrenheit (-23.3º Celsius) to 130º Fahrenheit (54.4º Celsius)
5. Applications include: supply, exhaust, return, or make-up air systems
6. UL-705 certified for indoor (standard) and outdoor applications (must configure fan for outdoor use to allow outdoor installation)
7. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

C. Wheel:

1. Non-overloading, backward inclined centrifugal wheel
2. Constructed of Aluminum
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
5. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone

D. Motors:

1. Electronically Commutated Motor
2. Motor enclosure: Open drip proof
3. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors
4. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
5. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
6. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
7. Motor shall be a minimum of 85% efficient at all speeds

E. Housing/Cabinet Construction:

1. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars

2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
3. Galvanized Construction material

F. Housing Supports and Drive Frame:

1. Housing supports are constructed of structural steel with formed flanges
2. Drive frame is welded steel which supports the motor

G. Disconnect Switches:

1. NEMA rated: NEMA 1: indoor application no water. Factory standard.
2. Positive electrical shut-off
3. Wired from fan motor to junction box

H. Duct Collars:

1. Square design to provide a large discharge area
2. Inlet and discharge collars provide easy duct connection

I. Access Panel:

1. Two sided access panels, permit easy access to all internal components
2. Located perpendicular to the motor mounting panel

J. Options/Accessories:

1. Dampers:
   a. Type: BD-330, Gravity
   b. Galvanized frames with prepunched mounting holes
   c. Balanced for minimal resistance to flow
2. Insulated Housing:
   a. 1 inch thick insulated housing
   b. For noise reduction and condensation control
   c. Constructed of fiberglass liner
3. Motor Cover:
   a. Constructed of galvanized steel
   b. Covers motor and drives for safety
   c. Standard on unit specified with UL

2.34 VARIABLE REFRIGERANT VOLUME HEAT PUMP SYSTEM

A. General

1. Per the equipment schedule, the variable capacity, heat pump heat recovery air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Trane, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.

3. Simultaneous heating/cooling (heat recovery) systems shall consist of an outdoor unit, BC (Branch Circuit) Controller (or comparable branch devices), multiple indoor units, and an integral DDC (Direct Digital Controls) system. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes.
4. No additional branch circuit controllers (or comparable branch devices) than shown on the drawings/schedule may be connected to any one outdoor unit. Contractors proposing alternate systems requiring more branch devices than those included as the basis of design are responsible for additional piping & electrical costs and are required to identify additional costs & installation time required of other trades with their bid.
5. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
6. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
7. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
8. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
9. System start-up supervision shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in system configuration and operation. The representative shall provide proof of manufacturer certification indicating successful completion within no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals.

B. System Start-Up

1. The manufacturer or manufacturer's representative shall provide start-up services for the system and shall provide a report on the start-up procedure and provide documentation that the system is installed and functioning per the manufacturer's specifications.
2. The manufacturer or manufacturer's representative shall provide integration system assistance as required to assist the ATC sub-contractor in integrating the VRV system with the DDC system.

C. System Training

1. The manufacturer or manufacturer's representative shall provide training for the Owner or Owner's representative. Training shall be a minimum of 4 hours and shall be conducted at the same time as the training for the other HVAC systems.
2. The manufacturer shall also provide 16 hours of structured off-site training for the Owner's personnel.

D. Warranty

1. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
2. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
3. All manufacturer's requirements to obtain the limited warranty shall be met, including but not limited to: designed by a certified City Multi Diamond Designer, installation by a contractor that has completed the Mitsubishi service course, and submission of a completed commissioning report that is approved by Mitsubishi.
4. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
5. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

E. System Efficiency

1. The systems shall have the following minimum efficiencies in order to comply with the Eversource Path 1 Net Zero Equivalent (NZE) rebate program for new buildings program requirements.
2. Units shall be ASHRAE 90.1 rated in accordance with AHRI 1230.
3. Minimum efficiencies for Units =>135,000<240,000 BTUH:
   a. EER – 10.6
   b. IEER – 11.8
   c. COP - 3.2
4. Minimum efficiencies for Units =>240,000 BTUH:
   a. EER – 9.5
   b. IEER – 10.6
   c. COP – 3.2

F. High Efficiency Y-Series Air Cooled Heat Pump

1. General
   a. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Controls section. The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped, and wired and run tested at the factory.
   b. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in

the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

c. Outdoor unit shall have a sound rating no higher than 68 dB(A) individually or 70 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 55 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

d. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

e. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.

f. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.

g. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

h. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

i. The outdoor unit shall be capable of operating in heating mode down to -25ºF ambient temperatures or cooling mode up to 126ºF ambient temperatures, without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

j. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.

k. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.

l. While in hot gas defrost the system shall slow the indoor unit fan speed

down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

m. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.

2. Unit Cabinet
   a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
   b. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
   c. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.
3. Fan
   a. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG. external static pressure, but capable of normal operation with a maximum of 0.32 in. WG. external static pressure via dipswitch.
   b. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
   c. All fan motors shall be mounted for quiet operation.
   d. All fans shall be provided with a raised guard to prevent contact with moving parts.
   e. The outdoor unit shall have vertical discharge airflow.
4. Refrigerant & Refrigerant Piping
   a. Refrigerant shall be R410A.
   b. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
   c. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
   d. All refrigerant piping must be insulated with minimum ½” closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
   e. Refrigerant line sizing shall be in accordance with manufacturer specifications.
   f. Contractor shall submit refrigerant piping diagrams with piping sized by

Manufacturer's electronic selection software. Piping lengths shall be based on installed conditions.

5. Coil
    a. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil
    b. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
    c. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
    d. The coil shall be protected with an integral metal guard.
    e. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
    f. Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.
    g. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.
6. Compressor
    a. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.
    b. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
    c. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.
    d. Compressor shall have an inverter to modulate capacity. The capacity for

each compressor shall be variable with a minimum turndown not greater than 15%.

e. The compressor shall be equipped with an internal thermal overload.

f. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

g. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

7. Controls

a. The unit shall be an integral part of the system & control network described in Controls section and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.

b. Each outdoor unit shall have the capability of 4 levels of demand control based on external input

8. Electrical

a. The outdoor unit electrical power shall be 208/230 or 460 volts, 3-phase, 60 hertz.

b. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz) or 414-506V (460V/60Hz).

c. The outdoor unit shall be controlled by integral microprocessors.

d. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

G. Indoor Unit – 4-Way Ceiling Cassette Type with Grille for 2’x2’ Grid

1. General

a. The indoor unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

2. Unit Cabinet:

a. The cabinet shall be a compact 22-7/16” wide x 22-7/16” deep so it will fit within a standard 24” square suspended ceiling grid.

b. The cabinet panel shall have provisions for a field installed filtered outside air intake.

c. Four-way grille shall be fixed to bottom of cabinet allowing two, three or

four-way blow.

3. Fan
   a. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
   b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
   c. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (4) speed settings, Low, Mid, High and Auto.
   d. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
   e. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
   f. Grille shall include a factory-installed "i-see" sensor, or equal, to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39' detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.
4. Filter:
   a. Return air shall be filtered by means of a long-life washable filter.
   b. Provide a spare filter for each unit.
5. Coil:
   a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
   b. The coils shall be pressure tested at the factory.
   c. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.
6. Electrical:
   a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
   b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
7. Controls
   a. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
   b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

c. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

d. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

e. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur, the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

H. Indoor Unit – Medium Static Ceiling Concealed Horizontal Ducted

1. General:

a. The ceiling-concealed ducted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

2. Unit Cabinet:

a. The unit shall be ceiling-concealed, ducted—with a 2-position, field adjustable return and a fixed horizontal discharge supply.

b. The cabinet panel shall have provisions for a field installed filtered outside air intake.

3. Fan:

a. Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG.

b. The indoor unit fan shall be an assembly with statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.

c. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function

4. Filter:

a. Return air shall be filtered by means of a standard factory installed return air filter.

b. Provide optional return filter box (rear or bottom placement) with high-efficiency filter for all PDFY indoor units.

c. Provide a spare filter for each unit.

5. Coil:

a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

b. The coils shall be pressure tested at the factory.

c. Coil shall be provided with a sloped drain pan. Units without sloped drain

pans which must be installed cockeyed to ensure proper drainage are not allowed.

d. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 27 inches above the condensate pan.

6. Electrical:
   a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
   b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
7. Controls:
   a. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
   b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
   c. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
   d. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

I. Multi-poise fan coil

1.

J. Controls

1. General:
   a. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
   b. Furnish energy conservation features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
   c. System shall be capable of email generation for remote alarm annunciation.
2. Electrical Characteristics:
   a. General
      1 Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.
   b. Wiring:
      1 Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

2 Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.

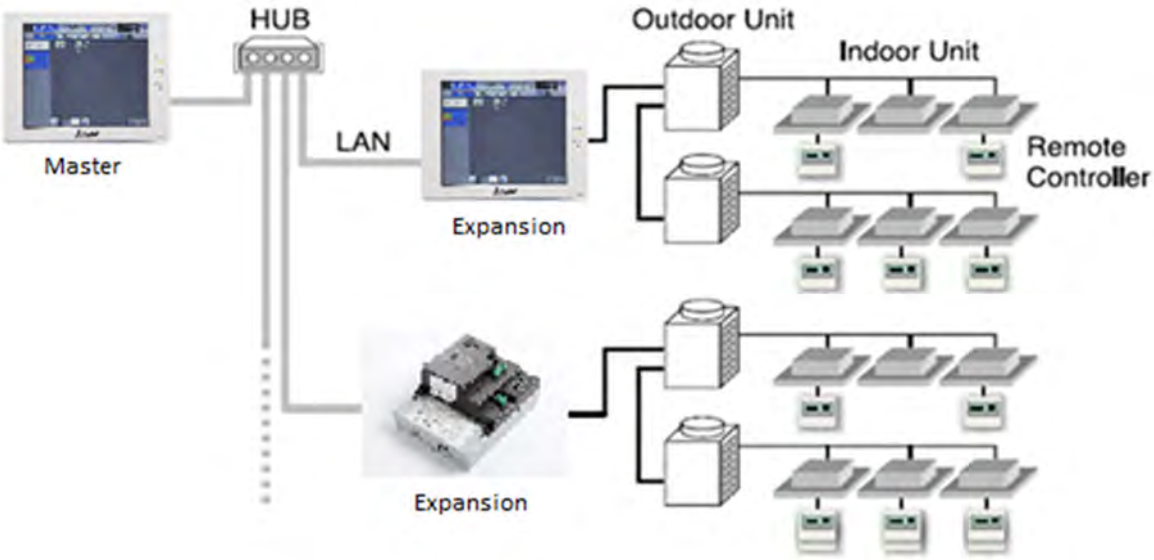
c. Wiring type:

1 Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.

2 Network wiring shall be CAT-5 with RJ-45 connection.

3. CITY MULTI Controls Network:

a. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.



CMCN System Configuration

K. Simple MA Remote Controllers

1. The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).

2. The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers or with other Backlit Simple MA Remote Controllers, with up to two remote controllers per group.

Simple MA Remote Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display "test run").	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group

L. Centralized Controller (Web-Enabled)

1. Master Centralized Controller

a. The Master Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY

MULTI outdoor units with the use of three expansion controllers. The Master Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The Master Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Master Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Master Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the master provides centralized control, it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Master Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of Lossnay unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.	Each Group	Each Group

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
Multiple Language	Other than English, the following language can be chosen. Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese are available.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: "Batch start/stop", "Batch emergency stop" By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective

b. All Master Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main master centralized controller interface.

c. The Master Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

d. Standard software functions shall be available so that the building manager can securely log into each master centralized controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Energy shall be available but are not included. The Energy Apportionment function shall require a LIC-Charge software license

2. Expansion Controller

a. The Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the Master Centralized Controller for the purpose of adding up to 50 indoor units to the main touch screen interface of the master centralized controller. Up to three (3) expansion controllers can be connected to the master via a local IP network (and their IP addresses assigned on the master) to the master to allow for up to two hundred (200) indoor units to be monitored and controlled from the master interface.

b. The expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the master and configured to display their units on the main controller, the individual indoor units connected to the expansion can still be monitored and controlled from the interface of the expansion. The last command entered will take precedence, whether at the wall controller, the expansion or the master Centralized Controller.

3. Non Touch Screen, Networked Centralized Controller:

a. The Non Touch Screen, Networked Centralized Controller shall be capable

of controlling a maximum of 50 indoor units across multiple CITY MULTI outdoor units. The controller shall be approximately 8-1/2”x10” in size and shall be powered by its internal power supply. The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, free contact interlock configuration and malfunction monitoring. The controller shall have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, temperature setting, fan speed setting, and airflow direction setting. Since the controller provides centralized control, it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the controller shall allow the user to define both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Opera-tion**	**Dis-play**
ON/OFF	Run and stop operation.	Each Block, Group or Col-lective	Each Group or Col-lective
Operation Mode	Indoor unit modes: COOL/DRY/FAN/AUTO/HEAT. Lossnay unit modes: HEAT RECOVERY/BYPASS/AUTO Air to water (PWFY) modes: HEATING/HEATING ECO/HOT WATER/ANTI-FREEZE/COOLING *Operation modes vary depending on the unit model connected. ** Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Col-lective	Each Group
Tempera-ture Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechan-ical equipment.	Each Block, Group or Col-lective	Each Group
Set Temper-ature Range Limit	The range of room temperature setting can be limited by the initial setting depending on the indoor unit con-nected.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depend on indoor unit model.	Each Block, Group or Col-lective	Each Group
Air Flow Direction Setting	*Air flow direction settings vary depending on the in-door unit model. *1. Louver cannot be set.	*1 Each Block, Group or Col-lective	Each Group

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Hold	Disables scheduled functions for indoor unit groups and their associated remote controller timers. *not available for general equipment	Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Fan Speed, Air Direction and Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group.	N/A	Each Group
Room Humidity	Displays the percent relative humidity in the space as sensed by the Smart ME Remote Controller	N/A	Each Group
Occupancy Sensor	Displays the occupancy icon on the group icon in the condition list page when the room is occupied (blue) or vacant (gray). *The Smart ME Remote Controller Occupancy sensor is required.	N/A	Each Group
Brightness Sensor	Displays the brightness icon on the group icon in the condition list when the space is determined to be bright (yellow) or dark (gray). *The Smart ME Remote Controller Brightness sensor is required.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the	N/A	*4 Each Unit or Collective

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
	abnormal unit address, error code and source of detection		
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between "Hi", "Low" and "Stop". When setting a group of only free plan LOSSNAY units, you can switch between "Normal ventilation", "Interchange ventilation" and "Automatic ventilation".	Each Group	Each Group
Multiple Language	Other than English, the following languages can be selected: Spanish, French, Japanese, German, Italian, Russian, Chinese, and Portuguese.	N/A	N/A
External Input / Output	By using accessory cables you can set and monitor the following. Input: By level: "Batch start/stop", "Batch emergency stop"; By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective
M-Net	The "M-NET" LED lights, when AC power supply is turned ON. The LED blinks while M-NET is communicating.	N/A	Each Group (LED)
Collective ON/OFF	All the units can be operated / stopped with a DIP switch.	Collective	N/A
Measurement	Displays the Temperature and Humidity inputs of the AI Board. Supports graph display and data export.	N/A	Each Unit
AHC Status	Displays the status of the of the inputs and outputs of each Advanced HVAC Controller (DC-A2IO)	N/A	Each Unit
Free Contact Status	Displays the input/output status of the Free Contacts on the indoor units	N/A	Each Unit
Free Contact Interlock Control	Operation of indoor groups, general equipment or free contact outputs based on group(s) conditions or free contact(s) input states.	Each Group, Output or Collective	N/A
Data Backup (PC)	Initial setting data can be exported to a PC.	Collective	N/A

b. All Non Touch Screen, Networked Centralized Controller shall be equipped with two RJ-45 Ethernet port to support interconnection with a network PC and BACnet/IP communication via a closed/direct Local Area Network (LAN). The controller shall be capable of performing initial settings online via a PC using the controller's initial setting browser or online/offline with the Initial Setting Tool.

c. Standard software functions shall be available so that the building manager can securely log into each controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Standard software functions shall not expire.

Additional optional software functions of personal browser for PCs and MACs and Energy Allocation shall be available. The Energy Allocation function shall require Master Centralized Controller Energy Allocation Integrated System in conjunction with Non Touch Screen, Networked Centralized Controller.

M. Graphical User Interface

1. Front End Computer:
   a. The Graphical User Interface (Integrated Centralized Web Control) shall require a filed supplied PC or Tablet.
   b. Contractor to include the provision of this computer or tablet.
2. ICCW
   a. The Integrated Centralized Control Web System (ICCW) interface shall enable the user to control multiple networked central controllers and shall provide additional functions such as energy apportionment from a single network PC configured with the Charge Calculation Tool. The ICCW shall be capable of controlling up to forty networked Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The ICCW shall be required if the user wants to simultaneously control more than 1 Centralized Controllers from a single PC or tablet using a single web browser session. Licensing per function, per Centralized Controller shall be required for the ICCW. Optional software features shall be available through the ICCW including energy apportionment and personalized web. These optional software features shall require the ICCW, advance purchase from the customer, and licensing from ICCW.

ICCW (Integrated System Software)	
Item	**Details**
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)
Interlocked Unit ON/OFF LOSSNAY	If there is an interlocked unit (LOSSNAY), then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)
Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)

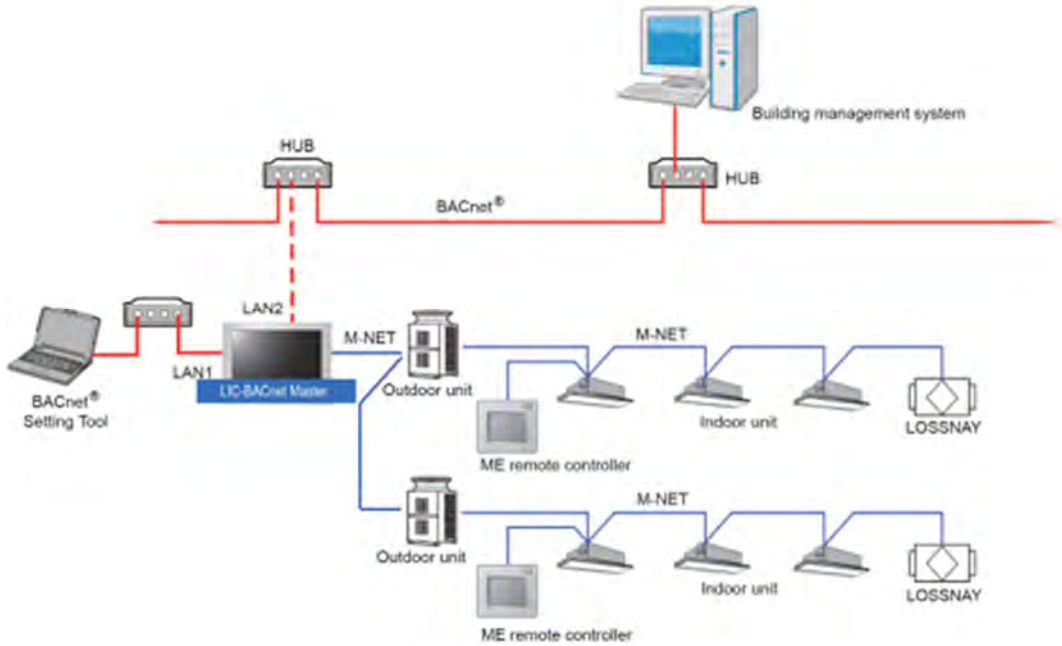
ICCW (Integrated System Software)	
Item	**Details**
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportion-ment Charg-ing	A watt-hour meter (WHM) with kWH pulse output is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Five charging rates can be applied per day. ***OPTIONAL ENERGY APPORTIONMENT SOFTWARE (LIC-CHARGE) and PI Controller (PAC-Y60MCA) REQUIRED
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the ICCW and is limited to some limited operation items.)
Operation Time Moni-tor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display Mask	The filter sign display at the remote controllers can be disabled.
Set Temper-ature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

N. CMCN: System Integration

1. BACnet® Integration:
   a. The Mitsubishi Electric Cooling & Heating BACnet® hardware, which is built into all networked central controllers, shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2010) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.
2. Licenses:
   a. LIC-BACnet Master: Master Controller license for Master Centralized Controller and Non Touch Screen, Networked Centralized Controller
   b. LIC-BACnet Expansion: Expansion Controller license for Expansion Controller and Non Touch Screen, Networked Centralized Controller
3. LIC-BACnet Specifications:
   a. Control up to 50 groups
   b. 1 to 16 indoor units can be collectively controlled in a group
   c. Supports dual set point functionality (connected model dependent)
   d. BTL Compliant
   e. BACnet communication specifications are based on ANSI/ASHRAE Standards 135-2010
4. PC Requirements:
   a. CPU: 1GHz or higher

b. Memory: 1GB or more
c. HDD Space: 100 MB or more
d. Screen Resolution: 1024 x 768 or higher
e. OS: Microsoft Windows 7 32-bit/64-bit, Microsoft 8.1 32-bit/64-bit. Not compatible with Windows Vista
f. Execution Environment: Microsoft .NET Framework 4.5 or later
g. Others: Pointing device such as a mouse, internet connection (required when installing a .NET Framework)

5. LIC-BACnet – System Example



6. BACnet Point List

Object List
On Off Setup
On Off State, Number of ON/OFF, Cumulative operation time
Alarm Signal (4-digit error code)
Error Code
Operational Mode Setup
Operational Mode State
Fan Speed Setup
Fan Speed State
Room Temp [Water Temp]
Set Temp [Set Water Temp]
Set Temp Cool
Set Temp Heat
Set Temp Auto
Filter Sign [Circulating Water Exchange Sign]
Filter Sign Reset [Circulating Water Exchange Sign Reset]
Prohibition On Off

Prohibition Mode
Prohibition Filter Sign Reset [Prohibition Circulating Water Exchange Sign Reset]
Prohibition Set Temperature
M-NET Communication State
System Forced Off
Air Direction Setup
Air Direction State
Set High Limit Setback Temp
Set Low Limit Setback Temp
Ventilation Mode Setup
Ventilation Mode State
Air To Water Mode Setup
System Alarm Signal (4-digit error code)
PI Controller Alarm Signal (4-digit error code)
Group Apportioned Electric Energy
Interlocked Units Apportioned Electric Energy
PI controller Electric Energy 1–4
Pulse Input Electric Energy 1–4
Group Apportionment Parameter
Interlocked Units Apportionment Parameter
Night Purge State
Thermo On Off State
Trend Log Room Temp
Trend Log Group Apportioned Electric Energy
Trend Log Interlocked Units Apportioned Electric Energy
Trend Log PI controller Electric Energy 1–4
Trend Log Pulse Input Electric Energy 1–4
Trend Log Group Apportionment Parameter
Trend Log Interlocked Units Apportionment Parameter

2.35 ROOF MOUNTED AIR HANDLER (Gymnasium)

A. General

1. This section includes units with split DX heat pump heating and cooling for outdoor installation. Integral Energy Recovery device shall be a rotary air-to-air total enthalpy wheel. Airflow arrangement shall be Outdoor Air with Recirculation. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in this specification.

B. Manufacturers

1. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:
   a. Mitsubishi Electric US, Inc.
   b. Greenheck Fan Corporation
   c. AAON

C. Manufactured Units

1. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake with 2" aluminum mesh filter assembly, exhaust air blower, evaporator coil, energy wheel, phase and brownout protection, motorized dampers, motorized recirculating damper, curb assembly, filter assembly intake air, supply air blower assembly, exhaust/relief blower assembly, filter assembly for exhaust air, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection.
    a. Option to field install DX coil.

D. Cabinet

1. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
    a. Unit's exterior shall be supplied from the manufacturer using G60 galvanneal steel with proprietary pre-painted material in the following finish color; Concrete Gray-RAL 7023. This has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours. Uncoated galvanized steel exterior is not acceptable.
    b. Internal assemblies: 22 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.
2. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
    a. Materials: Rigid urethane injected foam. Foam board not acceptable.
        1 Thickness: 2 inch (50.8 mm)
        2 Thermal Resistance R13
        3 Thermally broken
        4 Meets UL94HF-1 flame requirements.
        5 Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
    b. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
        1 Thickness: 2 inch (50.8 mm)
        2 Thermal Resistance R8
        3 Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
        4 Location and application: Divider panels between outdoor air and return air/exhaust air streams.
3. Roof Insulation:
    a. 2 inch (50.8 mm) fiberglass located above the 1 inch (25.4 mm) foam panel.
4. Access panels / doors:
    a. Unit shall be equipped with insulated, hinged doors to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge galvanized G90 steel or painted galvannealed steel.
5. Supply Air blower assemblies:

a. Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.

6. Exhaust Air blower assemblies:
   a. Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.
7. VRF Heat Pump unit
   a. Refer to Mitsubishi heat pump specification for requirements for this unit.
8. Evaporator Coil:
   a. Evaporator coil shall be sized and provided by the VRF heat pump manufacturer.
9. Control panel / connections:
   a. Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. RTU shall be equipped with a Unit Disconnect Switch.
10. Condensate drain pan:
    a. Drain Pan shall be an integral part of the unit. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.
11. P trap:
    a. If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.
12. Energy wheel:
    a. Unit energy wheel shall be sized for the full volume of outdoor and exhaust air without an energy wheel bypass damper(s). Bypass dampers are only acceptable during economizer operation – they cannot be used during normal operation.
    b. Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt or a link style belt with a five-year warranty. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and is designed and constructed to permit cleaning and servicing. The energy wheel is to have a five-year

warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.

13. Modulating frost control.
    a. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.
14. Electric Post-heater
    a. Post-heater shall be SCR control and shall include a temperature sensor with field adjustable set point, located in the outdoor air stream. Heat output of the post-heater shall be infinitely variable. Electric post-heater shall be able to simultaneously operate with the air-source heat pump for dehumidification mode reheat.
15. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.
16. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.
17. Motorized Recirculating Air Damper designed to permit 100% recirculation of exhaust air shall be factory installed.
18. Curb Assembly:
    a. Refer to vibration isolation roof curb requirements.
    b. Base of unit shall be minimum 12” above roof line (top of insulation).
19. UV Lights:
    a. UV-C lights are factory-mounted and access door kill switches are included.

E. Blower

1. Blower section construction, Supply Air: direct drive motor and blower shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.
2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
3. Fan: Direct drive, airfoil plenum fan with aluminum wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.
4. Blades: Welded aluminum blades only.
5. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

F. Motors

1. General: Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
2. Motors shall be 60 cycle, 3 phase 208 volts.

G. Unit Controls

1. The unit shall be constructed so that it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
2. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.
3. Unit supply fan shall be configured for Constant Volume (ON/OFF).
4. Unit exhaust fan shall be configured for damper tracking.
5. Room thermostat shall be provided as a shipped loose item. The room thermostat shall have an LCD display to adjust the room temperature set point from within the space. The room thermostat shall average four (4) temperature sensors and one (1) relative humidity sensor.
6. Outside Air / Return Air damper control shall be CO2 sensor by DDC Contractor.
7. Economizer control shall be temperature / enthalpy.
8. Dirty filter sensor shall be factory installed.
9. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the supply and exhaust air blower assemblies. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
10. Airflow monitoring required in the outdoor airstreams.
11. A web user-interface (web UI) must be available for the manufacturer installed controls. The interface can be accessed via a web browser (when an Ethernet cable is connected to the building network) or to a laptop plugged in directly to the controller. Web UI must have the following features available which allow simple access to the unit, improved startup / commissioning and provide quick troubleshooting capabilities:
    a. Graphical overview screen for easy access to current conditions and set point changes
    b. All sensor values, set point and control outputs recorded each minute with 1 week of history stored on the controller for simple troubleshooting
    c. Refrigeration details screen with compressor status, temperature and pressure readings
    d. Access to current alarms and alarm history
    e. Service override capabilities to manually change I/O and verify proper operation of the unit.

H. Filters

1. Unit shall have permanent metal filters located in the outdoor air intake and shall be accessible from the exterior of the unit.

2. MERV 8 disposable pleated filters shall be provided in the supply air stream.
3. MERV 8 and MERV 13 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.

I. Start-up Service

1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

J. Demonstration and Training

1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

2.36 HIGH EFFICIENCY SPLIT HEAT PUMP, AIR COOLED

A. Heat pumps shall provide heating and cooling to the Energy Recovery Ventilators. Refer to plans for quantity, capacity and ERV served.

B. General

1. Per the equipment schedule, the variable capacity, heat pump air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Trane, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.
3. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter- driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
4. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.
5. Outdoor unit shall have a sound rating no higher than 68 dB(A) individually or 69.5 dB(A) twinned. Units shall have a sound rating no higher than 55 dB(A) individually or
6. 55.5 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate

manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

7. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
8. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
9. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.
10. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
11. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
12. The outdoor unit shall be capable of guaranteed operation in heating mode down to - 25F ambient temperatures and cooling mode up to 126± F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.
13. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.
14. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.
15. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

C. Unit Cabinet

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
2. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
3. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

D. Fan:

1. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG external static pressure, but capable of normal operation with a maximum of 0.32 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fans shall be provided with a raised guard to prevent contact with moving parts.

E. Refrigerant and Refrigerant Piping

1. R410A refrigerant shall be required for systems.
2. Polyolester (POE) oil—widely available and used in conventional domestic systems— shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
4. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
5. Refrigerant line sizing shall be in accordance with manufacturer specifications

F. Coil

1. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil.
   a. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
   b. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
   c. The coil shall be protected with an integral metal guard.
   d. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
   e. Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.

f. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

G. Compressor:

1. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.
2. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
3. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.
4. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.
5. The compressor shall be equipped with an internal thermal overload.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
7. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

H. Controls

1. The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor e control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
2. The outdoor unit shall have the capability of 4 levels of demand control for each refrigerant system based on external input.

I. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.
2. The outdoor unit shall be controlled by integral microprocessors.
3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

J. System Start-Up

1. The manufacturer or manufacturer's representative shall provide start-up services for the system and shall provide a report on the start-up procedure and provide documentation that the system is installed and functioning per the manufacturer's specifications.
2. The manufacturer or manufacturer's representative shall provide integration system assistance as required to assist the ATC sub-contractor in integrating the VRV system with the DDC system.

K. System Training

1. The manufacturer or manufacturer's representative shall provide training for the Owner or Owner's representative. Training shall be a minimum of 4 hours and shall be conducted at the same time as the training for the other HVAC systems.
2. The manufacturer shall also provide 16 hours of structured off-site training for the Owner's personnel.

L. Warranty

1. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
2. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
3. All manufacturer's requirements to obtain the limited warranty shall be met, including but not limited to: designed by a certified City Multi Diamond Designer, installation by a contractor that has completed the Mitsubishi service course, and submission of a completed commissioning report that is approved by Mitsubishi.
4. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
5. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

2.37 DX COILS FOR AHU-111

A. DX coils for ERV's shall be designed and provided by the VRF air source heat pump unit provider for installation in the ERV units. Refer to the plans and schedules for quantities, capacities and circuiting requirements.

1. Basis of design is Heatcraft (Modine) as provided by Mitsubishi.

B. DESIGN PRESSURES AND TEMPERATURES

1. Coils shall be designed to withstand 250 psi maximum operating pressures and a maximum temperature of 300°F for standard duty copper tube coils with standard headers. Higher limits are available, depending on coil construction and / or materials used.

C. FACTORY TESTING REQUIREMENTS

1. Coils are to be pressurized and then completely submerged in warm water containing special wetting and final cleaning agents for leak testing and tested with a minimum of 320 psi air pressure for standard copper tube coils. A hydrostatic leak test is available upon request. Certified hydrostatic leak test and Certificate of Conformance are also available upon request. Coils must display a tag with the inspector's identification as proof of testing. Upon request, after the coils have been tested they can receive a 5 lb. Nitrogen charge assuring the coil as received remains leak free and clear of internal contamination.

D. FINS

1. Coils shall be of plate fin type construction providing uniform support for all coil tubes. Coils are to be manufactured with die-formed aluminum, copper, cupro-nickel, stainless steel or carbon steel fins with self-spacing collars, which completely cover the entire tube surface. Any manufacturer not capable of offering the full range of these materials shall be considered as unacceptable.
2. Fin corrugations available shall include: Flat, Rippled and “Hi-F” Sine Wave for coils built with 0.625” OD tubes and utilizing a 1.5” equilateral tube pattern; Flat, Rippled and “Hi-F” Sine Wave for coils built with 0.50” OD tubes and utilizing a 1.25” equilateral tube pattern; “Hi-F” Sine Wave for coils built with 0.50” OD tubes and utilizing a 1.5” equilateral tube pattern; Rippled and “Hi-F” Sine Wave for coils built with 0.375” OD tubing and utilizing a 1.0” equilateral tube pattern; “Hi-F” Sine Wave for coils built with 0.375” OD tubes and utilizing a 1.25” equilateral tube pattern; Raised Lance for coils built with 0.375” OD tubing and utilizing a 1.0” equilateral tube pattern. Manufacturers not capable of producing the full range of these fin surface styles, corrugations and tube patterns shall be considered as unacceptable.
3. Standard fin thickness’ available shall include: 0.0060” +/- 5% for aluminum and copper; 0.0075” +/- 5% for aluminum, copper, and cupro-nickel, carbon steel and stainless steel; 0.0095” +/- 5% for aluminum, copper, carbon steel and stainless steel; 0.016” +/- 5% for aluminum and copper. Manufacturers not capable of providing the full range of these fins thicknesses shall be considered as unacceptable.
4. Fins are to be formed with full collar on all of available materials, corrugation styles, tube diameters and tube patterns. Manufacturers unable of providing full collars on the full range of fin offerings shall be considered as unacceptable.
5. Fin spacing available shall include: 6-14 fins / inch on coils supplied with 0.625” OD tubing; 7-18 fins / inch on coils supplied with 0.50” OD tubing; 6-24 fins / inch on coils supplied with 0.375” OD tubing. Manufacturers with tooling not capable of providing full collar, die formed fins, accurately space with a tolerance of +/- 4% and not offering the full range fin spacing for the appropriate tube diameter shall be considered as unacceptable.

E. TUBING

1. All tubing and return bends shall be fabricated from UNS 12200 seamless copper conforming to ASTM B75 for standard pressure and temperature applications. Elevated duty and special application construction tube cores shall be available in seamless 90/10 Cupro-Nickel Alloy #706, Stainless Steel ASTM #A249

grade 304L or 316L and Carbon Steel ASTM #A214 welded or #A179 Seamless.

2. Core tubes (excluding hot dipped galvanized steel coils) shall be mechanically expanded to form an interference fit within the fin collars. Expansion shall not decrease the tube wall thickness.
3. Coils shall be manufactured using return bends of the same material as the core tubing. Return bend wall thickness, at the outside circumference of the bend, shall be no less than the core tube wall thickness.
4. Available tube size and wall thickness shall be as follows:

Material	0.375" O.D.	0.50" O.D.	0.625" O.D.
Copper	0.013, .016, .020, 0.025, 0.030	0.016, 0.022, 0.030	0.020, 0.025, 0.035, 0.049
Cupro-Nickel			0.020, 0.035, 0.049
Carbon Steel			0.035, 0.049, 0.065
Stainless Steel			0.035, 0.049, 0.065
Admiralty Brass			0.049

5. Coils shall be made available with copper tubes utilizing internally enhanced Rifled Surfacing when required. As a quality control measure, Coil Manufacturer shall be capable of providing copper rifled tubing, enhanced within it's own facility, and not supplied by an outside source.
6. Available distributor tube size and wall thicknesses shall be as follows:

Material	0.188" O.D.	0.25" O.D.	0.312" O.D.
Copper	0.028	0.028	0.030
Stainless Steel		0.035	0.035
Carbon Steel		0.035	

F. HEADERS

1. Headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and B251 with an H55 temper for standard applications. Other option for headers for high-pressure construction shall incorporate seamless 90/10 Cupro-Nickel Alloy #706 conforming to ASTM B111, Carbon Steel conforming to ASTM A53A or A135A, Stainless Steel conforming to ASTM A249, at Sch. 10 or Sch. 40, per the application requirements.
2. Headers shall be manufactured using a Pierce and Flare die-punch method when possible. This shall insure that the tube-to-header tube hole intrusions into the header are such that the landed surface area contact length for joint brazing approximates three times the core tube wall thickness. Manufacturers not

capable of providing headers of the Pierce and Flare design shall be considered as unacceptable.

3. Standard construction shall be such that the core tubes will penetrate directly into the header without the use of intermediate adapter tube studs, except when necessary. Each of the tubes shall extend evenly within the inside diameter of the header between 0.12" and 0.75" depending on OD of tubes. In addition, on 0.375" OD tube coils, each tube shall pass through an oversized hole in the sheet metal casing of no less than 25% larger than the outside diameter of the core tube. This will prevent metal to metal contact between the tube and the sheet metal casing, allowing the header and core tubes to "float" and eliminating the possibility of premature failure caused by excess vibration. Manufacturers not capable of providing such floating headers shall be considered as unacceptable.
4. End caps shall be precision die-formed and positioned inside the header so that the thickness of the brazed fillet joint approximates three times that of the header wall thickness. Manufacturers using standard copper tube end caps, which are brazed over the outside of the end of the headers, shall be considered as unacceptable.

G. CONNECTIONS

1. Standard construction of copper tube condenser coils shall allow for copper sweat connections for type L or K wall copper. Other materials shall be made available dependent upon the materials of construction of the tube core.

H. BRAZING & WELDING

1. Oxyfuel gas brazing, using fillet rod material of minimum 5% silver shall be used for all non-ferrous tube joints to headers and connections. Ferrous to non-ferrous joints shall contain as much as 35% silver or may be Tobin bronze.
2. Gas shielded arc welding shall be used for all stainless steel joints and also for non-ferrous tube joints made to compatible or alike material headers and connections.

I. CASING

1. Coil casing and endplate shall be fabricated from Galvanized steel, as a standard construction, meeting ASTM and UL G90U requirements. Casing materials available shall include: aluminum, copper, carbon steel and stainless steel. All materials are available at different gauges. Double-flange casing shall be provided when coils are specified as vertical stacking.
2. Standard coil intermediate tube sheets (center tube supports) shall be fabricated from 16 gauge sheet stock and same material as the end plates, and to the following schedule:

Finned Length (inches)	Number of Tube Sheets
6.00 – 48.00	0
48.01 – 96.00	1
96.01 – 144.00	2
144.01 and greater	4

J. CERTIFICATIONS

1. Coil manufacturer shall be certified and registered with the Air Conditioning, Heating and Refrigeration Institute (AHRI) and shall be an active and current member of the AHRI Standard 410 Air-Cooling and Air-Heating Coils certification program and shall have original coil line certifications and computerized selections dating back a minimum of 30 years, as proof of overall company performance, stability and longevity. Manufacturers not capable of meeting this requirement shall be considered as unacceptable.

K. AGENCY APPROVAL Coil manufacturer shall be registered by UL to ISO 9000 (ANSI/ASQC Q92). Applicable commercial coil models shall be UL Standard 207 and registered as Refrigerant Containing Components and Accessories; non-electrical. CRN (Canadian Registration Numbers) shall be provided for all coils shipping into Canada as requested. Coil manufacturer shall also possess ASME Section VIII Division 1, U and UM stamping certification as proof of acceptable quality control methods. Manufacturers unable to meet the above listed agency approvals shall be considered as unacceptable.

2.38 ROOF EQUIPMENT AND PIPING SUPPORTS

A. Support Variable Refrigerant Flow (VRF) Heating Ventilation and Air Conditioning equipment on roof with an engineered system designed for installation without penetrating roof membrane. The engineered support system shall consist of injection molded glass fiber filled nylon support feet, recycled rubber bound by polyurethane pre-polymer anti-vibration mat, hot dipped galvanized mild steel framework and fittings. System shall be factory designed to fit VRF equipment in service conditions.

B. Support piping on roof with an engineered system designed for installation without penetrating roof membrane. The engineered support system shall consist of injection molded glass fiber filled nylon support feet, recycled rubber bound by polyurethane pre-polymer anti-vibration mat, hot dipped galvanized mild steel framework and fittings. System shall be factory designed to fit equipment in service conditions.

C. Systems shall be Big Foot Systems from the RectorSeal Corp., Quicksling or equal.

D. General

1. Galvanized steel engineered framework support with injection molded glass fiber reinforced nylon foot assemblies with recycled rubber anti-vibration mats.
2. Material: Steel, nylon, rubber.
3. Finish: Hot Dip Galvanized.
4. Rail system shall be specifically design for the equipment it is supporting.

E. Support feet shall be mechanically attached to the structure.

1. Connection point shall be sealed weathertight.
2. Coordinate with Structural Contract for attachment points to structural support elements.

2.39 CONDENSATE PUMPS

A. Condensate pumps shall be fully automatic.

B. Basin shall be constructed of ABS plastic.

C. Volute and propeller shall be polypropylene.

D. Shaft shall be stainless steel.

E. Cover shall be ABS with 3 drain holes.

F. Unit shall be provided with a discharge check valve.

G. Thermal overload protection shall be provided.

H. Unit shall have a six foot power cord with plug.

I. Provide Blue Diamond or equal mini split style condensate pumps for all Mitsubishi wall cassette style units.

J. Provide condensate pumps where required by structure, where gravity drainage is not possible.

2.40 ELECTRIC UNIT HEATER

A. The electric ceiling heating panel shall be as manufactured by Berko (or equal).

B. The sizes, capacities and voltages shall be as per the schedules on the drawings.

C. Commercial grade construction and ceiling mounting brackets for horizontal or vertical flow mounting or any position in between.

D. Copper-brazed steel fins with steel sheathed tubular elements for uniform heating and longevity.

E. Adjustable louvers to control air throw direction.

2.41 ELECTRIC WALL HEATER

A. The electric fan powered wall heater shall be designed for recessed mounting and shall be as manufactured by Berko (or equal).

B. The heater shall be designed for surface or recessed wall mounting in any position. For surface mounting, a surface mounting box shall be used. For semi-recessed installation a semi-recessed sleeve shall be used.

C. The back box shall be designed for duty as a recessed rough-in box in either masonry or frame. The back box shall be 20-gauge cold rolled steel and shall contain knock outs through which field wiring leads are brought and connected to pigtails of the preinstalled female disconnect receptacle. Connecting of the male plug of the inner frame completes the wiring of the heater.

D. The inner frame assembly shall consist of a 20-gauge steel chassis on which are mounted the heating element, fan motor and blade, thermostat, fan control and thermal cut out. The inner frame assembly shall be completely prewired with the leads terminating in a male plug, thus facilitating positive disconnect and easy removal for service without disturbing the back box or field wiring.

E. The heating element shall be of nonglowing design consisting of a special resistance wire enclosed in a steel sheath to which steel plate fins are brazed. The element shall cover the entire air discharge area to ensure uniform heating of all discharge air.

F. The fan motor shall be impedance protected, permanently lubricated and with totally enclosed rotor.

G. Fan control shall be bimetallic, snap-action type and shall activate fan after heating element reaches operating temperature, and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. The thermostat shall be of bimetallic, snap-action, two-pole type with enclosed contacts and with positive "off" on all models. Thermal cutout shall be bimetallic, snap-action type designed to automatically shut off heater in the event of overheating and reactivate the heater when temperatures return to normal.

H. The louvered front cover shall be of 20-gauge cold rolled steel finished in desert tan baked enamel or chrome finish, with four mounting holes, mounting screws, and plug button to match finish.

I. Unit shall be supplied with front covers without the hole for the thermostat knob to provide full tamper-proof installation.

J. All sheet metal parts, except chrome finished front covers, shall be phosphatized, then completely painted as determined by the architect by an electrostatic, baked enamel, painting process.

2.42 LOUVERS

A. General:

1. Furnish and install louvers, bird screens, blank-off panels, supports and mounting brackets. Refer to plans for sizes and quantities. Basis of design is Greenheck ESD-403 (or equal).

B. Frame:

1. Type: Channel
2. Frame Depth: 4 inches.
3. Material: Extruded aluminum, Alloy 6063-T5.
4. Wall Thickness: 0.063 inch, nominal.
5. Construction: Welded

C. Blades:

1. Style: Drainable.
2. Material: Formed aluminum, Alloy 6063-T5.
3. Wall Thickness: 0.063 inch, nominal.
4. Angle: 45 degrees.
5. Centers: 3 inches, nominal.

D. Gutters: Drain gutter in head frame and each blade.

E. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

F. Fabrication: Mullion/Hidden Intermediate Support Style – Design incorporates visible mullions or frames at the perimeter of the louver and at section joints only. Rear-mounted hidden blade supports are utilized where required and do not interrupt the louver blade sightlines. The rear-mounted blade support depth varies depending on louver height and the design wind load.

G. Factory assembled louver components. Mechanically fastened construction.

H. Performance Data:

1. Performance Ratings: AMCA licensed. Based on testing 48 inch by 48 inch size unit in accordance with AMCA 500.
2. Free Area: 37 percent, nominal.
3. Maximum Recommended Air Flow through Free Area: 800 feet per minute
4. Maximum Pressure Drop (Intake): 0.10 inches w.g.
5. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1250 feet per minute free area velocity when tested for 15 minutes.

I. Finish

1. AAMA 2605 compliant coating
2. 3-Coat 70% Kynar (PVDF).
3. Color: By Architect

2.43 AIR CURTAIN

A. The unheated air curtain shall be manufactured by Powered Aire (Basis of Design), Mars Air Systems , Schwank or Berner International.

B. Motor Fan Assembly: Design for easy removal, assembly, repair, and maintenance.

1. Motor: Totally enclosed air over (TEAO) cooled motor with sealed lifetime pre-lubricated ball bearings, motor starter and thermal overload protection.
   a. Wired for single speed operation.
   b. Wired for two speed operation.
   c. Wired for three speed operation.
   d. Provide wash down type motors, NEC IP-54 for the locations indicated.
   e. Provide explosion proof type motors, NEC Class 1, Division 1, Group D for the locations indicated.
   f. Meets NEC. ETL Listed to conform to UL 507 (US) and CSA22.2 (Canada) Standards. AMCA 211 Certified.
   g. Electrical Characteristics: 115V AC, single phase; 5.1 Amp full load per motor/fan.

C. Fans: Forward curved centrifugal type, double width, and double inlet design, directly driven to an electric motor.

1. Provide resilient isolation dampening mountings between motor frame and motor mounting pan.
2. Factory balanced blower wheel assembly statically and dynamically.

D. Housing: Self-contained one-piece type for units up to 72 inches in length with sufficient strength for mounting from pre-punched mounting holes at both ends to

ceiling without intermediate support. Units longer than 72" are two units tandem mounted next to each other

1. Size:
    a. Unheated: 26 inches deep by 15-1/2 inches high by width of unit.
2. Mounting:
    a. Unheated Inside Mount.
3. Material:
    a. Provide T5052 20 gage aluminum conforming to ASTM B 209 and 20-gauge electro or hot dipped galvanized steel sheet housing conforming to ASTM A 591 and/or ASTM A 653.
4. Air Inlet Grille and/or Filters: Provide air inlet grille and/or filters specified.
5. Discharge: Provide integral discharge nozzle specified.
6. Finish and Color: Provide with, no VOC, corrosion resistant polyurethane powder coated finish for sheet metal housings. Color selection by Architect.
    a. Pearl White.
    b. Obsidian Black.
    c. Titanium Silver.
    d. Stainless Steel.

E. Environmental Air Curtains: Internal mounted models for heights up to 12 feet (3658 mm) for Environmental Separation and Temperature Control and up to 10 feet (3048 mm) for Flying Insect Control.

1. Discharge Nozzle: Adjustable air foil vanes with a plus/minus 40-degree sweep front to back.
2. Air Velocity at Nozzle:
    a. PH10 36-1: 36 Inch (915 mm) Wide Units: 1947 feet/min (9.9 m/s) single 1/2HP motor/fan assembly.
    b. PH10 42-1: 42 Inch (1065 mm) Wide Units: 1806 feet/min (9.2 m/s) single 1/2HP motor/fan assembly.

F. Air Speed at Floor: Minimum of 400 fpm (2 m/s) at 3 feet (914 mm) from the floor.

G. Air Inlet Grille and Filters:

1. Location: Bottom/
    a. Filter: Cleanable polyester filter, 1 inch (25.4 mm).
2. Type: Fixed air intake grille
    a. Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable.
3. Type: Filter Only as follows:
    a. Filter: Flat bank 1 inch, disposable.
    b. Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable
4. Speed: 2550 cu ft/min (1200 L/s), minimum, per motor/fan assembly
5. Sound Pressure Level At 10 feet (3 m) From Nozzle:
    a. Single Motor/Fan Units: 66 dBA.
    b. Two Motor/Fan Units: 68 dBA.

H. Motor Control Panels for Unheated Units: Recommended for all three-phase units and single-phase units with combined motor capacities of more than 1 HP whenever a door limit switch is used to automatically start and stop the air curtain. Provide motor control panels as follows:

1. Mounting: Factory mounted on right hand side of air curtain housing.
2. Mounting: Factory mounted on left hand side of air curtain housing.
3. Electrical components UL/CUL listed.
4. Optional Digital Programmable Controller:
5. Remote Mounted High Resolution 5" Color LCD Display with Capacitive Touch technology
6. Fully programmable controller
7. Pre-set and fully customizable programs
8. Time delay (Passive & Adaptive)
9. 24/7 timer
10. Maintenance schedule alerts
11. Status display showing date, time, temperature, and air curtain mode
12. Multi-unit control capability
13. English (IP) or Metric (SI) display readings
14. Password protected
15. Auto Lock display
16. Emergency shut-off button
17. Low voltage control signal for door activation
18. Integrated BMS controls
19. VFD compatible with 0-10VDC output
20. Optional BACnet option
21. Optional adaptive fan speed control based on existing

I. Door-Activated Limit switch(s): Provide, field installed 250-Volts, 20 amps limit switch to control air curtain(s) as follows; Automatic on/off control, activates air curtain when door is opened and turns off when door is closed. Provide limit switch for direct control one 1 HP or up to two 1/2 HP single phase motors without a separate control panel. Provide a separate control panel for three-phase motors and/or units exceeding 1 HP, 250-Volts or 20 amps controlled by a limit switch.

1. Type: Combination plunger/roller switch for swing and sliding doors.
   a. Provide limit switches with NEMA 1 (20 amps) ratings in locations indicated.
2. Operation for Unheated Units: Automatic on/off control, on when door is opened, off when door is closed.

J. Provide mounting hardware as required for the opening.

2.44 DIRECT DIGITAL CONTROL SYSTEM

A. NOTE: CONTRACTOR IS REQUIRED TO PROVIDE ALL COMPONENTS, WIRING, LABOR, APPURTENANCES, AND COORDINATION SERVICES TO DELIVER A FULLY-FUCNTIONAL BUILDING AUTOMATION SYSTEM.

B. General

1. Automatic temperature control field monitoring and control system using field programmable micro-processor based units as an expansion of the existing city-wide building automation system.
2. The BAS contractor shall provide all interconnecting wiring, interfaces, and programming required to completely integrate any VRF or packaged HVAC systems into the building automation system and achieve full read / write capability of all system points from the BAS operator workstation as available at the system control workstation. The BAS contractor is responsible for achieving the specified sequences of operations.
3. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
4. Include computer software and all hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
5. Controls for variable refrigerant flow (VRF) system, packaged rooftop units, packaged unit ventilators, radiation, reheat coils, unit heaters, fan coils, blower coils, and the like when directly connected to the control units. Individual terminal unit control requirement is specified in its equipment section.
6. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment, power transformers and electrical feeds, and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
7. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

C. MANUFACTURERS

1. Honeywell International, Inc; Niagara/Tridium: www.honeywell.com/#sle.
2. Johnson Controls, Inc; Tridium Based FX-Series: www.johnsoncontrols.com/#sle.
3. KMC Controls; Niagara/Tridium: www.kmccontrols.com/#sle.
4. Substitutions: Not Permitted

D. CONTROLLERS

1. BUILDING LEVEL CONTROLLERS
   a. General:
      1 Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
      2 Provide sufficient memory to support controller's operating system, database, and programming requirements.
      3 Share data between networked controllers.
      4 Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
      5 Utilize real-time clock for scheduling.
      6 Continuously check processor status and memory circuits for abnormal

operation.

7 Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

8 Communication with other network devices to be based on assigned protocol.

b. Communication:

1 Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.

2 Perform routing when connected to a network of custom application and application specific controllers.

3 Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

c. Anticipated Environmental Ambient Conditions:

1 Outdoors and/or in Wet Ambient Conditions:

a)Mount within waterproof enclosures.

b)Rated for operation at 40 to 150 degrees F.

2 Conditioned Space:

a)Mount within dustproof enclosures.

b)Rated for operation at 32 to 120 degrees F.

d. Provisions for Serviceability:

1 Diagnostic LEDs for power, communication, and processor.

2 Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

e. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

f. Power and Noise Immunity:

1 Maintain operation at 90 to 110 percent of nominal voltage rating.

2 Perform orderly shutdown below 80 percent of nominal voltage.

3 Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

E. CUSTOM APPLICATION CONTROLLERS

1. General:

a. Provide sufficient memory to support controller's operating system, database, and programming requirements.

b. Share data between networked, microprocessor based controllers.

c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.

d. Utilize real-time clock for scheduling.

e. Continuously check processor status and memory circuits for abnormal operation.

f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

g. Communication with other network devices to be based on assigned protocol.

2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1 Mount within waterproof enclosures.
      2 Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1 Mount within dustproof enclosures.
      2 Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LED's for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

F. APPLICATION SPECIFIC CONTROLLERS

1. General:
   a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
   b. Customized for operation within the confines of equipment served.
   c. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1 Mount within waterproof enclosures.
      2 Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1 Mount within dustproof enclosures.

2 Rated for operation at 32 to 120 degrees F.

4. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

G. INPUT/OUTPUT INTERFACE

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
   a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
   b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
   a. Allow monitoring of On/Off signals from remote devices.
   b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
   c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
   b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for

building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.

c. Drift to not exceed 0.4 percent of range per year.

8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
      1 VAV or duct terminal units.
      2 Duct mounted heating coils.
      3 Zone dampers.
      4 Radiation.
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
   a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
   b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

H. POWER SUPPLIES AND LINE FILTERING

1. Power Supplies:
   a. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
   b. Limit connected loads to 80 percent of rated capacity.
   c. Match DC power supply to current output and voltage requirements.
   d. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
   e. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
   f. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
   g. Operational Ambient Conditions: 32 to 120 degrees F.
   h. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.
   i. Line voltage units UL recognized and CSA approved.
2. Power Line Filtering:
   a. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
   b. Minimum surge protection attributes:
      1 Dielectric strength of 1000 volts minimum.

2 Response time of 10 nanoseconds or less.
3 Transverse mode noise attenuation of 65 dB or greater.
4 Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

I. CONTROL UNITS

1. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.
2. Battery Backup: For minimum of 48 hours for complete system including RAM without interruption, with automatic battery charger.
3. Control Units Functions:
   a. Monitor or control each input/output point.
   b. Completely independent with hardware clock/calendar and software to maintain control independently.
   c. Acquire, process, and transfer information to operator station or other control units on network.
   d. Accept, process, and execute commands from other control unit's or devices or operator stations.
   e. Access both data base and control functions simultaneously.
   f. Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.
   g. Perform in stand-alone mode:
      1 Start/stop.
      2 Duty cycling.
      3 Automatic Temperature Control.
      4 Demand control via a sliding window, predictive algorithm.
      5 Event initiated control.
      6 Calculated point.
      7 Scanning and alarm processing.
      8 Full direct digital control.
      9 Trend logging.
      10 Global communications.
      11 Maintenance scheduling.
4. Global Communications:
   a. Broadcast point data onto network, making that information available to all other system control units.
   b. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
5. Input/Output Capability:
   a. Discrete/digital input (contact status).
   b. Discrete/digital output.
   c. Analog input.
   d. Analog output.

e. Pulse input (5 pulses/second).

f. Pulse output (0-655 seconds in duration with 0.01 second resolution).

6. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.
7. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
8. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard wired LAN, or 60 seconds over voice grade phone lines.
9. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
   a. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from work station.
   b. Control output points but change only data base state or value; leave external field hardware unchanged.
   c. Enable control actions on output points but change only data base state or value.
10. Local display and adjustment panel: Portable control unit, containing digital display, and numerical keyboard. Display and adjust:
    a. Input/output point information and status.
    b. Controller set points.
    c. Controller tuning constants.
    d. Program execution times.
    e. High and low limit values.
    f. Limit differential.
    g. Set/display date and time.
    h. Control outputs connected to the network.
    i. Automatic control outputs.
    j. Perform control unit diagnostic testing.
    k. Points in "Test" mode.

J. LOCAL AREA NETWORK (LAN)

1. Provide communication between control units over local area network (LAN).
2. LAN Capacity: Not less than 100 stations or nodes.
3. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
4. LAN Data Speed: Minimum 19.2 Kb.
5. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
6. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

7. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

K. SYSTEM SOFTWARE

1. Operating System:
   a. Concurrent, multi-tasking capability.
      1 Common Software Applications Supported: Microsoft Excel.
   b. System Graphics:
      1 Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
      2 Animation displayed by shifting image files based on object status.
      3 Provide method for operator with password to perform the following:
         a)Move between, change size, and change location of graphic displays.
         b)Modify on-line.
         c)Add, delete, or change dynamic objects consisting of:
            (a) Analog and binary values.
            (b) Dynamic text.
            (c) Static text.
            (d) Animation files.
   c. Custom Graphics Generation Package:
      1 Create, modify, and save graphic files and Visio format graphics in PCX formats.
      2 HTML graphics to support web browser compatible formats.
      3 Capture or convert graphics from AutoCAD.
   d. Standard HVAC Graphics Library:
      1 HVAC Equipment:
         a)Air Handlers.
         b)Terminal HVAC Units.
         c)Fan Coil Units.
         d)VRF Fan Coils.
         e)VRF Heat Pumps.
         f) Energy Recovery Ventilators with Electric Duct Heating Coils.
         g) Packaged Rooftop Units.
      2 Ancillary Equipment:
         a)Fans.
         b)Pumps.
         c)Coils.
         d)Valves.
         e)Piping.
         f)Dampers.
         g)Ductwork.

3 File Format Compatible with Graphics Generation Package Program.

L. Workstation System Applications:

1. Automatic System Database Save and Restore Functions:
   a. Current database copy of each Building Controller is automatically stored on hard disk.
   b. Automatic update occurs upon change in any system panel.
   c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
   a. Save database from any system panel.
   b. Clear a panel database.
   c. Initiate a download of a specified database to any system panel.
3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.
5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.
6. System Diagnostics:
   a. Operations Automatically Monitored:
      1 Workstations.
      2 Printers.
      3 Modems.
      4 Network connections.
      5 Building management panels.
      6 Controllers.
   b. Device failure is annunciated to the operator.
7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal

state.

b. Configurable Objects:
   1 Alarm limits.
   2 Alarm limit differentials.
   3 States.
   4 Reactions for each object.

8. Alarm Messages:
   a. Descriptor: English language.
   b. Recognizable Features:
      1 Source.
      2 Location.
      3 Nature.

9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.

10. Custom Trend Logs:
   a. Definable for any data object in the system including interval, start time, and stop time.
   b. Trend Data:
      1 Sampled and stored on the building controller panel.
      2 Archivable on hard disk.
      3 Retrievable for use in reports, spreadsheets and standard database programs.
      4 Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
      5 Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.

11. Alarm and Event Log:
   a. View all system alarms and change of states from any system location.
   b. Events listed chronologically.
   c. Operator with proper security acknowledges and clears alarms.
   d. Alarms not cleared by operator are archived to the workstation hard disk.

12. Object, Property Status and Control:
   a. Provide a method to view, edit if applicable, the status of any object and property in the system.
   b. Status Available by the Following Methods:

1 Menu.
2 Graphics.
3 Custom Programs.

13. Reports and Logs:
    a. Reporting Package:
        1 Allows operator to select, modify, or create reports.
        2 Definable as to data content, format, interval, and date.
        3 Archivable to hard disk.
    b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
    c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
    d. Set to be printed on operator command or specific time(s).
14. Reports:
    a. Standard:
        1 Objects with current values.
        2 Current alarms not locked out.
        3 Disabled and overridden objects, points and SNVTs.
        4 Objects in manual or automatic alarm lockout.
        5 Objects in alarm lockout currently in alarm.
        6 Logs:
            a) Alarm History.
            b) System messages.
            c) System events.
            d) Trends.
    b. Custom:
        1 Daily.
        2 Weekly.
        3 Monthly.
        4 Annual.
        5 Time and date stamped.
        6 Title.
        7 Facility name.
    c. Tenant Override:
        1 Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
        2 Annual report showing override usage on a monthly basis.
    d. Electrical, Fuel, and Weather:
        1 Electrical Meter(s):
            a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
            b) Annual summary showing monthly electrical consumption and peak

demand with time and date stamp for each meter.

2 Fuel Meter(s):

a) Monthly showing daily natural gas consumption for each meter.

b) Annual summary showing monthly consumption for each meter.

3 Weather:

a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

M. Workstation Applications Editors:

1. Provide editing software for all system applications at the PC workstation.
2. Downloaded application is executed at controller panel.
3. Full screen editor for each application allows operator to view and change:
   a. Configuration.
   b. Name.
   c. Control parameters.
   d. Set-points.
4. Scheduling:
   a. Monthly calendar indicates schedules, holidays, and exceptions.
   b. Allows several related objects to be scheduled and copied to other objects or dates.
   c. Start and stop times adjustable from master schedule.
5. Custom Application Programming:
   a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
   b. Programming Features:
      1 English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
      2 Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
      3 Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
      4 Allows the development of independently, executing, program modules designed to enable and disable other modules.
      5 Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
      6 Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
      7 Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.

8 Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.

9 Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

N. CONTROLLER SOFTWARE

1. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
2. System Security:
   a. User access secured via user passwords and user names.
   b. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
   c. User Log On/Log Off attempts are recorded.
   d. Automatic Log Off occurs following the last keystroke after a user defined delay time.
3. Object or Object Group Scheduling:
   a. Weekly Schedules Based on Separate, Daily Schedules:
      1 Include start, stop, optimal stop, and night economizer.
      2 10 events maximum per schedule.
      3 Start/stop times adjustable for each group object.
   b. Exception Schedules:
      1 Based on any day of the year.
      2 Defined up to one year in advance.
      3 Automatically discarded and replaced with standard schedule for that day of the week upon execution.
   c. Holiday or Special Schedules:
      1 Capability to define up to 99 schedules.
      2 Repeated annually.
      3 Length of each period is operator defined.
4. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
5. Alarms:
   a. Binary object is set to alarm based on the operator specified state.
   b. Analog object to have high/low alarm limits.
   c. All alarming is capable of being automatically and manually disabled.
   d. Alarm Reporting:
      1 Operator determines action to be taken for alarm event.
      2 Alarms to be routed to appropriate workstation.
      3 Reporting Options:
         a)Start programs.

b)Print.

c)Logged.

d)Custom messaging.

e)Graphical displays.

f)Dial out to workstation receivers via system protocol.

6. Demand Limiting:
   a. Building power consumption monitored from signals generated by a pulse generator, mounted at the building power meter.
   b. Demand limit controlled via load shedding or load restoration in a predetermined and predictive manner.
   c. Demand Reduction Methods:
      1 Supply air temperature reset.
      2 Space temperature set-point reset.
      3 Equipment off/on prioritization.
   d. Relevant variables that influence demand limiting control are based on the power company methodology for computing demand charges.
   e. Operator On-Line Changes Allowed:
      1 Addition and deletion of loads controlled.
      2 Changes in demand intervals.
      3 Changes in demand limit for meter(s).
      4 Maximum equipment shutoff time.
      5 Minimum equipment shutoff time.
      6 Select rotational or sequential shedding and restoring.
      7 Shed/restore priority.
   f. Information and Reports available Hourly, Daily, and Monthly:
      1 Total electric consumption.
      2 Peak demand.
      3 Date and time of peak demand.
      4 Daily peak demand.
7. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
8. Sequencing: Application software based upon specified sequences of operation in Section 23 09 93.
9. PID Control Characteristics:
   a. Direct or reverse action.
   b. Anti-windup.
   c. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
   d. User selectable controlled variable, set-point, and PED gains.
10. Staggered Start Application:
   a. Prevents all controlled equipment from simultaneously restarting after power outage.

b. Order of equipment startup is user selectable.

11. Energy Calculations:
    a. Accumulated instantaneous power or flow rates are converted to energy use data.
    b. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
    c. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
12. Anti-Short Cycling:
    a. All binary output objects protected from short-cycling.
    b. Allows minimum on-time and off-time to be selected.
13. On-Off Control with Differential:
    a. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
    b. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
14. Run-Time Totalization:
    a. Totalize run-times for all binary input objects.
    b. Provides operator with the capability to assign high run-time alarm.

O. OPERATING SYSTEM SOFTWARE

1. Input/Output Capability From Operator Station:
    a. Request display of current values or status in tabular or graphic format.
    b. Command selected equipment to specified state.
    c. Initiate logs and reports.
    d. Change analog limits.
    e. Add, delete, or change points within each control unit or application routine.
    f. Change point input/output descriptors, status, alarm descriptors, and engineering unit descriptors.
    g. Add new control units to system.
    h. Modify and set up maintenance scheduling parameters.
    i. Develop, modify, delete or display full range of color graphic displays.
    j. Automatically archive select data even when running third party software.
    k. Provide capability to sort and extract data from archived files and to generate custom reports.
    l. Support two printer operations.
        1 Alarm printer: Print alarms, operator acknowledgements, action messages, system alarms, operator sign-on and sign-off.
        2 Data printer: Print reports, page prints, and data base prints.
    m. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
    n. Print selected control unit data base.
2. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.

3. Data Base Creation and Support: Changes shall utilize standard procedures. Control unit shall automatically check work station data base files upon connection and verify data base match. Minimum capability shall include:
   a. Add and delete points.
   b. Modify any point parameter.
   c. Change, add, or delete English language descriptors.
   d. Add, modify, or delete alarm limits.
   e. Add, modify, or delete points in start/stop programs, trend logs, etc.
   f. Create custom relationship between points.
   g. Create or modify DDC loops and parameters.
   h. Create or modify override parameters.
   i. Add, modify, and delete any applications program.
   j. Add, delete, develop, or modify dynamic color graphic displays.
4. Dynamic Color Graphic Displays:
   a. Utilizes custom symbols or system supported library of symbols.
   b. Sixteen (16) colors.
   c. Sixty (60) outputs of real time, live dynamic data per graphic.
   d. Dynamic graphic data.
   e. 1,000 separate graphic pages.
   f. Modify graphic screen refresh rate between 1 and 60 seconds.
5. Operator Station:
   a. Accept data from LAN as needed without scanning entire network for updated point data.
   b. Interrogate LAN for updated point data when requested.
   c. Allow operator command of devices.
   d. Allow operator to place specific control units in or out of service.
   e. Allow parameter editing of control units.
   f. Store duplicate data base for every control unit and allow down loading while system is on line.
   g. Control or modify specific programs.
   h. Develop, store and modify dynamic color graphics.
   i. Provide data archiving of assigned points and support overlay graphing of this data utilizing up to four (4) variables.
6. Alarm Processing:
   a. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state/value and which alarms shall cause automatic dial-out.
   b. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
   c. Print on line changeable message, up to 100 characters in length, for each alarm point specified.
   d. Display alarm reports on video. Display multiple alarms in order of occurrence.
   e. Define time delay for equipment start-up or shutdown.

f. Allow unique routing of specific alarms.
g. Operator specifies if alarm requires acknowledgement.
h. Continue to indicate unacknowledged alarms after return to normal.
i. Alarm notification:
   1 Automatic print.
   2 Display indicating alarm condition.
   3 Selectable audible alarm indication.

7. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change-of-state, specified state, or alarm occurrence or return to normal.
8. Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop.
9. Messages:
   a. Automatically display or print user-defined message subsequent to occurrence of selected events.
   b. Compose, change, or delete any message.
   c. Display or log any message at any time.
   d. Assign any message to any event.
10. Reports:
   a. Manually requested with time and date.
   b. Long term data archiving to hard disk.
   c. Automatic directives to download to transportable media such as floppy diskettes for storage.
   d. Data selection methods to include data base search and manipulation.
   e. Data extraction with mathematical manipulation.
   f. Data reports shall allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
   g. Generating reports either normally at operator direction, or automatically under work station direction.
   h. Reports may either manually displayed or printed, or may be printed automatically on daily, weekly, monthly, yearly or scheduled basis.
   i. Include capability for statistical data manipulation and extraction.
   j. Provide capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.
11. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
12. Data Collection:
   a. Automatically collect and store in disk files.
   b. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2 year period.
   c. Daily consumption for up to 30 meters over a 2 year period.
   d. Daily billable electrical energy consumption and time for up to 1024 zones over a

10 year period.

e. Provide archiving of stored data for use with system supplied custom reports.

13. Graphic Display: Support graphic development on work station with software features:
    a. Page linking.
    b. Generate, store, and retrieve library symbols.
    c. Single or double height characters.
    d. Sixty (60) dynamic points of data per graphic page.
    e. Pixel level resolution.
    f. Animated graphics for discrete points.
    g. Analog bar graphs.
    h. Display real time value of each input or output line diagram fashion.
14. Maintenance Management:
    a. Run time monitoring, per point.
    b. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
    c. Equipment safety targets.
    d. Display of maintenance material and estimated labor.
    e. Target point reset, per point.
15. Advisories:
    a. Summary which contains status of points in locked out condition.
    b. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
    c. Report of power failure detection, time and date.
    d. Report of communication failure with operator device, field interface unit, point, programmable control unit.

P. LOAD CONTROL PROGRAMS

1. General: Support inch-pounds and SI (metric) units of measurement.
2. Demand Limiting:
    a. Monitor total power consumption per power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
    b. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
    c. Forecast demand (kW): Predicted by sliding window method.
    d. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
    e. Demand Target: Minimum of 3 per demand meter; change targets based upon (1) time,
    f. (2) status of pre-selected points, or (3) temperature.
    g. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
    h. Limits: Include control band (upper and lower limits).

i. Output advisory if loads are not available to satisfy required shed amount, advise shed requirements and requiring operator acknowledgement.

3. Duty Cycling:
4. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.
5. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by same amount that off portion is reduced.
6. Set and modify following parameters for each individual load.
   a. Minimum and maximum Off time.
   b. On/Off time in one minute increments.
   c. Time period from beginning of interval until load can be cycled.
   d. Manually override the DCC program and place a load in an On or Off state.
   e. Cooling Target Temperature and Differential.
   f. Heating Target Temperature and Differential.
   g. Cycle off adjustment.
7. Automatic Time Scheduling:
   a. Self-contained programs for automatic start/stop/scheduling of building loads.
   b. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two
   c. (2) temporary day schedules.
   d. Special days schedule shall support up to 30 unique date/duration combinations.
   e. Any number of loads assigned to any time program; each load can have individual time program.
   f. Each load assigned at least 16 control actions per day with 1 minute resolution.
   g. Time schedule operations may be:
      1 Start.
      2 Optimized Start.
      3 Stop.
      4 Optimized Stop.
      5 Cycle.
      6 Optimized Cycle.
   h. Minimum of 30 holiday periods up to 100 days in length may be specified for the year.
   i. Create temporary schedules.
   j. Broadcast temporary "special day" date and duration.
8. Start/Stop Time Optimization:
   a. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
   b. Adaptive and self-tuning, adjusting to changing conditions unattended.
   c. For each point under control, establish and modify:
      1 Occupancy period.
      2 Desired temperature at beginning of occupancy period.

3 Desired temperature at end of occupancy period.

9. Night Setback/Setup Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
10. Calculated Points: Define calculations and totalization computed from monitored points (analog/digital points), constants, or other calculated points.
    a. Employ arithmetic, algebraic, Boolean, and special function operations.
    b. Treat calculated values like any other analog value, use for any function that a "hard wired point" might be used.
11. Event Initiated Programming: Event may be initiated by any data point, causing series of controls in a sequence.
    a. Define time interval between each control action between 0 to 3600 seconds.
    b. Output may be analog value.
    c. Provide for "skip" logic.
    d. Verify completion of one action before proceeding to next. If not verified, program shall be able to skip to next action.
12. Direct Digital Control: Each control unit shall provide Direct Digital Control software so that the operator may customize control strategies and sequences of operation by defining the appropriate control loop algorithms and choosing the optimum loop parameters.
    a. Control loops: Defined using "modules" that are analogous to standard control devices.
    b. Output: Paired or individual digital outputs for pulse-width modulation, and analog outputs, as required.
    c. Firmware:
        1 PID with analog or pulse-width modulation output.
        2 Floating control with pulse-width modulated outputs.
        3 Two-position control.
        4 Primary and secondary reset schedule selector.
        5 Hi/Lo signal selector.
        6 Single pole double throw relay.
        7 Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
    d. Direct Digital Control loops: Downloaded upon creation or on operator request. On sensor failure, program shall execute user defined failsafe output.
    e. Display: Value or state of each of the lines which interconnect DDC modules.
13. Fine Tuning Direct Digital Control PID or floating loops:
    a. Display information:
        1 Control loop being tuned
        2 Input (process) variable
        3 Output (control) variable
        4 Setpoint of loop
        5 Proportional band
        6 Integral (reset) Interval

7 Derivative (rate) Interval

b. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" vs "variable".

14. Trend logging:
    a. Each control unit will store samples of control unit's data points.
    b. Update file continuously at discretely assignable intervals.
    c. Automatically initiate upload request and then store data on hard disk.
    d. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
    e. Co-ordinate sampling with on/off state of specified point.
    f. Display trend samples on work station in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time vs data.

Q. HVAC CONTROL PROGRAMS

1. General:
    a. Support Inch-pounds and SI (metric) units of measurement.
    b. Identify each HVAC Control system.
2. Optimal Run Time:
    a. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
    b. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
    c. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
    d. Use outside air temperature to determine early shut down with ventilation override.
    e. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
    f. Operator commands:
        1 Define term schedule
        2 Add/delete fan status point.
        3 Add/delete outside air temperature point.
        4 Add/delete mass temperature point.
        5 Define heating/cooling parameters.
        6 Define mass sensor heating/cooling parameters.
        7 Lock/unlock program.
        8 Request optimal run time control summary.
        9 Request optimal run time mass temperature summary.
        10 Request HVAC point summary.
        11 Request HVAC saving profile summary.
    g. Control Summary:
        1 HVAC Control system begin/end status.

2 Optimal run time lock/unlock control status.
3 Heating/cooling mode status.
4 Optimal run time schedule.
5 Start/Stop times.
6 Selected mass temperature point ID.
7 Optimal run time system normal start times.
8 Occupancy and vacancy times.
9 Optimal run time system heating/cooling mode parameters.

h. Mass temperature summary:
1 Mass temperature point type and ID.
2 Desired and current mass temperature values.
3 Calculated warm-up/cool-down time for each mass temperature.
4 Heating/cooling season limits.
5 Break point temperature for cooling mode analysis.

i. HVAC point summary:
1 Control system identifier and status.
2 Point ID and status.
3 Outside air temperature point ID and status.
4 Mass temperature point ID and point.
5 Calculated optimal start and stop times.
6 Period start.

3. Supply Air Reset:

a. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.

b. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
1 Raising cooling temperatures to highest possible value.
2 Reducing heating temperatures to lowest possible level.

c. Operator commands:
1 Add/delete fan status point.
2 Lock/unlock program.
3 Request HVAC point summary.
4 Add/Delete discharge controller point.
5 Define discharge controller parameters.
6 Add/delete air flow rate.
7 Define space load and load parameters.
8 Request space load summary.

d. Control summary:
1 HVAC control system status (begin/end).
2 Supply air reset system status.
3 Optimal run time system status.

4 Heating and cooling loop.
5 High/low limits.
6 Deadband.
7 Response timer.
8 Reset times.

e. Space load summary:
1 HVAC system status.
2 Optimal run time status.
3 Heating/cooling loop status.
4 Space load point ID.
5 Current space load point value.
6 Control heat/cool limited.
7 Gain factor.
8 Calculated reset values.
9 Fan status point ID and status.
10 Control discharge temperature point ID and status.
11 Space load point ID and status.
12 Air flow rate point ID and status.

f. Enthalpy Switchover:

g. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.

h. Operator commands:
1 Add/delete fan status point.
2 Add/delete outside air temperature point.
3 Add/delete discharge controller point.
4 Define discharge controller parameters.
5 Add/delete return air temperature point.
6 Add/delete outside air dew point/humidity point.
7 Add/delete return air dew point/humidity point.
8 Add/delete damper switch.
9 Add/delete minimum outside air.
10 Add/delete atmospheric pressure.
11 Add/delete heating override switch.
12 Add/delete evaporative cooling switch.
13 Add/delete air flow rate.
14 Define enthalpy deadband.
15 Lock/unlock program.
16 Request control summary.
17 Request HVAC point summary.

i. Control summary:

1. HVAC control system begin/end status.
2. Enthalpy switchover optimal system status.
3. Optimal return time system status.
4. Current outside air enthalpy.
5. Calculated mixed air enthalpy.
6. Calculated cooling cool enthalpy using outside air.
7. Calculated cooling cool enthalpy using mixed air.
8. Calculated enthalpy difference.
9. Enthalpy switchover deadband.
10. Status of damper mode switch.

R. PROGRAMMING APPLICATION FEATURES

1. Trend Point:
   a. Sample up to 150 points, real or computed, with each point capable of collecting 100 samples at intervals specified in minutes, hours, days, or month.
   b. Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.
2. Alarm Messages:
   a. Allow definition of minimum of 100 messages, each having minimum length of 100 characters for each individual message.
   b. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
   c. Output assigned alarm with "message requiring acknowledgement".
   d. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.
3. Weekly Scheduling:
   a. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
   b. Provide program times for each day of week, per point, with one minute resolution.
   c. Automatically generate alarm output for points not responding to command.
   d. Provide for holidays, minimum of 366 consecutive holidays.
   e. Operator commands:
      1. System logs and summaries.
      2. Start of stop point.
      3. Lock or unlock control or alarm input.
      4. Add, delete, or modify analog limits and differentials.
      5. Adjust point operation position.
      6. Change point operational mode.
      7. Open or close point.
      8. Enable/disable, lock/unlock, or execute interlock sequence or computation

profile.

9 Begin or end point totalization.

10 Modify totalization values and limits.

11 Access or secure point.

12 Begin or end HVAC or load control system.

13 Modify load parameter.

14 Modify demand limiting and duty cycle targets.

f. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

4. Interlocking:

a. Permit events to occur, based on changing condition of one or more associated master points.

b. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.

c. Operator commands:

1 Define single master/multiple master interlock process.

2 Define logic interlock process.

3 Lock/unlock program.

4 Enable/disable interlock process.

5 Execute terminate interlock process.

6 Request interlock type summary.

2.45 INSTRUMENTATION AND CONTROL DEVICES

A. General

1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. Input/Output Sensors

1. Temperature Sensors:

a. Sensor range shall provide a resolution of no worse than .4°F (unless noted otherwise).

b. Room temperature sensor shall be an element contained within a ventilated cover, suitable for wall mounting with digital output. Sensors located in mechanical areas, plenums, garages, gymnasiums, or corridors shall be a flat plate sensor with no possible adjustment or shall be provided with aesthetically-pleasing lockable protective cover. Security screws shall be used in institutional settings as deemed necessary by the design engineer. ATC contractor shall coordinate requirements with the design engineer during the submittal process. Provide insulated base. Following sensing elements are acceptable:

1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

2 Units shall be capable of +/- 2 degrees (F) adjustment by the occupant, with display showing current temperature and setpoint.

c. Single point duct temperature sensor shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 316 stainless steel.
   1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

d. Averaging duct temperature sensor shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide enough sensors to give one lineal foot of sensing element for each square foot of cooling coil face area. Temperature range as required for resolution indicated in paragraph A.
   1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

e. Liquid immersion temperature sensor shall include stainless steel thermowell, sensor and connection head for wiring connections.
   1 Sensing element for chilled water applications - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point. Temperature range shall be as required for resolution indicated in paragraph A.
   2 Sensing element for non-chilled water applications - Platinum RTD, +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of no worse than 0.1°F.

2. Humidity Sensors:
   a. Elements: Accurate within 5 percent full range with linear output.
   b. Room Sensors: With locking cover , span of 10 to 60 percent relative humidity.
   c. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 – 100 percent relative humidity.
3. Building Static Pressure Transmitters:
   a. Manufacturers:
      1 Dwyer Instruments Inc; : www.dwyer-inst.com/#sle.
      2 Johnson Controls International, PLC; : www.johnsoncontrols.com/#sle.
      3 Setra Systems, Inc; : www.setra.com/#sle.
      4 Veris Industries; : www.veris.com/#sle.
      5 Substitutions: See Section 01 60 00 - Product Requirements.
   b. Single port for direct or tubing connection into wall or ceiling static pressure tip, direct acting, double bell, scale range 0.01 to 6.0 in-wc positive or negative, and sensitivity of 0.0005 in-wc. Transmit electronic signal to receiver with matching scale range.
4. Carbon Monoxide Sensors:
   a. Gas sensing module that holds fixed or replaceable carbon monoxide gas-sensor cartridge.
   b. Form Factor: IEC 60529, IP20 enclosure, single-gang electrical box mounted.
   c. Electromechanical sensor with 0 to 500 ppm measurement range.
   d. Accuracy: Plus/minus Five percent of range with 1 ppm resolution.
   e. Hardwired Output: Three-wire, 4 to 20 mA, loop powered.
   f. Alarm: Auxiliary dry contact relay driven by setpoint adjustable between 25 to

180 ppm.

5. Equipment Operation Sensors:
   a. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
   b. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

C. Thermostats

1. Line Voltage Thermostats:
   a. Integral manual On/Off/Auto selector switch, single or two pole as required.
   b. Dead band: Maximum 2 degrees F.
   c. Cover: Locking with set point adjustment, with thermometer.
   d. Rating: Motor load.
2. Outdoor Reset Thermostat:
   a. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
   b. Scale range: -10 to 70 degrees F.
3. Immersion Thermostat:
   a. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
4. Airstream Thermostats:
   a. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
   b. Averaging service remote bulb element: 7.5 feet.
5. Electric Low Limit Duct Thermostat:
   a. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
   b. Bulb length: Minimum 20 feet.
   c. Provide one thermostat for every 20 sq ft of coil surface.
6. Electric High Limit Duct Thermostat:
   a. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
   b. Bulb length: Minimum 20 feet.
   c. Provide one thermostat for every 20 sq ft of coil surface.
7. Fire Thermostats:
   a. UL labeled, factory set in accordance with NFPA 90A.
   b. Normally closed contacts, manual reset.
8. Heating/Cooling Valve Top Thermostats:
   a. Proportional acting for proportional flow, molded rubber diaphragm, remote bulb liquid filled element, direct and reverse acting at differential pressure to 25 psig, cast housing with position indicator and adjusting knob.

2.46 SCAFFOLDS AND STAGING

A. General: Filed subcontractors shall obtain required permits for, and provide scaffolds, staging, and other similar raised platforms, required to access their Work as specified in Section 01 50 00 - Temporary Facilities and Controls and herein.

1. Scaffolding and staging required for use by this Filed subcontractor pursuant to requirements of Section 01 50 00 - Temporary Facilities and Controls shall be furnished, erected, maintained in a safe condition, and dismantled when no longer required, by this Filed Subcontract requiring such scaffolding.
2. Each Filed subcontractor is responsible to provide, maintain and remove at dismantling, all tarpaulins and similar protective measures necessary to cover scaffolding for inclement weather conditions other than those required to be provided, maintained and removed by the General Contractor pursuant to MGL (Refer to Section 01 50 00 - Temporary Facilities and Controls and as additionally required for dust control).
   a. General Contractor is responsible to provide enclosures required for temporary heat from November 1 to March 31; refer to Section 01 50 00 - Temporary Facilities and Controls.
3. Furnishing portable ladders and mobile platforms of all required heights, which may be necessary to perform the work of this trade, are the responsibility of this Filed subcontractor.

2.47 HOISTING MACHINERY AND EQUIPMENT

A. All hoisting equipment, rigging equipment, crane services and lift machinery required for the work by this Filed subcontractor shall be furnished, installed, operated and maintained in safe conditions by this Filed subcontractor, as referenced under Section 01 50 00 - Temporary Facilities and Controls.

2.48 TEXTILE AIR DISPERSION SYSTEM *(Addendum #1)*

A. Refer to the plans and this specification for the requirements of the non-metal ductwork systems.

B. The basis of design is DuctSox Corporation.

1. Alternate manufactures:
   a. Hero FabriDuct, LLC
   b. KE Fibetec NA, Inc.

C. Hoops (IHS) System: Air diffusers shall be constructed with internal retention system.

1. System shall consist of an internal 360 degree hoop system, spaced 5’ on center.
2. System shall be installed with a one row suspension system located 1.5” above top-dead-center of the textile system.
3. System attachment to cable or U-Track shall be made using Gliders spaced 12 inches.
4. Available for diameters from 8” – 60”.
5. One row suspension options (must specify if multiple on same project)
   a. U-Track suspension hardware to include 8’ sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits – consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.

1 U-Track suspension options (must specify if multiple on same project)
a)Galvanized steel cable
b)Stainless steel cable
c)Impregnated steel cable (required for natatorium applications)
2 Support lengths available in 5'(standard), 10', 15', & 30'

D. Textile: Verona Np

1. Textile Construction: Filament/spun plain weave polyester, fire retardant in accordance with UL 2518. Also Classified by UL-C (Canada) S102.2 and AS/NZS 1530.3.
2. Air Permeability: 0.7 (+/-0.25) CFM/ft2 per ASTM D737, Frazier
   a. The air permeability of the fabric must NOT be created by perforating the fabric.
   b. The air permeability must be confirmed be third party testing to eliminate the formation of condensate on the fabric.
3. Weight: 6.5 oz. /yd2 per ASTM D3776
4. Warranty: 10 years
5. Textile Color
   a. Standard: blue, white, tan, red, green, silver, black
   b. Custom
   c. *Color to be selected by the Architect.*

E. Textile System Fabrication Requirements:

1. Textile system to be constructed in modular lengths (zippered) with proper radial securing clips along the length of the system.
2. Integrated air dispersion shall be specified and approved by manufacturer. (select only those that apply)
   a. Orifices
      1 Air dispersion and extended throws are accomplished by orifices. Dispersion orifice sizing, up to 5 inch diameter (design dependent).
      2 Diameter, quantity, and location of orifices to be specified and approved by manufacturer.
3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via. zip screw fastener – supplied by contractor.
4. Inlet connection includes zipper for easy removal / maintenance.
5. Lengths to include required intermediate zippers as specified by manufacturer.
6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
7. End cap includes zipper for easy maintenance.
8. Each section of the textile shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.

F. Design Parameters:

1. Textile air diffusers shall be designed from 0.25” water gage minimum to 3.1” maximum, with 0.5” as the standard.
2. Textile air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
3. System overall design: diameter, length, airflow, operating static pressure and dispersion shall be designed or approved by the manufacturer.
4. Do not use textile diffusers in concealed locations.
5. Use textile air dispersion systems only for positive pressure air distribution components of the mechanical ventilation system.

G. Warranty

1. Manufacturer must provide a 10 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

3 PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All work shall be coordinated with the work to be installed by other sections of these specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. All duct supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers, and rating identifications shall be securely attached to equipment.

E. The work shall be performed in a timely manner so as to cause no delay in the overall job progress. The HVAC Sub-Contractor shall cooperate with the other trades so that the work is installed in the most beneficial sequence for expeditious project completion.

3.2 CLEANING OF SYSTEMS AND PREMISES

A. Before the systems are tested and balanced, all ducts serving the area under construction shall be cleaned so that no dirt, dust or other foreign matter will be carried through or deposited in the systems or the space served by the duct systems.

B. At all times keep the premises clear of rubbish.

C. Upon completion of the work in an area, remove all debris and rubbish resulting from the execution of this contract, and dispose of same. At any time should the General Contractor be dissatisfied with the performance of the HVAC Sub-Contractor's clean up responsibilities, he may elect after notifying the HVAC Sub-Contractor to undertake this operation and to backcharge the HVAC Sub-Contractor accordingly.

3.3 HVAC SUB-CONTRACTOR'S WARRANTY

A. The HVAC Sub-Contractor shall provide a one year warranty against failure of the installed materials for any reason. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and

shall run from the date of the Architect's acceptance of the system. The warranty shall also include provision for field inspection at no charge to the Owner, to verify failure, establish probable cause, and determine corrective action required. The HVAC Sub-Contractor shall furnish all service during the first year of operation. Any material, that in the opinion of the architect, requires excessive service during the first year of operation shall be considered defective and will be replaced by the HVAC Sub-Contractor at no charge to the Owner.

B. The HVAC Sub-Contractor shall provide a listing of all manufacturers' commercial warranties provided by those manufacturers on their Materials. The list of these warranties must include the time period of each warranty. One copy each of those warranties shall be submitted with the listing.

C. The HVAC Sub-Contractor shall be responsible for warranting the testing, adjusting and balancing work for a period of one year after final date of completion. The HVAC Sub-Contractor shall also be responsible for all damage to existing systems as a result of the work performed. All damaged systems shall be repaired or replaced at the option of the Owner at no additional cost to the Owner. All such repair or replacement work shall be done immediately upon finding.

D. Warranty response to any malfunction shall be on a next day, normal working hour basis.

E. Work under warranty shall be performed by fully qualified workmen and/or technicians.

F. All guarantees and warranties required to be provided for the work in this Section shall begin their term on the date of final written acceptance of the entire system by the Owner.

3.4 SUBMITTALS

A. The capacity of each HVAC unit shall be substantiated by computer generated selection data or other detailed selection data provided by the manufacturer, for the specific conditions defined on the drawings.

1. The selection data shall clearly show the entering and leaving fluid conditions, the fluid flow volume and the fluid pressure drop through the unit, the ambient conditions, the heat rejection media entering and leaving conditions, the available external static pressure, the unit total static pressure, the airside pressure drops, the refrigerant and the saturated suction temperature, the required RPM of the unit, the motor horsepower, the motor voltage, the motor efficiency, the motor RPM, the motor type, the fuel efficiency, the fuel consumption rate, the maximum capacity, the part load performance data of the anticipated operation of the system, and the radiated sound ratings at design conditions as may be appropriate for any specific piece of equipment.

B. HVAC Sub-Contractor shall submit shop drawings indicating the method of supporting all units.

3.5 PERFORMANCE

A. The drawings are diagrammatic and the final arrangement of the work shall suit the existing and field conditions, the characteristics of the materials used and the instructions of the Engineer and/or the Architect.

B. The HVAC Sub-Contractor shall be responsible for repair of damaged or disturbed existing work or the work of other trades caused by his work, testing of his work or repair to his work.

C. All devices shall be installed in accordance with the manufacturer's recommendations, the Engineer's instructions and so as to provide all required access for cleaning, operation, repair and maintenance.

3.6 START UP

A. All equipment, systems, controls and units shall be started as part of a heating, ventilating and air conditioning system, in accordance with all manufacturers' recommendations.

B. Copies of startup sheets shall be included in Operations & Maintenance Manuals.

3.7 VIBRATION ISOLATION

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, as specified herein or as shown on the drawings.

B. Mounting sizes shall be determined by the mounting manufacturer and the mountings shall be installed in accordance with the manufacturer's recommendations. The HVAC Sub-Contractor shall be responsible for the adequacy of the mountings to provide the minimum isolation efficiency required by these specifications or as specifically noted on the drawings.

C. Suspended centrifugal fans shall be installed on vibration isolation hangers.

3.8 RECTANGULAR DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Sealing

1. All ductwork shall be sealed in accordance with the following table:

SMACNA SEAL CLASS	SEALING REQUIRED	SMACNA STATIC PRESSURE CONSTRUCTION CLASS
A	All transverse joints All longitudinal seams All duct wall penetrations	4" W.G. and up
B	All transverse joints All longitudinal seams	3" W.G.
C	All transverse joints	2" W.G. and down

2. For the purposes of these specifications sealing shall mean the following:
   a. The use of adhesives, gaskets, liquids, mastics, hot melt sealant, pressure sensitive tape or combinations thereof to close openings in the surface of the

ductwork and field erected plenums and casings through which air leakage would occur.

b. The requirements to seal apply to both positive and negative pressure modes.

3. Pressure sensitive tape shall only be acceptable for sealing ductwork which operates at a static pressure of ½" or less.
4. Liquid sealant shall only be acceptable for slip joints where metal clearances do not exceed 1/16".
5. Gaskets shall be used for all flanged connections and shall have an adhesive backing to adhere to the flange during assembly of the joint.

C. Reinforcement

1. Unless specified otherwise on the drawings rectangular ductwork shall be constructed and reinforced per the following "Rectangular Duct Reinforcement" tables, where the duct wall thickness, the reinforcement spacing and the rigidity class are specified by duct size and pressure classification. Rigidity class designations are based on the SMACNA standards for "Intermediate Reinforcement" and "Transverse Joint Reinforcement" as published in the SMACNA "HVAC DUCT CONSTRUCTION STANDARDS - Metal and Flexible".
2. Duct sides that are 19" and over and are 20 gauge or less with more than 10 square feet of unbraced panel shall be cross broken or beaded unless they are lined or externally insulated.
3. Fittings shall be reinforced similarly to sections of straight duct. On size change fittings the greater fitting dimension determines the duct gauge. Where fitting curvature or internal members provide equivalent rigidity, such features may be credited as reinforcement.
4. The duct side with the largest dimension shall determine the duct gauge.
5. Holes made in the duct walls for the passage of tie rods shall be of minimum size and shall be sealed in accordance with the required duct seal classification.
6. Where used tie rods shall be evenly spaced in the width of the duct dimension.

D. Transverse Joints

1. Transverse joints shall be selected and used consistent with the static pressure class, sealing requirements and duct support intervals for proper assembly.
2. Where bar or angle stock is incorporated in a joint it shall be secured.
3. Fasteners shall be steel and may be zinc or cadmium coated. They shall not project into duct more than ½".
4. Where bolts or welds are specified other types of fasteners shall not be used.

E. Seams

1. Seams shall be suitably selected for the material and pressure classification of the duct.
2. Seams shall be formed and assembled with proper dimension and proportion for tight and secure fit.

3.9 RECTANGULAR DUCT FITTINGS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

3.10 ROUND DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Duct Gauge

1. Round ducts shall be constructed of the galvanized steel with duct walls in accordance with ”SMACNA” standards.

3.11 ROUND DUCT FITTINGS

A. Elbows larger than 8" shall be five piece welded construction.

B. Branch and take-off fittings shall be conical tee or conical reducing tee fittings.

C. Final connections to the individual terminal supply units shall be by means of flexible duct.

3.12 BALANCING DAMPERS

A. Balancing dampers shall be located as shown on the drawings and in the following locations as a minimum:

1. All supply and return air branches from the trunks and all sub-branches from the mains shall have balancing dampers.
2. Branch duct connections from low pressure ducts to diffusers shall be made with dampered spin collars.

B. Locate dampers as far as possible from air outlets.

3.13 FLEXIBLE DUCTS

A. Use

1. Flexible ducts shall not exceed 5 feet in length.
2. All flexible duct used on the supply air system shall be insulated with 1½" thick vinyl jacketed fiberglass insulation.

B. Length

1. The minimum length of flexible duct shall be used.
2. The maximum length of flexible duct in any single duct run shall be four feet.
3. Flexible duct shall not be used on supply air systems.

C. Bends

1. Bends shall be made with not less than one and one half duct diameter centerline radius.
2. Maximum bend shall be 90°.

D. Fastening

1. Secure flexible duct to collar or sleeve by peeling back jacket and insulation at end of flexible duct. Fit duct over collar or sleeve and clamp with ½" wide galvanized steel or stainless steel bands or clamps and matching seals. Pull jacket and insulation back in place and secure it with two wraps of pressure sensitive sealing tape. Clamping device shall be two inches back from end of flexible duct. Seal with two wraps of duct tape.

E. Installation

1. Flexible duct is to be installed as straight as possible and as tight as possible.
2. Submittals shall include product data sheets as well as the manufacturer's recommended installation practices.

3.14 SUSPENSION OF DUCTWORK

A. Rigid round and rectangular ducts shall be installed with support systems as required to maintain alignment. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection.

B. Strap hangers on rectangular ducts may be used on ducts less than 60" wide if they are secured to the bottom of the duct with an approved fastener and with a minimum 1" tab below the duct, or with no fasteners if the strap is a single continuous loop.

C. Multiple trapeze hangers may be suspended from rod hangers to support ducts directly above and below each other if the rods are sized to support the combined load.

D. Round ducts less than 10" in diameter may be suspended by wire.

E. All hangers and trapezes shall be sized, spaced and selected in accordance with Section IV of SMACNA "HVAC DUCT CONSTRUCTION STANDARDS".

3.15 MISCELLANEOUS DUCT WORK REQUIREMENTS

A. Ductwork connected to intake or discharge louvers shall be painted inside for the first ten feet with bitumastic and pitched to a low point. The low point is to be provided with a 1½" copper drain piped by this trade to a building drain.

B. A gasket type joint shall be used where dissimilar metals are joined.

3.16 DUCT INSULATION - DUCT WRAP

A. All work shall be in strict accordance with applicable codes and ordinances and the manufacturers recommendations.

B. All completed work shall be smooth in appearance.

C. Seams shall be stapled 6" on center with outward clinching staples and sealed with pressure sensitive aluminum foil tape.

D. All seams, joints punctures and tears shall be sealed with pressure sensitive aluminum, foil tape.

E. All make-up air ductwork, air conditioning supply ductwork, and ductwork connected to SF-1 shall be insulated. All exterior insulated ductwork shall be weather proofed per Section 2.7.

3.17 TEXTILE AIR DISPERSION SYSTEM (Addendum #1)

A. Installation Of Textile Air Dispersion System:

1. Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

B. Cleaning And Protection:

1. Clean air handling unit and ductwork prior to the DuctSox system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
2. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
3. If DuctSox systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

3.18 PIPE HANGERS, SUPPORTS, ANCHORS AND GUIDES

A. The HVAC Sub-Contractor shall submit shop drawings indicating the method of supporting all piping furnished by this trade.

B. The Structural Engineer or Architect must approve the method of hanging before work commences.

C. Shop drawings of anchors shall be submitted before work commences.

D. Shop drawings of guides shall be submitted before work commenced.

E. Sleeves of the specified type shall be installed wherever pipe lines penetrate walls, roofs, floors or partitions.

F. Sleeves shall be installed in accordance with the requirements of NFPA and the Massachusetts State Building Code.

3.19 PIPING SYSTEM INSTALLATION AND ASSEMBLY

A. All piping shall be installed at right angles to building surfaces, supports and structures.

B. Pipe welding shall performed by a certified welder with oxy-acetylene or electric arc in accordance with the latest revision of the applicable code, ASME Boiler Construction Code, ASA Code for Pressure Piping, or state and/or local codes which may supersede codes mentioned.

C. Threaded joints shall be made with Teflon tape only applied to male threads and care being taken to insure that the tape does not reach the interior of the pipe. All burrs and/or cuttings shall be removed and the pipe shall be reamed or filed out to not less than the original diameter. Piping shall be kept free from scale and dirt.

D. All pipes shall be straight, true and round without obstructions and with sharp, full cut threads or with ends beveled for welding.

E. Provide drain valves with hose connections at all low points and at the bottoms of all risers to allow for complete drainage of the system.

F. All openings shall be capped or plugged during construction to prevent dirt and/or rubbish from entering the piping.

G. Unions or flanged connections shall be placed wherever necessary to permit easy dismantling of the piping and equipment.

H. Where possible, piping shall be grouped together and supported in a neat and orderly manner.

I. Insulating bushings or dielectric nipples shall be provided between steel piping and copper piping on equipment.

J. Air vents shall be provided where indicated on the drawings and at all high points in the water systems.

K. Pipe must be supported before and after expansion compensation devices.

L. Mount all pressure gauges to be read from the floor.

M. Install pressure gauges on the suction and discharge of pumps.

N. Provide two spare pressure gauges of each pressure range and type.

O. Mount all thermometers to be read from the floor.

P. Install thermometers on the supply and return of the chill water system.

Q. Provide two spare thermometers of each range and type.

3.20 SEISMIC RESTRAINTS

A. Seismic restraints shall be provided in accordance with 780 CMR 1612.0 EARTHQUAKE LOADS. This specification does not require any additional seismic restraints beyond those of 780 CMR.

B. Seismic restraints are required for:

1. The energy recovery ventilator.
2. Make Up Air Unit

C. The HVAC Sub-Contractor shall be responsible for the design of the seismic restraints. The HVAC Sub-Contractor shall have the seismic restraint shop drawings stamped by a registered structural engineer.

3.21 VRF SYSTEM

A. General

1. The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an

authorized training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process

2. Upon completion of the Equipment Start-Up, the VRF manufacturer or VRF representative shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be a close-out letter, manufacturer's design software as-built file, and all recorded system information.

B. Pre Start-Up Inspection

1. Contractor shall employ the services of the VRF manufacturer or representative whose primary job responsibilities are to provide direct technical support of VRF products; sales staff or in-house support staff are not permitted to complete this scope of work, to provide a comprehensive physical startup of equipment. The following shall be completed prior to the startup of equipment:
2. The installing contractor shall provide a copy of the as-built electronic design file used in the installation of the system being inspected. This electronic design file shall have been completed on software approved by the specified VRF manufacture and shall have been updated to reflect as-built conditions.
3. Prior to start-up, all systems components shall be in a final state of readiness having been fully installed and awaiting start-up. Manufacturer's pre-startup checklist shall be completed and provided to engineer.
4. The installing contractor shall have prepared the refrigeration piping systems per equipment installation and service manuals. All refrigerant piping systems, upon completion of assembly, shall have been pressurized to a minimum 600 PSI, using dry nitrogen, and held for a consecutive 24HR period. A record of the pressure check process shall be recorded and tagged at the outdoor unit. The tag shall contain information for two events: start & stop. Each event shall include: date, time, fill pressure, outdoor temperature, and the person's full name completing each task.
5. Upon completion of the 600 PSI pressure check, the system shall be evacuated to a level of 500 microns, where it will be held for a period of 1HR with no deflection. The installing contractor shall utilize the triple evacuation method per the equipment install and service manuals. Evacuation start & stop dates, times, and persons involved shall be recorded and tagged at the outdoor equipment.
6. Upon the completion of the 500 micron hold, the calculated additional refrigerant charge can be added. The calculated refrigerant charge shall have been calculated using the manufactures design software. Total refrigerant charge of the system shall be recorded and displayed at the outdoor unit by permanent means.
7. A review of the equipment settings shall be completed, with recommendations provided to improve system performance, if applicable. Physical changes of system settings will be completed by the contractor.
8. All pressure check and evacuation tags shall be reviewed by the Mechanical Engineer before physical start-up begins.
9. Engineer must be notified (1) week before physical system start-up date. Manufacturer's pre start-up checklist must be provided with this notification.

C. Physical Start-Up of Equipment

1. Upon proper equipment start up by the contractor, following the manufacturer's guidelines and specifications, The representative shall complete a review of the system performance and complete the following tasks:

a. Check and confirm all communication addressing of system components.
b. Check and confirm each indoor unit, individually, is properly piped and wired by commanding the indoor unit on, in either heat or cool mode.
c. Electronically record a minimum of one-hour of operational data per refrigeration system.
d. Electronically record dip switch positions on all indoor and outdoor equipment.

D. VRF Equipment Warranty

1. Contractor is responsible for successfully completing the Start-Up & Extended Warranty processes and fulfilling all requirements, as outlined by the manufacturer. The equipment shall be provided with the following warranty period:
   a. Compressor: 10-year
   b. Parts: 10-years

E. Close-Out Information

1. The Manufacturer or VRF representative shall issue a system close out document at the completion of all field work. Contained within this report shall be an overview of the system performance, recommendations, all electronic data, and as-built design file.
2. Contractor shall submit proof of extended warranty registration.

F. Owner Turnover

1. The VRF manufacturer or representative shall provide the owner's representative with a minimum [4]-hour operation and maintenance training class covering systems installed under this scope of work. Training is to be provided at the time of owner occupancy.

3.22 ENERGY RECOVERY VENTILATORS

A. Examination

1. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
2. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
3. Proceed with installation only after all unsatisfactory conditions have been corrected.

B. Installation

1. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

C. Connections

1. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
2. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
3. Duct installation and connection requirements are specified in Division 23 of this document.

4. Electrical installation requirements are specified in Division 26 of this document.

D. Field Quality Control

1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

E. Start-up Service

1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

F. Demonstration and Training

1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit.

3.23 AUTOMATIC TEMPERATURE CONTROLS

A. Installation Standards

1. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

B. TAB Support

1. Pre-TAB Meeting: Approximately 2 weeks prior to the initiation of Division 23 "Testing, Adjusting and Balancing for HVAC" services on site, schedule a meeting giving notice to the Construction Manager, Architect and Engineer and facilities representative(s).
   a. Publish an agenda with a minimum of the following discussion items:
      1 “Instrumentation and Controls for HVAC" sequence of upcoming construction.
      2 "Testing, Adjusting and Balancing for HVAC" sequence of upcoming construction.
      3 TAB for support from "Instrumentation and Controls for HVAC."
      4 "Instrumentation and Controls for HVAC" requirements for support from TAB.
      5 Timing, support and documentation procedures.
      6 Operation, diversities and setpoints of systems and equipment.
   b. Division 23 "Testing, Adjusting and Balancing for HVAC" shall fully support Division 23 "Instrumentation and Controls for HVAC" in the testing and calibration of all devices with fluid flow, motor transformers, static pressures and the like and shall coordinate work so as to not interfere with instrumentation and controls installation and setup activities.
   c. Division 23 "Instrumentation and Controls for HVAC" shall fully support Division 23 "Testing, Adjusting and Balancing for HVAC" in the operation, start and stop of all systems as well as the setting of values required for proper balancing and shall coordinate work so as to not interfere with TAB activities.

C. Construction/Commissioning Access Account

1. Individual read/view only web based access accounts shall be provided to the Engineer and to the Commissioning Agent. Account shall be set up once on-site server/workstation is active and pertinent access username, password, information and instructions shall be emailed to the Engineer and to the Commissioning Agent as early in the project as possible. Minimum read/view only access shall be provided to the following:
   a. Graphics.
   b. Programming.
   c. Trend Data.
   d. Alarms.

D. Examination

1. Verify that power supply is available for control units and operator workstation.
2. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.
3. Examine pathway elements intended for cables.
   a. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
   b. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
   c. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
   d. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Installation

1. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
2. Connect and configure equipment and software to achieve sequence of operation specified.
3. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches above the floor.
   a. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
4. Install guards on thermostats, if the functionality cannot be disabled, in the following locations
   a. Entrances.
   b. Public areas.
   c. Where indicated.
5. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

6. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
7. Install labels and nameplates to identify control components according to Division 23 requirements.
8. Install refrigerant instrument wells, valves, and other accessories according to Division 23 requirements.
9. Install duct volume-control dampers according to Division 23 requirements.
10. Install electronic and fiber-optic cables according to Division 27 Section requirements.

F. Application of Media

1. Backbone Cable for Data Service: Use UTP Category 6 for runs between cabinets.
2. Horizontal Cable for Data Service: Use UTP Category 5e cable for runs between cabinets and peripheral equipment.

G. Electrical Wiring And Connection Installation

1. Comply with NECA 1.
2. Wiring Method: Install wiring and optical fiber in raceway within the following areas: mechanical rooms, electrical rooms, exposed areas, within walls and above inaccessible ceilings. Conceal raceway except in mechanical rooms and areas where other raceway and piping are exposed.
3. Wiring Method: Install wiring and optical fiber in raceway except consoles, cabinets, desks, and counters, and except in accessible ceiling spaces where unenclosed wiring method may be used for systems that are not part of life safety systems, including but not limited to, smoke exhaust systems, stair pressurization systems, smoke control systems, or hazardous exhaust systems, or systems on emergency/standby power, or main communications systems cable. Use UL listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in mechanical rooms and areas where other raceway and piping are exposed.
4. Cable Installation:
   a. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
   b. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   c. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   d. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
   e. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   f. Install UTP cables using techniques, practices, and methods that are consistent with Category 5e or 6 rating of components and that ensure Category 5e or 6 performance of completed and linked signal paths, end to end.
      1 Do not untwist more than 1/2 inch of Categories 5e and 6 cables at connector terminations.

5. Separation from EMI Sources: Comply with BICSI TDM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:
   a. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:
      1 Electrical Equipment Rating Less Than 2 kVA: 5 inches.
      2 Electrical Equipment Rating Between 2 and 5 kVA: 12 inches.
      3 Electrical Equipment Rating More Than 5 kVA: 24 inches.
   b. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:
      1 Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches.
      2 Electrical Equipment Rating Between 2 and 5 kVA: 6 inches.
      3 Electrical Equipment Rating More Than 5 kVA: 12 inches.
   c. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:
      1 Electrical Equipment Rating Less Than 2 kVA: No requirement.
      2 Electrical Equipment Rating Between 2 and 5 kVA: 3 inches.
      3 Electrical Equipment Rating More Than 5 kVA: 6 inches.
   d. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches.
   e. Fluorescent Fixtures: 5 inches.
6. Conduit:
   a. Comply with TIA/EIA-569-A for maximum length of conduit and bends between pull points, and for pull-box sizing.
   b. Use manufactured conduit sweeps and long-radius ells whenever possible.
   c. In mechanical rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead. Extend conduits 1 to 3 inches in finished floor.
   d. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   e. Install exposed cable in raceway.
   f. Install concealed cable in raceway.
   g. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   h. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   i. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
   j. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

7. Install raceways, boxes, and cabinets according to Division 26 requirements.
8. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
9. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

H. Grounding

1. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with TIA/EIA 607.
2. Grounding Points:
   a. Locate grounding terminals in each equipment room, wiring closet, rack, and cabinet.
   b. Telecommunications Grounding Busbars: Mount on wall of equipment room and closet, with standoff insulators.

I. Bonding Conductors:

1. Extend from telecommunications entrance facility to grounding busbars.
2. Extend from grounding busbars to ground terminals in cabinets.

J. Special Requirements:

1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
2. Install only in nonmetallic conduit, unless specifically required for protection of conductor. Metallic conduit, if used, shall be RMC. For RMC that exceeds 36 inches in length, conductors shall be bonded at each end of conduit.
3. Bonding conductors shall be installed without splices unless approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

K. Field Quality Control

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
2. Perform the following field tests and inspections and prepare test reports:
   a. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   b. Test and adjust controls and safeties.
   c. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
   d. Test each point through its full operating range to verify that safety and operating control set points are as required.
   e. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
   f. Test each system for compliance with sequence of operation.
   g. Test software and hardware interlocks.

3. DDC Verification:
   a. Verify that instruments are installed before calibration, testing, and loop or leak checks.
   b. Check instruments for proper location and accessibility.
   c. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
   d. Check instrument tubing for proper fittings, slope, material, and support.
   e. Check installation of air supply for each instrument.
   f. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
   g. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
   h. Check temperature instruments and material and length of sensing elements.
   i. Check control valves. Verify that they are in correct direction.
   j. Check DDC system as follows:
      1 Verify that DDC controller power supply is from emergency power supply, if applicable.
      2 Verify that wires at control panels are tagged with their service designation and approved tagging system.
      3 Verify that spare I/O capacity has been provided.
      4 Verify that DDC controllers are protected from power supply surges.
4. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
5. In addition to requirements in this Article, comply with TIA/EIA-606-A and with applicable requirements in Division 26 requirements.
   a. Administration class for this Project shall be Class 2 or 3.
   b. Color-code cross-connect fields. Apply colors to service backboards, connections, covers, and labels.
6. Using cable and asset management software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement. At completion, cable and asset management software shall reflect as-built conditions.
7. Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.
8. Cable and Wire Identification:
   a. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   b. Label each terminal strip and screw terminal in each cabinet.
      1 All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
      2 Label each unit and field within distribution racks and frames.

9. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

L. GRAPHICS ORGANIZATION

1. General:
   a. Graphics shall be full color with motion utilizing floor plans wherever possible to indicate location of applicable information and fully accessible through the web-based software.
   b. A general color scheme shall be utilized to indicate status of equipment and information.
      1 BLUE: Equipment/system normal, off; point normal.
      2 GREEN: Equipment/system normal, on.
      3 YELLOW: Equipment/system alarm, operating; point minor alarm.
      4 RED: Equipment failure; point major alarm.
      5 PURPLE: Operator override.
   c. Provide the following links in a block in the same general location on every graphic:
      1 Primary graphic.
      2 All screens associated with the current graphic.
      3 As-Built Sequence of Operation
      4 Back to previous.
      5 Forward to next.
   d. Organize graphics in easily understandable levels to minimize search time for desired information.
      1 There shall be at least 2 levels and no more than 4 levels.
      2 Smaller systems can have one primary graphic with links to all other graphics.
      3 Larger systems can be organized with one primary graphic, a secondary set of categorized graphics to organize like specific graphics (i.e., zones, air systems, chilled water systems, hot water systems, etc.), then a third layer to take the user to specific graphics.
2. Primary Graphic:
   a. The primary graphic will show well organized links to all other graphic levels with short descriptive labels.
   b. Import the Owner's logo and clearly show the project name.
3. Zone Graphics:
   a. Provide floor plan based graphics to show zones. Organize in a similar fashion to Contract Drawings and provide a sufficient scale so all information is easily readable and understandable.
   b. Provide links to all other zone graphics.
   c. Provide links to all individual zone terminal equipment.
   d. Show all zone terminal equipment information with blocks in the associated zone. Each block shall change color to indicate normal/alarm modes.

4. System Graphics:
   a. Each discreet system shall have a single graphic organized in schematic form accurately representing the installation configuration.
   b. Each system or piece of equipment that has been provided with 2-way communications such as through an RS 485 connection shall be provided with a dedicated graphic regardless of which contract it was provided under or if it was Owner/tenant provided.
   c. Provide links to all associated graphics (i.e., AHU to other AHU's and to exhaust systems, chilled water system to cooling tower system and hot water system).
   d. Locate pertinent information next to its associated graphic representation.
   e. Provide a link to a separate page that displays the system as-built sequence of operation.
5. Monitoring Graphics:
   a. Where equipment is monitored for specific information and no 2-way communication is available, it may be grouped on a floor plan or multiple plans.
6. Energy Usage Graphics:
   a. Provide separate graphics pages for the ongoing accountability of building energy usage and consumption over time. Building energy usage graphics shall be provided with hyperlinks to the main building graphics homepage to facilitate "user friendly" operations.
   b. Provide dynamic historical trending and totalization of each piece of equipment (energy use of each component). Totalize data for the continuous monitoring of metering equipment for constant and variable motor loads, VFD operation, cooling loads, AHU energy usage (air-side), air and water-side economizers, air distribution static pressure and air ventilation volumes.
   c. Monitor electrical system power and lighting system power consumption through each switchboard circuit breaker connection. Provide dynamic historical trending and totalization of each circuit.
   d. Coordinate data (run-time hours, electrical consumption, kW hours, kW/ton, kWH/year, $savings/year, etc.) with building energy model and the Commissioning Agent.
7. Show the block in its general location with an equipment label and normal and alarm color changing.
8. Custom Graphics: Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Designer or AutoCAD.
9. Graphics Library: Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

M. Programming

1. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.
2. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Use the following naming convention: AA.BBB.CCDDE where AA is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment, BBB is used to designate the mechanical system with which the point is associated (e.g., A01, HTG, CLG, LTG), CC represents the equipment or material referenced (e.g., SF for supply fan, RW for return water, EA for exhaust air, ZN for zone), D or DD may be used for clarification or for identification if more than one CC exists (e.g., SF10, ZNB), E represents the action or state of the equipment or medium (e.g., T for temperature, H for humidity, C for control, S for status, D for damper control, I for current).
3. Software Programming:
   a. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
      1 Text-based:
      2 Organized in single purpose blocks of programming.
      3 Must provide actions for all possible situations.
      4 Must be modular and structured.
      5 Must be commented with a description and purpose.
   b. Graphic-based:
      1 Organized in single purpose functional blocks.
      2 Must provide actions for all possible situations.
      3 Organize blocks in a neat flowing structure.
      4 Blocks must be annotated with a description and purpose in a text block.
      5 Must be documented.
4. Operator Interface:
   a. Standard Graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
   b. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point shown.
   c. The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this Section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.

N. Adjusting

1. Calibrating and Adjusting:
   a. Coordinate onsite time and integration of services with Division 23 Section "Testing, Adjusting, and Balancing of HVAC" to utilize and mutually support activities. Air and water devices requiring flow information for calibration (i.e., VAV box, flow station/meters, etc.) shall be calibrated in conjunction with TAB activities and shall not interfere with the work and general schedule of construction.
   b. Calibrate instruments.
   c. Make single-point calibration test for accuracy, plus testing of full span for each analog instrument.
   d. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
   e. Control System Inputs and Outputs:
      1 Check analog inputs at 0, 50, and 100 percent of span.
      2 Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
      3 Check digital inputs using jumper wire.
      4 Check digital outputs using ohmmeter to test for contact making or breaking.
      5 Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
   f. Flow:
      1 Set differential pressure flow transmitters for 0 and 100 percent values with single-point calibration accomplished at approximately mid-point of span, and check full span with an artificial signal generator.
      2 Manually operate flow switches to verify that they make or break contact.
   g. Pressure:
      1 Calibrate pressure transmitters at approximately mid-point of span, and check full span with an artificial signal generator.
      2 Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
   h. Temperature:
      1 Calibrate resistance temperature transmitters at approximately mid-point of span using a precision-resistance source, and check full span with an artificial signal generator.
      2 Calibrate temperature switches to make or break contacts.
   i. Stroke and adjust control valves and dampers, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
   j. Provide diagnostic and test instruments for calibration and adjustment of system.
   k. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

2. Adjust initial temperature and humidity set points.
3. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

O. Field Quality Testing

1. Perform the following field tests and inspections and prepare test reports:
   a. Category 5e UTP Cabling Tests:
      1 Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
      2 Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
      3 Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
      4 Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
   b. Category 6 UTP Cabling Tests:
      1 Tests shall include all tests of Category 5e, conducted from 1 to 250 MHz.
      2 Channel and permanent link tests shall be performed with at ester that complies with performance requirements in TIA/EIA-568-B.2, Level III. Include tests for longitudinal or transverse conversion loss.
      3 Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
2. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
3. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
4. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

P. STABILITY TRENDING SET-UP

1. Set up trending of points for confirmation of stability and control.
2. Trend three weeks of data as follows:
   a. Trend all analog input values on a 30 minute basis.
   b. Trend all digital input points on a change of value basis.
   c. Trend all analog virtual points on a 60 minute basis.
3. Test network capacity according to standards indicated during trending tests.

4. When trending indicates system instability for certain points, set-up additional trending for one week as follows to facilitate tuning and trouble-shooting:
   a. Trend all associated analog input points on a 10 minute basis.
   b. Trend all associated digital input points on a change of value basis.
   c. Trend all associated analog outputs on a 10 minute basis.
   d. Trend all associated digital outputs on a change of value basis.
   e. Trend all associated virtual analog points on a 10 minute basis.
   f. Trend all associated virtual digital points on a change of value basis.
5. Reporting system shall automatically email trend reports to the Engineer and the Commissioning Agent on a daily basis.
6. Continue trending as long as required to enable system stability and trouble shooting. Owner's representative must sign off.
7. Leave trending of point as directed by Owner's representative for long term information gathering.

Q. DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 for additional requirements.
2. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new outlets. Refer to Division 01 for additional requirements.

3.24 FINAL ACCEPTANCE

A. The HVAC Sub-Contractor shall leave all system components in proper working order, such as belt guards in place, access doors closed, doors to electrical switch boxes closed, thermostats restored to specified setting. All recorded data shall represent a true, actually measured, or observed condition. Any abnormal conditions in the mechanical systems or conditions that prevent total system balance shall be reported to the Architect immediately upon finding. The HVAC Sub-Contractor shall permanently mark all dampers and other adjustment devices in a manner that will allow the settings to be restored.

B. The HVAC Sub-Contractor shall verify control system operation as specified, and shall report all system problems and malfunctions. The verification and checkout of the control system shall be accomplished during the heating and cooling cycles of operation for an appropriate period of time to assure control response and overall stability.

C. The HVAC Sub-Contractor shall verify that all air systems are in compliance with all standards, such as ASHRAE minimum outside air, and all other applicable codes and requirements.

D. All filters shall be replaced by the HVAC Sub-Contractor before commencing.

E. The HVAC Sub-Contractor shall make any necessary changes in fan speed, and shall realign all belts when necessary.

3.25 AIR BALANCING

A. The HVAC Subcontractor shall employ an independent TAB Sub-Contractor, acceptable to and approved by the Architect/Engineer, to balance and adjust the air systems.

B. Balancing and adjusting shall not begin until all HVAC systems have been installed and are in full working order. Prior to the start of balancing, the following shall be checked:

1. Rotation of all fans.
2. Dampers are free to open and close
3. Clean filters are in place.

C. Upon completion of balancing and adjusting of the systems hereinafter specified, submit six (6) copies of the data for review and approval by the Architect/Engineer.

D. The TAB Sub-Contractor shall be procured early enough in the project to allow for him/her to review the project documents and determine if sufficient components are in place to balance and adjust the systems. The TAB Sub-Contract shall provide a list of any deficient are he/she identifies.

E. TAB Sub-Contractor shall provide all testing instruments, manpower, temporally connections and materials needed for balancing and adjusting of the air systems. All test instruments should have been calibrated within the last six (6) months. The TAB Sub-Contractor shall provide verification of calibration upon request.

F. Architect/Engineer and Owner shall be notified a minimum of five (5) days prior to balancing commencing so that a representative can be available to witness the balancing work. In addition, the TAB Sub-Contractor shall (upon completion of the balancing work and report submittal), at the request of the Architect/Engineer or Owner's representative, verify the balancing readings at four (4) locations. The locations shall be chosen by the Architect/Engineer or Owner's representative.

G. All balancing and adjusting of air systems shall be done in accordance with the latest edition of the NEBB procedural Standards for Testing, Adjusting and Balancing of Environmental systems or the latest edition of SMACNA's HVAC Systems Testing, Adjusting and Balancing.

1. Balancing of air systems with Constant Airflow Regulators shall follow the recommendations of the manufacturer American Aldes or approved substitute product.

H. Balancing of the cooling systems shall be performed in the air conditioning season, heating systems in the heating season.

I. Prior to balancing of the air systems, and as part of the balancing report, the TAB Sub-Contractor shall prepare ductwork schematics of the systems to be balanced. Schematics shall be similar to those indicated in the NEBB and SMACNA publications previously identified.

J. Air Balancing Report forms shall be similar to the standard NEBB and SMACNA forms found in the previously identified manuals. The following information shall be provided at minimum (reports for equipment and systems not indicated shall be obtained from the NEBB/SMACNA manuals or prepared by the TAB Sub-Contractor. Reports prepared by the TAB Sub-Contractor shall be submitted for review and approval prior to final Balancing Report submittal):

1. Air Apparatus Test Report
    a. Location.
    b. System Number.
    c. Manufacturer.
    d. Airflow - design and actual.
    e. Total CFM.
    f. Total Static pressure.
    g. Discharge Static Pressure.
    h. Suction Static Pressure.
    i. Coil pressure drops (static pressure).
    j. Filter pressure drops.
    k. Motor volts and amps.
    l. Outside Air and Return Air CFM.
    m. Drive data.
2. Fan Test Report
    a. System Number.
    b. Location.
    c. Manufacturer.
    d. Airflow - design and actual.
    e. Total static pressure - design and actual.
    f. Inlet static pressure.
    g. Discharge static pressure.
    h. Motor and Drive data.
    i. Fan RPM.
    j. Voltage and Amperage.
3. Duct Traverse
    a. System zone/branch.
    b. Duct Size.
    c. Area.
    d. Design Velocity.
    e. Design Airflow.
    f. Test Velocity.
    g. Test Airflow.
    h. Duct Static Pressure.
    i. Air temperature.
4. Air Outlet Report
    a. Area Served.
    b. Outlet Number.
    c. Type.
    d. Size.
    e. AK factor.

f. Velocity - design and actual.
g. Airflow - design and actual.

K. The TAB Sub-Contractor shall balance and adjust air systems to meet design requirements. ±5%. Balancing shall be accomplished by adjusting dampers, drives, etc. to obtain design requirements.

L. The HVAC Sub-Contractor shall cooperate and make provisions for the TAB Sub-Contractor as needed to accommodate the air balancing. As part of this Contract, the HVAC Sub-Contractor shall provide and/or change pulleys, belts and sheaves, and dampers, at no additional cost, in order to properly balance the systems to design requirements.

3.26 START UP AND TESTING OF COOLING AND HEATING EQUIPMENT

A. All cooling equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

B. All heating equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

C. The HVAC Sub-Contractor shall verify that all operating and safety controls are correctly adjusted.

D. The HVAC Sub-Contractor shall verify that the cooling equipment controls are operating properly.

E. Tests shall be made to verify that the capacity control is fully modulating according to the required load. Tests shall be made at minimum load, 50% load, 100% load and various other loads throughout the modulating cycle.

F. The HVAC Sub-Contractor shall record the following non-test data:

1. Equipment designation number.
2. Equipment manufacturer.
3. Model number.
4. Serial number.
5. Rated input.
6. Rated output.
7. All other pertinent data.

G. The HVAC Sub-Contractor shall perform and record the following to meet minimum requirements:

1. Verify proper system operation.
2. Verify that the cooling system controls are operating according to design specifications.
3. All other measurements required for complete system testing.

H. The HVAC Sub-Contractor shall calculate the system coefficient of performance as measured. All calculations made using the measured data shall be included in the report. In general, the HVAC Sub-Contractor shall complete all tests necessary for complete cooling and heating systems analysis.

3.27 COMMISSIONING OF HVAC EQUIPMENT AND SYSTEMS

A. TESTING PREPARATION

1. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
2. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
3. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
4. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
5. Inspect and verify the position of each device and interlock identified on checklists.
6. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
7. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

B. TESTING AND BALANCING VERIFICATION

1. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
2. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
3. During Functional Testing the CxA shall spot-check airflows and equipment operation. The TAB contractor shall be required to re-calibrate if any of the following instances occur:
   a. Any diffuser, grille, or other air flow device is excessively loud.
   b. Any item is observed to be operating improperly.
   c. A discrepancy between the recorded information on the TAB report and field observations during functional testing.

C. GENERAL TESTING REQUIREMENTS

1. Provide control system technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
2. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
3. Test operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
4. The CxA shall prepare detailed functional testing plans, for HVAC&R systems, subsystems, controls, and equipment.
5. Tests will be performed using design conditions whenever possible.

6. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. In most cases the artificial loads will be simulated by adjusting setpoints and manipulating controls. In some cases the contractor may be required to provide equipment to simulate loads.
7. The CxA may direct that set points be altered when simulating conditions is not practical.
8. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
9. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
10. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
11. If, in the CxA's sole judgment the systems or equipment fail to perform according to the design intent, a list of deficiencies will be generated which, when remedied, shall result in retesting of the deficiency, as well as the system as a whole.

3.28 SEQUENCES OF OPERATION *(Addendum #1)*

A. Refer to HVAC floor plans and Piping Schematics located on the drawings for equipment designations and locations.

B. Sequence Of Operation Documentation:

1. Submit written sequence of operation for the entire HVAC system and each piece of equipment.
   a. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
   b. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
   c. Include at least the following sequences:
      1 Start-up.
      2 Warm-up mode.
      3 Normal operating mode.
      4 Unoccupied mode.
      5 Shutdown.
      6 Capacity control sequences and equipment staging.
      7 Temperature and pressure control, such as setbacks, setups, resets, etc.
      8 Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
      9 Effects of power or equipment failure with all standby component functions.
      10 Sequences for all alarms and emergency shut downs.
      11 Seasonal operational differences and recommendations.
      12 Interactions and interlocks with other systems.
   d. Include initial and recommended values for all adjustable settings, setpoints and

parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.

e. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.

f. Include schedules, if known.

2. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.

a. Label with settings, adjustable range of control and limits.

b. Include flow diagrams for each control system, graphically depicting control logic.

c. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.

d. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

e. Include all monitoring, control and virtual points specified in elsewhere.

f. Include a key to all abbreviations.

3. Points List: Submit list of all control points indicating at least the following for each point.

a. Name of controlled system.

b. Point abbreviation.

c. Point description; such as dry bulb temperature, airflow, etc.

d. Display unit.

e. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.

f. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.

g. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.

h. Calculated point (Yes / No); i.e. a “virtual” point generated from calculations of other point values.

4. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

C. Common Requirements for Sequences of Operation: The following items are common requirements that apply unless noted otherwise:

1. All setpoints shall be program adjustable at the operator workstation.

2. All high and low limits shall be alarmed.

3. All cooling coils located in or over occupied spaces shall have a condensate pan high level alarm.

4. All fan proof of operation shall be by high and low current sensors.
5. All unit smoke detection, freeze protection, high condensate level and other emergency shutdown shall be done by hardwired relay interlock and shall not rely on control system programming.
6. All dampers shall have open and close status indication through end switches or integral actuator feature.
7. All dampers shall have an independent control point. Multiple dampers of different applications (i.e., outdoor, return, relief) controlled from a single point are not acceptable.
8. All air handling systems with ducted outdoor air shall be provided with freeze protection.

D. All spaces shall have the capability of being individually scheduled for Occupied and Unoccupied periods.

E. Variable Refrigerant Volume Heat Pump (VRV) System

1. The variable refrigerant volume heat pump system will have a manufacturer provided control system.
2. The ATC sub-contractor shall provide all required control wiring between air handlers, condensing units, control panels, etc., per the manufacturer's recommendations and requirements.
3. The HVAC sub-contractor shall provide the set-up of the VRV system manufacturer provided control system. The ATC sub-contractor shall assist the HVAC sub-contractor in identifying any requirements of the system for integration with the DDC system.
4. The variable refrigerant volume heat pump system shall operate on internal controls to modulate the compressors to provide heating or cooling as required.
5. Indoor Fan Coil Units
   a. The indoor units shall be controlled by MA controllers.
   b. During occupied periods, the indoor units shall operate to maintain the space controller heating and cooling setpoints.
   c. The space controller setpoint shall be determined by the central control system unless overridden at the space controller.
   d. During unoccupied periods, the indoor units shall operate to maintain the unoccupied setpoint temperature.
   e. Rooms with multiple indoor units shall have all units controlled from a single controller unless multiple controllers are indicated on the drawings.

F. Air Handler with Heating, Cooling and Energy Recovery (Gymnasium)

1. ERV's shall be provided with a communication card to allow interface with the DDC system.
2. ERV's shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When an ERV is energized:
   a. The supply and exhaust fans shall be energized and run continuously.
      1 The exhaust fan shall modulate as required to maintain the space at 0.05" SP above outdoors.

b. The ERV heating mode supply discharge air temperature setpoint shall be determined by the space demand. If the SAT is below the heating supply air temperature setpoint and the enthalpy wheel is energized, the heat pump and DX coil with associated LEV kits shall modulate to maintain the supply air temperature setpoint.
   1 If the ERV supply discharge air temperature is greater than the supply air heating mode temperature setpoint, the heat pump shall be de-energized.

c. The ERV cooling mode supply discharge air temperature setpoint shall be determined by the space demand. If the SAT is above the cooling supply air temperature setpoint and the enthalpy wheel is energized, the heat pump and DX coil with associated LEV kits shall modulate to maintain the supply air temperature setpoint.
   1 If the ERV supply discharge air temperature is less than the supply air cooling mode temperature setpoint, the heat pump shall be de-energized.

d. If the space RH level is greater than 55%RH (adjustable) the ERV shall operate in dehumidification mode, the heat pump and DX coil with associated LEV kits shall be energized at 100% and the reheat coil shall modulate to maintain the space cooling supply air temperature setpoint.
   1 When the space RH level drops to below 50% RH (adjustable) the dehumidification mode shall be disabled.

4. Enthalpy Wheel
   a. When the outdoor air temperature is between 65ºF and 75ºF (adjustable), the enthalpy wheel shall be de-energized.
5. When ERV is de-energized:
   a. The supply and exhaust fans shall be de-energized.
   b. The supply and exhaust dampers shall be closed.

G. Energy Recovery Ventilator (Locker Rooms)
1. ERV's shall be provided with a communication card to allow interface with the DDC system.
2. ERV's shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When an ERV is energized:
   a. The supply and exhaust fans shall be energized and run continuously.
      1 The exhaust fan shall be balanced to maintain the space at 0.05" SP above outdoors.
4. Enthalpy Wheel
   a. When the outdoor air temperature is between 65ºF and 75ºF (adjustable), the enthalpy wheel shall be de-energized.
5. When the ERV is de-energized:
   a. The supply and exhaust fans shall be de-energized.
   b. The supply and exhaust dampers shall be closed.

H. Energy Recovery Ventilator (Multipurpose Room)
1. ERV's shall be provided with a communication card to allow interface with the DDC system.

2. ERV's shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When an ERV is energized:
   a. The supply and exhaust fans shall be energized and run continuously.
      1 The supply fan shall modulate to maintain the supply air duct static pressure setpoint, initially 0.50" SP (final setpoint to be determined during balancing).
      2 The exhaust fan shall be balanced to maintain the space at 0.05" SP above outdoors.
4. Enthalpy Wheel
   a. When the outdoor air temperature is between 65ºF and 75ºF (adjustable), the enthalpy wheel shall be de-energized.
5. When the ERV is de-energized:
   a. The supply and exhaust fans shall be de-energized.
   b. The supply and exhaust dampers shall be closed.

I. Constant Volume Regulators (CVR)

1. Two stage regulators shall have the first stage open at all times. The second stage (booster) damper shall be interlocked with the associated space's occupancy sensor (room or lighting fixture) and shall open the second stage damper when occupancy is sensed. The damper shall close when the occupancy period ends.
2. Multi-Purpose Room
   a. The space mounted CO2 sensors shall control operation of the associated outside air CVR damper.
   b. During Occupied periods the supply CVR damper shall open to the minimum airflow.
   c. On a rise in space CO2 above 900 ppm (adjustable) the CVR damper shall modulate open.
   d. On a drop in space CO2 below 600 ppm (adjustable) the CVR damper shall modulate to the minimum airflow position.
   e. The exhaust CVR damper shall track the supply CVR damper.

J. Electric Heating Devices

1. Electric heating devices shall be controlled by their integral or space mounted thermostats.
2. On a demand for space heating the fan and heating element shall be energized.
   a. When the space temperature is satisfied the fan and the heating element shall be deenergized.

K. Air Curtain

1. The air curtain shall be controlled by a door switch. When the door is open the unit shall be energized and run continuously.

L. Exhaust Fans

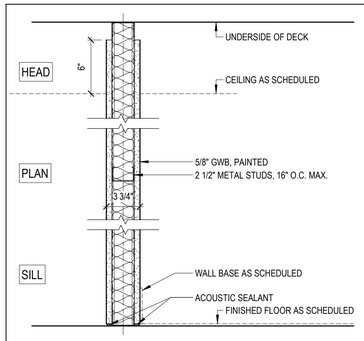
1. Exhaust fan EF-B01 & EF-B02 shall be controlled by the associated temperature & humidity sensor.
   a. If the space temperature rises above 80°F (adjustable) or the space humidity level

rises above 55% RH (adjustable) the fan shall be energized and run continuously and the outside air intake louver motor operated damper shall open.

b. When the space temperature drops below 75°F (adjustable) or the space RH level drops to below 50% RH (adjustable) the fan shall be deenergized.

2. Destratification Fans (DF)
   a. If the associated heat/cool system is in heating mode and the temperature at the DF is 10°F (adjustable) above the space temperature (measured at the thermostat/sensor) the fan shall be energized and run continuously.
3. Data Closet
   a. If the space temperature rises above 80°F (adjustable) the fan shall be energized and run continuously.
      1 When the space temperature drops below 75°F (adjustable) the fan shall be deenergized.
4. Restrooms
   a. If the lights are turned on the fan shall be energized and run continuously.
      1 When the lights are turned off the fan shall continue to run for 10 minutes (adjustable) and then be deenergized.

- END OF SECTION -



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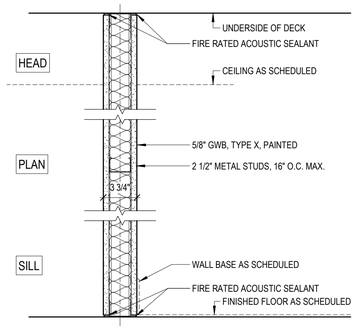

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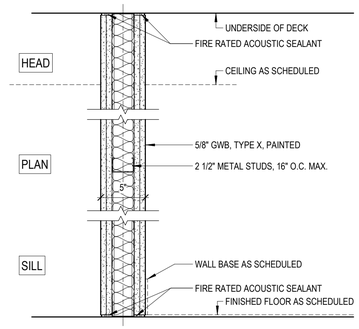

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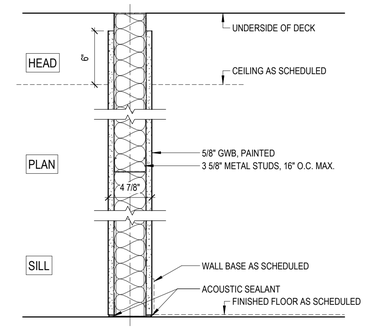

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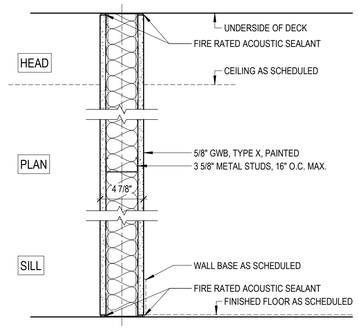

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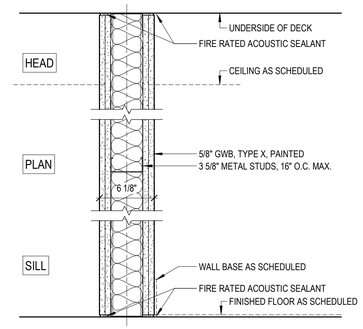

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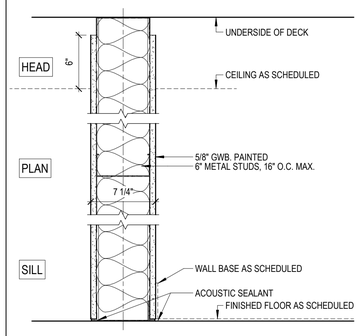

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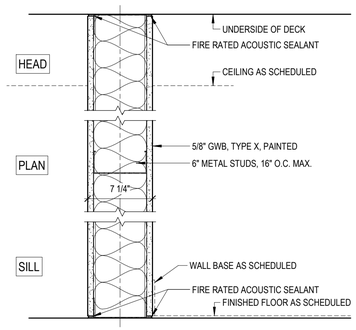

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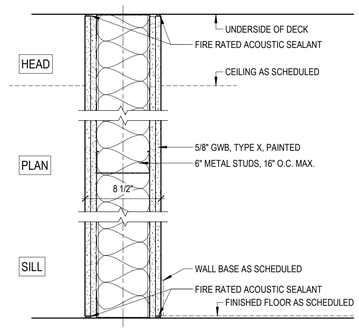

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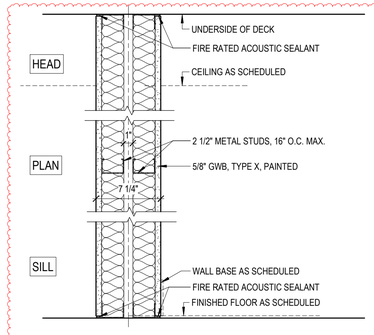

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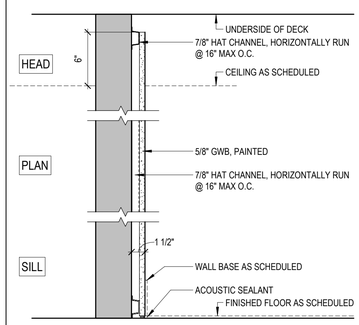

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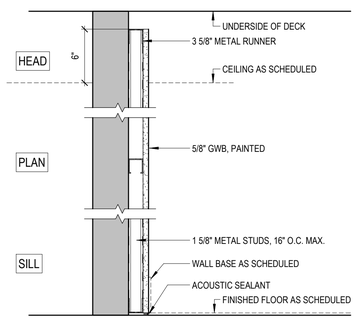

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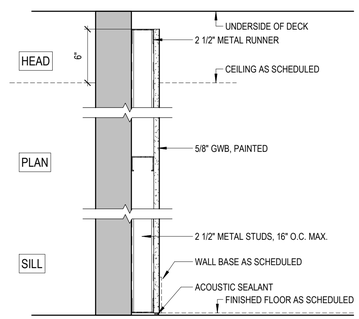

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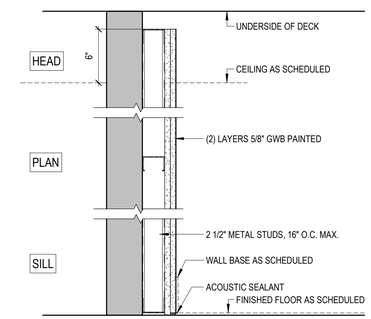

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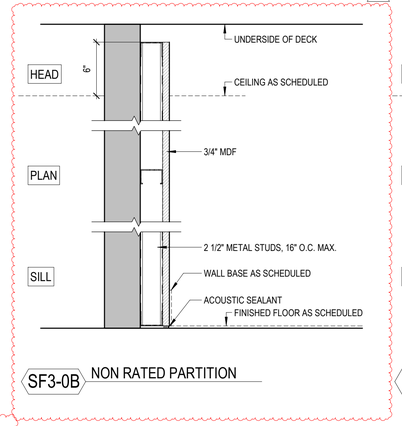

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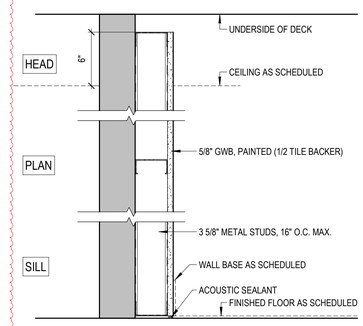

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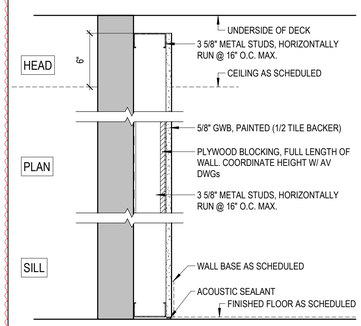

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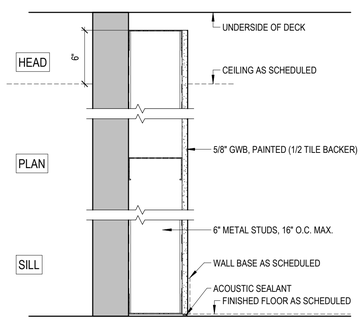

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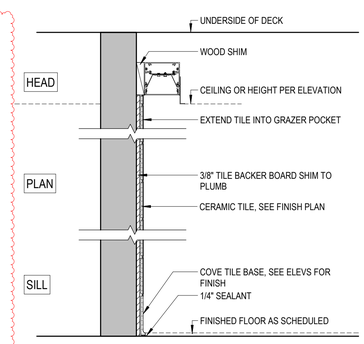
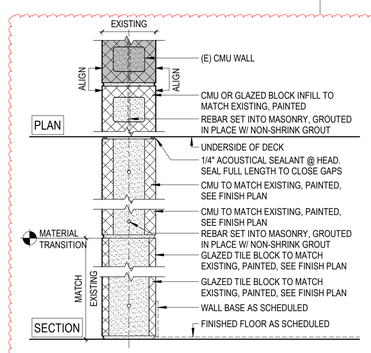


T-1 TILE BACKER @ TILE

TYPICAL @ MASONRY WALLS



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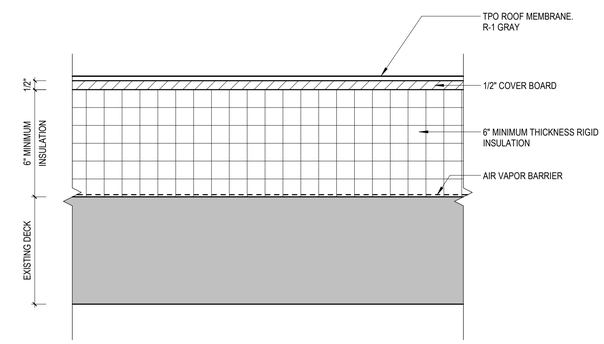

R-1 - Typical Roof Assembly

ARCHITECT

bh+a

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Boston, MA 02210
(617) 350 0450

PROJECT NAME

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CLIENT

City of Providence

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Land Surveyor
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401-683-6630

Structural Engineer
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617-926-9300

MEP/FP Engineer
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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE

Partition & Roof Types

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

As indicated	Author
SCALE	DRAWN BY
3524	3524 - Davey Lopes v24_Educational.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

A006

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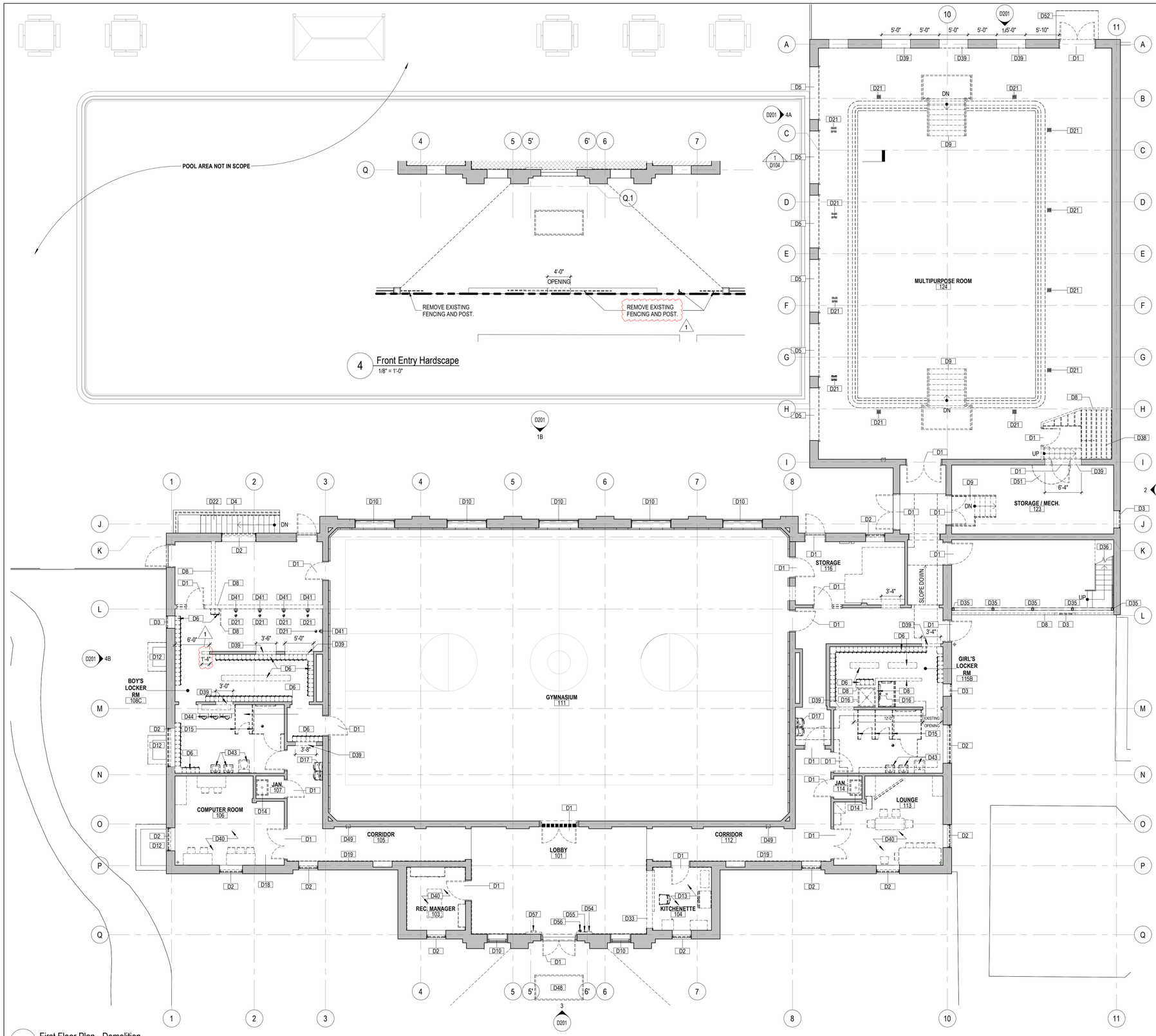
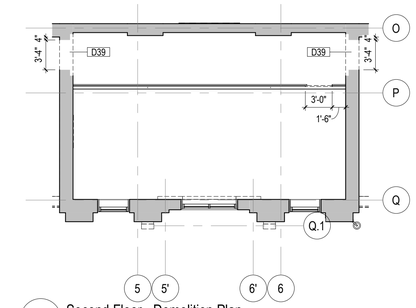


4 Front Entry Hardscape
1/8" = 1'-0"

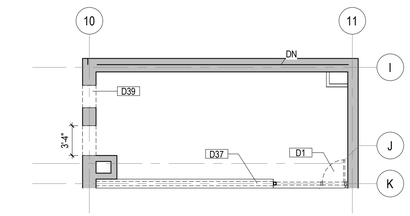
1 First Floor Plan - Demolition
1/8" = 1'-0"

DEMOLITION LEGEND

- EXISTING WALL TO BE REMOVED
- EXISTING TO REMAIN
- EXISTING DOOR AND FRAME TO BE REMOVED



2 Second Floor - Demolition Plan
1/8" = 1'-0"



3 Mezzanine - Demolition Plan
1/8" = 1'-0"

Keynote Schedule - Demolition

KEY VALUE	KEYNOTE
D1	REMOVE AND DISPOSE OF EXISTING DOOR, FRAME ANCHORAGES, AND GROUT.
D2	REMOVE AND DISPOSE OF EXISTING WINDOW, GLAZING, SECURITY SCREENS, AND ANCHORAGES.
D3	REMOVE AND DISPOSE OF EXISTING LOUVER, ASSOCIATED TRIM, AND FASTENERS.
D4	REMOVE EXISTING AREAWAY RAILINGS.
D5	REMOVE AND DISPOSE OF EXISTING OVERHEAD DOOR TRACKS. EXISTING DOORS AND MURALS TO REMAIN. PROTECT DURING DEMOLITION.
D6	REMOVE AND DISPOSE OF EXISTING LOCKERS AND BENCHES.
D8	REMOVE AND DISPOSE OF EXISTING WALL.
D9	REMOVE AND DISPOSE OF EXISTING STAIR, RAILINGS, AND ASSOCIATED STRUCTURE.
D10	EXISTING WINDOWS TO REMAIN. PROTECT DURING DEMOLITION.
D12	REMOVE EXISTING WOOD AREAWAY COVERS.
D13	REMOVE AND DISPOSE OF EXISTING APPLIANCES, CASEWORK, AND KITCHEN EQUIPMENT.
D14	REMOVE AND DISPOSE OF EXISTING SLOP SINK.
D15	REMOVE AND DISPOSE OF EXISTING TOILET PARTITIONS, DOORS, GRAB BARS, AND ACCESSORIES.
D16	REMOVE AND DISPOSE OF EXISTING SHOWER PANS AND ASSOCIATED PLUMBING FIXTURES.
D17	REMOVE AND SALVAGE EXISTING WATER FOUNTAIN.
D18	REMOVE AND DISPOSE OF EXISTING EPOXY FLOORING AND WOOD BASE.
D19	REMOVE AND DISPOSE OF EXISTING WALL BASE THROUGHOUT EXCEPT IN GYMNASIUM
D21	REMOVE AND DISPOSE OF EXISTING FLOOR DRAINS AND ASSOCIATED PIPING. CUT AND CAP AT EXTERIOR WALL.
D22	
D33	REMOVE AND DISPOSE OF WALL INFILL.
D35	EXISTING STEEL FRAME TO REMAIN. PROTECT DURING DEMOLITION.
D36	EXISTING STAIR TO REMAIN. PROTECT DURING DEMOLITION.
D37	REMOVE AND DISPOSE OF PARTITION. LEAVE STRUCTURE IN PLACE.
D38	REMOVE AND DISPOSE OF EXISTING MEZZANINE FLOOR, STAIR, AND ASSOCIATED STRUCTURE.
D39	REMOVE AND DISPOSE OF EXISTING EXTERIOR MASONRY WALL.
D40	REMOVE EXISTING FURNITURE AND EQUIPMENT. COORDINATE DISPOSAL/SALVAGING WITH OWNER.
D41	REMOVE AND DISPOSE OF EXISTING SHOWER FIXTURES AND ASSOCIATED PIPING.
D43	EXISTING SINKS TO REMAIN. PROTECT DURING DEMOLITION.
D44	REMOVE AND SALVAGE EXISTING URINALS.
D48	REMOVE AND DISPOSE OF EXISITNG EXTERIOR PAVING AND PLANTER AT MAIN ENTRANCE.
D49	REMOVE AND SALVAGE EXISTING FEC.
D51	REMOVE AND DISPOSE OF MASONRY AND CONCRETE WELL.
D52	REMOVE AND DISPOSE OF SLAB ON GRADE
D54	REMOVE AND SALVAGE ANNUNCIATOR
D55	REMOVE AND SALVAGE PULL STATION
D56	REMOVE AND SALVAGE FIRE EXTINGUISHER
D57	REMOVE AND SALVAGE OPIOID RESCUE KIT

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City of Providence

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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE

First Floor Demolition Plan

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/8" = 1'-0"
SCALE

Author
DRAWN BY

3524
PROJECT #

3524 - Davey Lopes v24_Educational.rvt
FILE NAME

DRAWING NUMBER

D101

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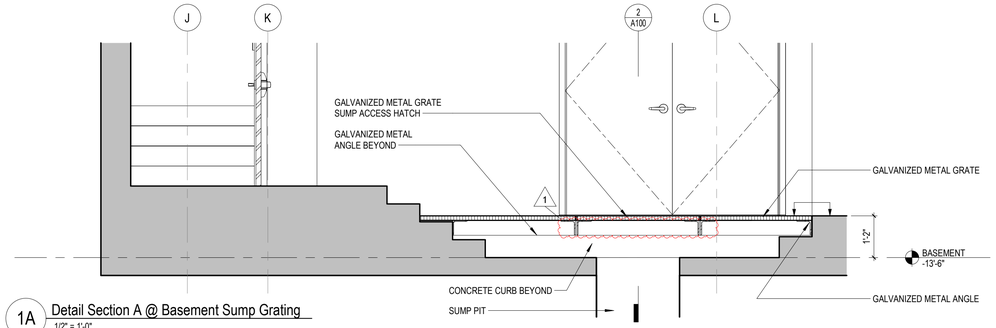
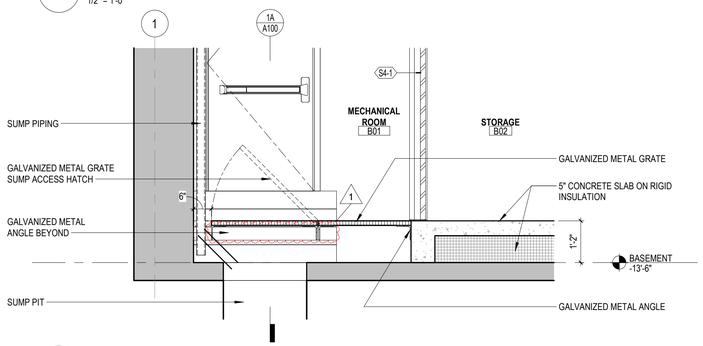
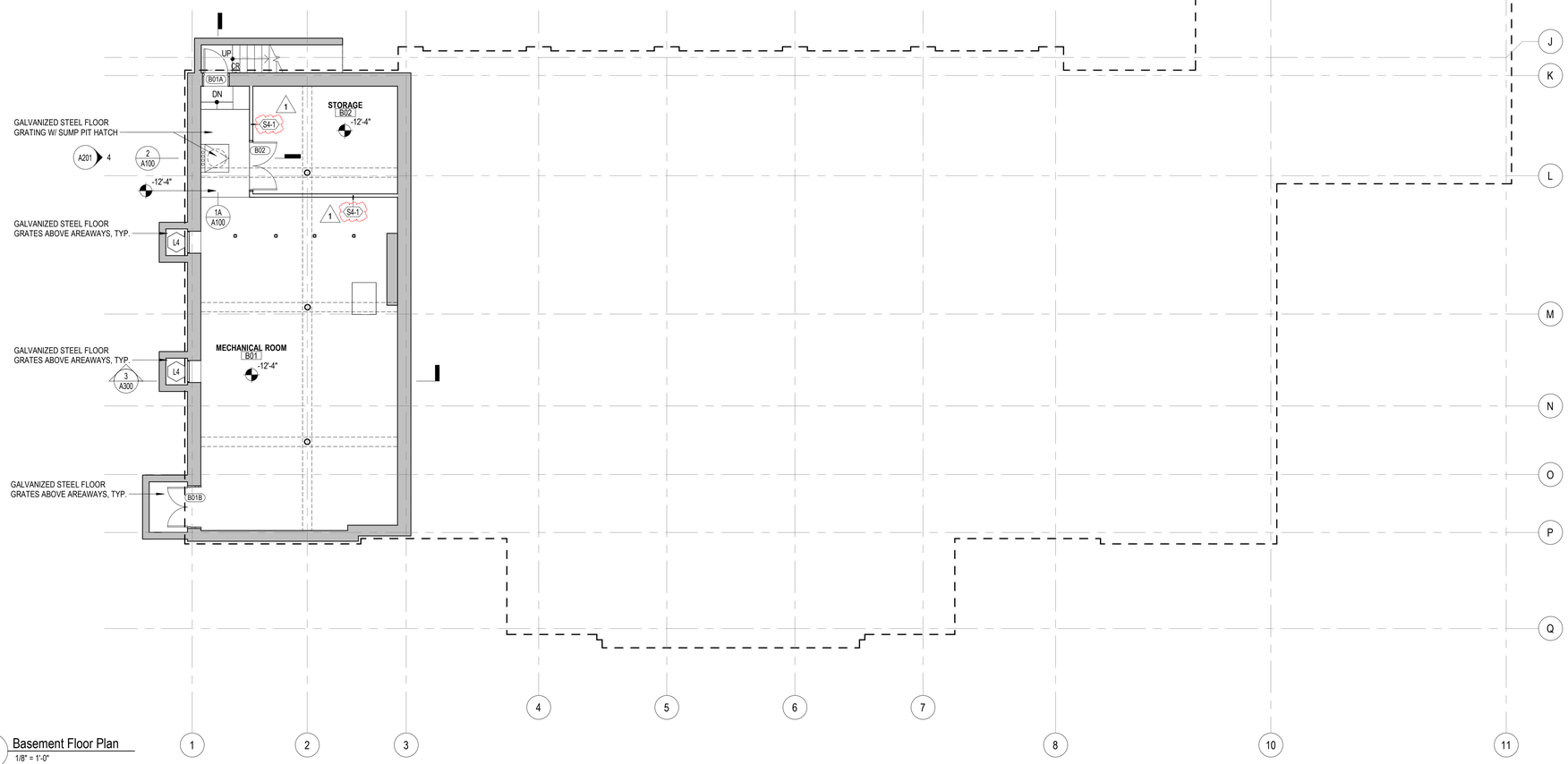


1A Detail Section A @ Basement Sump Grating
1/2" = 1'-0"



2 Detail Section B @ Basement Sump Grating
1/2" = 1'-0"



1 Basement Floor Plan
1/8" = 1'-0"

GENERAL NOTES

SEE SHEET SERIES **A400** FOR ENLARGED PLANS.

INDICATES AREA OF RAISED SLAB.

INDICATES AREA OF HOUSEKEEPING PAD. SIZES INDICATED ARE FOR GRAPHICAL REPRESENTATION ONLY. SIZES TO BE COORDINATED IN FIELD.

WALL HATCH LEGEND

EXISTING FRAMING/WALLS TO REMAIN

NEW CONSTRUCTION / WALLS

2HR RATED CHASE, REFER TO ENLARGED PLANS AND DETAILS.

0' 4' 8' 16'

N

ARCHITECT

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REVISIONS

1	Addendum 1	05/16/2025

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Basement Plan

DRAWING INFORMATION

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DESCRIPTION

As indicated
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Author
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3524 - Davey Lopes v24_Educational.rvt
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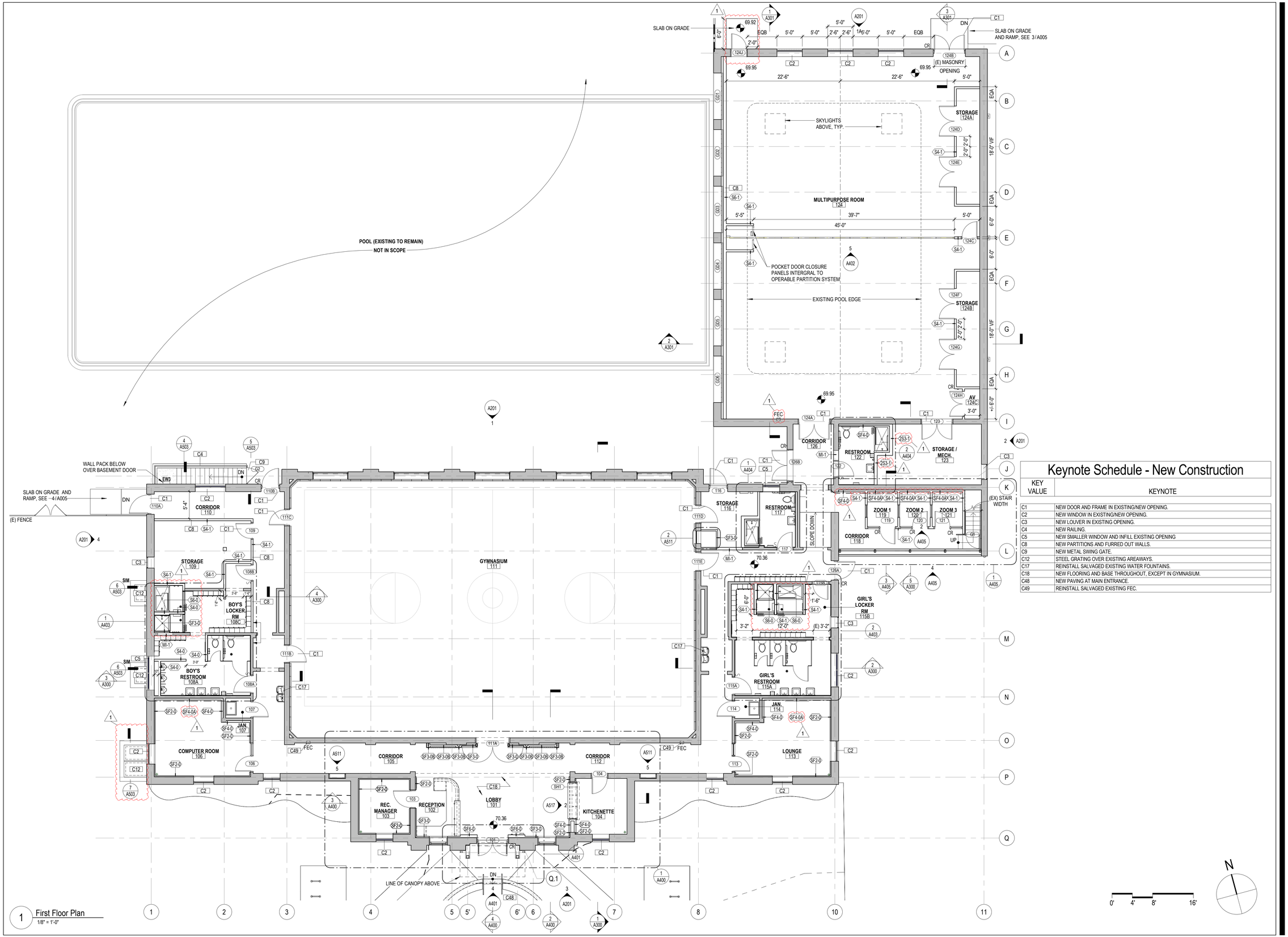

1 First Floor Plan
1/8" = 1'-0"

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C1	NEW DOOR AND FRAME IN EXISTING/NEW OPENING.
C2	NEW WINDOW IN EXISTING/NEW OPENING.
C3	NEW LOUVER IN EXISTING OPENING.
C4	NEW RAILING.
C5	NEW SMALLER WINDOW AND INFILL EXISTING OPENING
C8	NEW PARTITIONS AND FURRED OUT WALLS.
C9	NEW METAL SWING GATE.
C12	STEEL GRATING OVER EXISTING AREAWAYS.
C17	REINSTALL SALVAGED EXISTING WATER FOUNTAINS.
C18	NEW FLOORING AND BASE THROUGHOUT, EXCEPT IN GYMNASIUM.
C48	NEW PAVING AT MAIN ENTRANCE.
C49	REINSTALL SALVAGED EXISTING FEC.

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1	Addendum 1	05/16/2025

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First Floor Plan

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05/16/2025
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1/8" = 1'-0"
SCALE

Author
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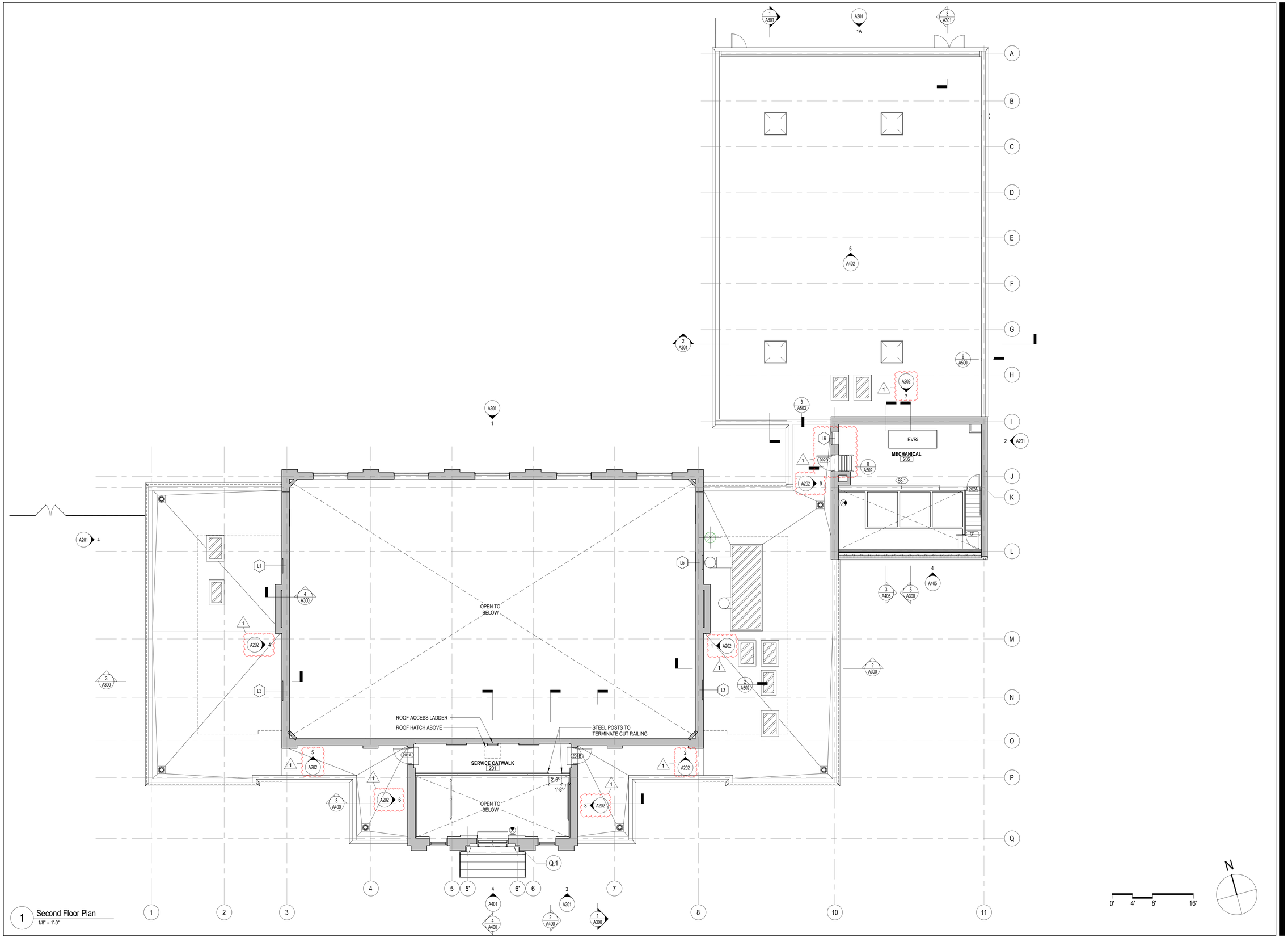

1 Second Floor Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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DRAWING TITLE

Second Floor Plan

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1/8" = 1'-0"	Author
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3524	3524 - Davey Lopes
PROJECT #	FILE NAME

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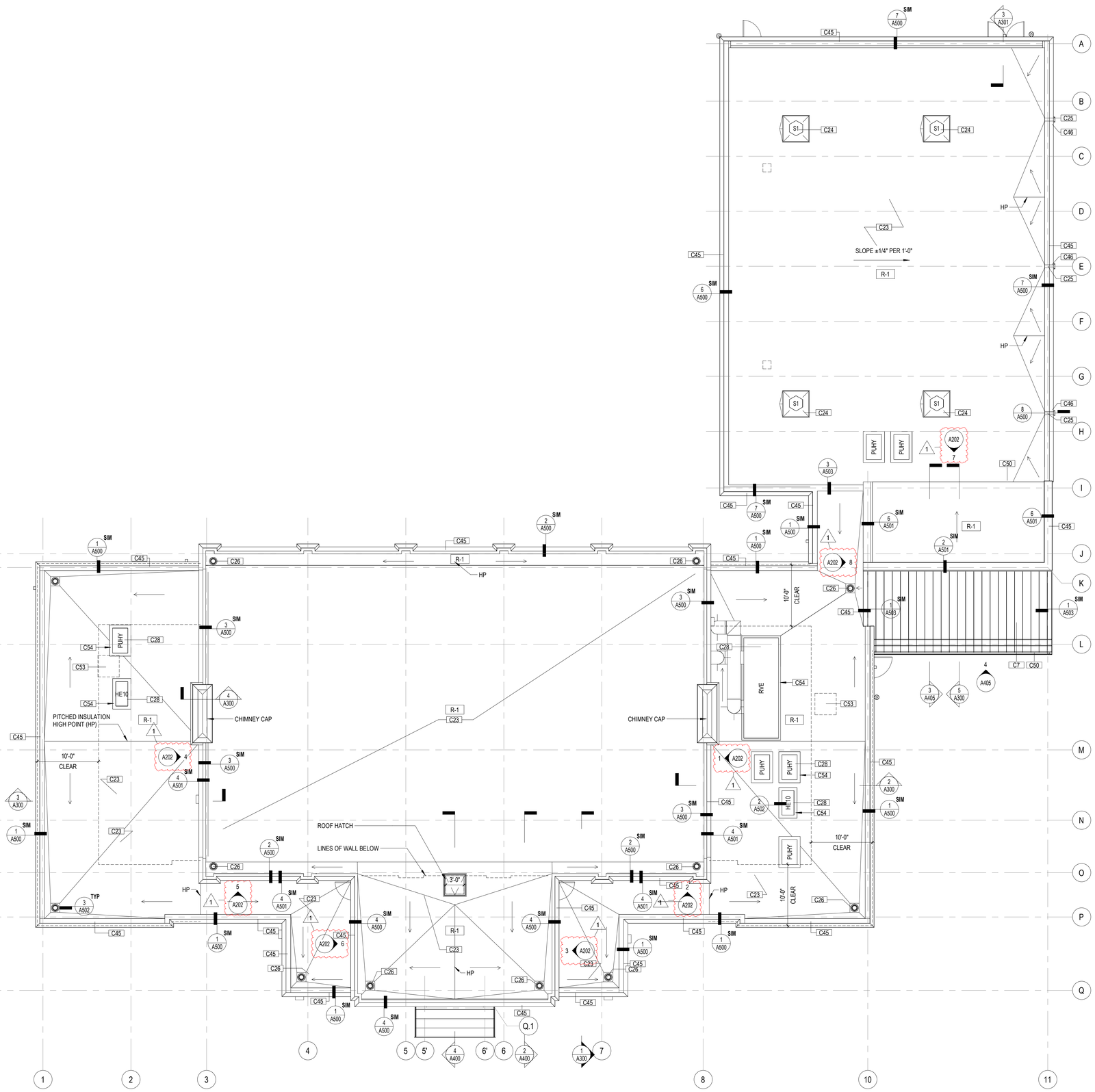

1 Roof Plan
1/8" = 1'-0"

ROOF PLAN LEGEND

R-1 TPO ROOF ASSEMBLY - GRAY

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C7	NEW STANDING SEAM METAL ROOF.
C23	NEW TPO ROOFING MEMBRANE, INSULATION AND ASSOCIATED FASTENERS AND TRIM, THROUGHOUT.
C24	NEW SKYLIGHTS IN EXISTING OPENINGS, TYP. OF 4.
C25	NEW THROUGH WALL SCUPPERS.
C26	NEW ROOF DRAINS.
C28	NEW MECHANICAL EQUIPMENT AND DUCTWORK THROUGHOUT. SEE MECHANICAL DRAWINGS.
C45	NEW ROOF EDGE FLASHING AND PREFINISHED METAL TRIM.
C46	NEW PREFINISHED ALUMINUM DOWNSPOUT.
C50	NEW PREFINISHED ALUMINUM GUTTER.
C53	INFILL SLAB AT EXISTING CUTOUT. MATCH EXISTING THICKNESS.
C54	MECHANICAL EQUIPMENT PAD.

ROOF NOTES

1. ALL ROOFTOP EQUIPMENT ON INSULATED CURBS
2. ALL ROOF SLOPES TO 1/4" PER FOOT, MINIMUM
3. MINIMUM ROOF INSULATION THICKNESS TO BE 6"
4. MINIMUM ROOF INSULATION AT DRAIN SUMPS TO BE 2"

0' 4' 8' 16'

N

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REVISIONS

1	Addendum 1	05/16/2025

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Roof Plan

DRAWING INFORMATION

05/16/2025
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1/8" = 1'-0" — SCALE
Author — DRAWN BY
3524 — PROJECT #
3524 - Davey Lopes v24_Educational.rvt — FILE NAME

DRAWING NUMBER

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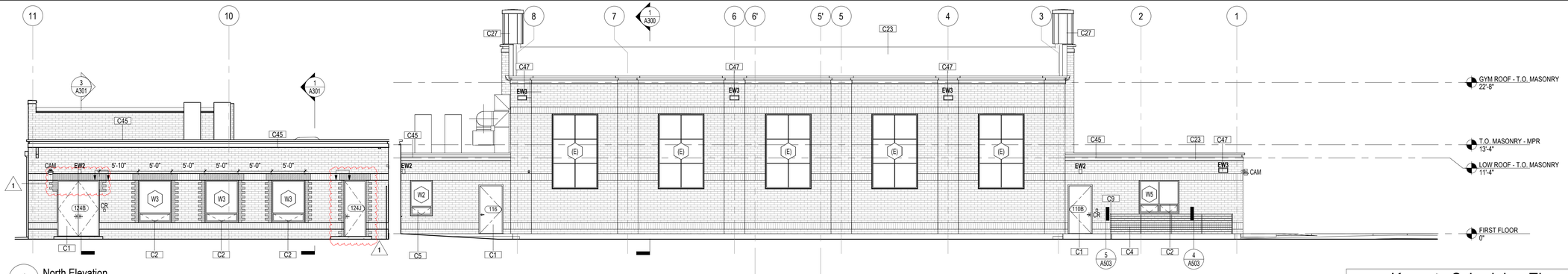
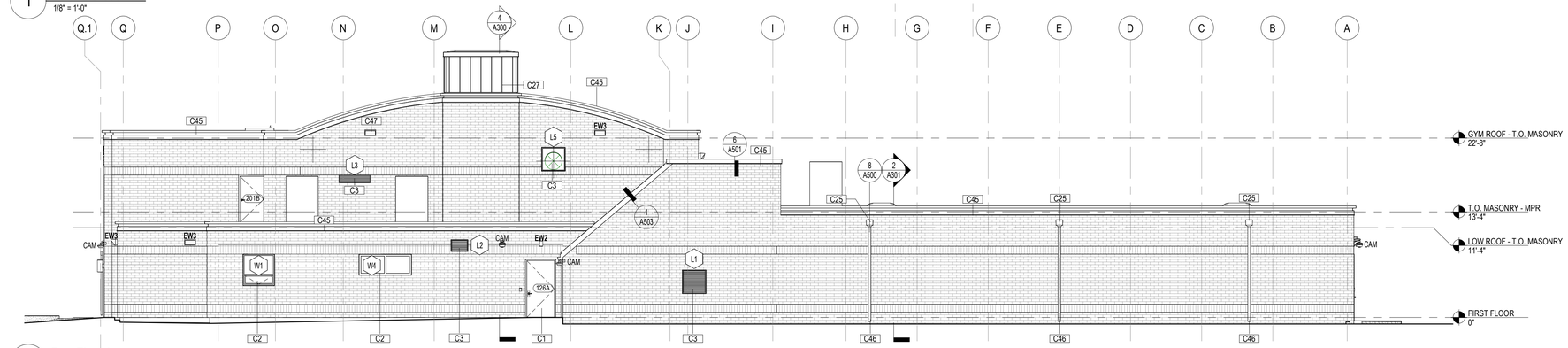
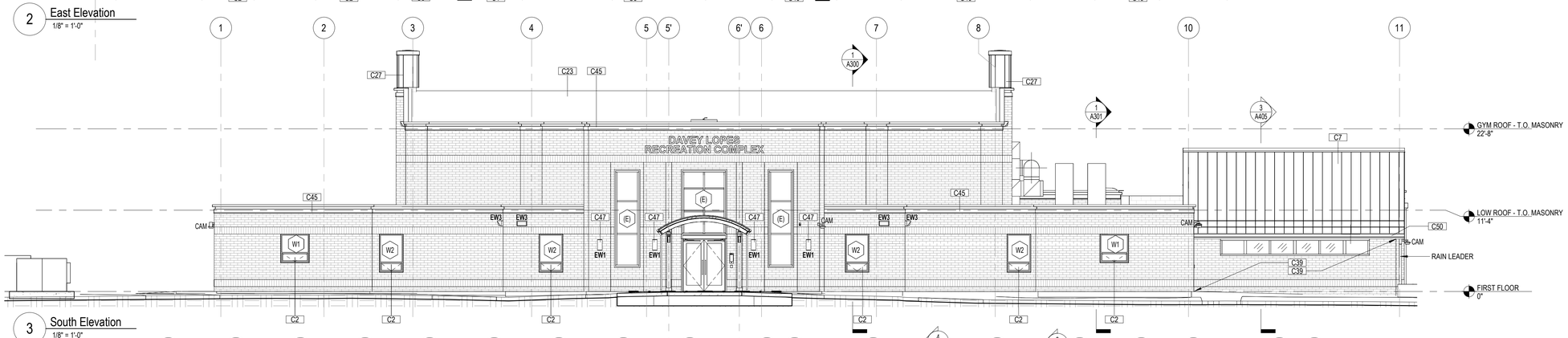


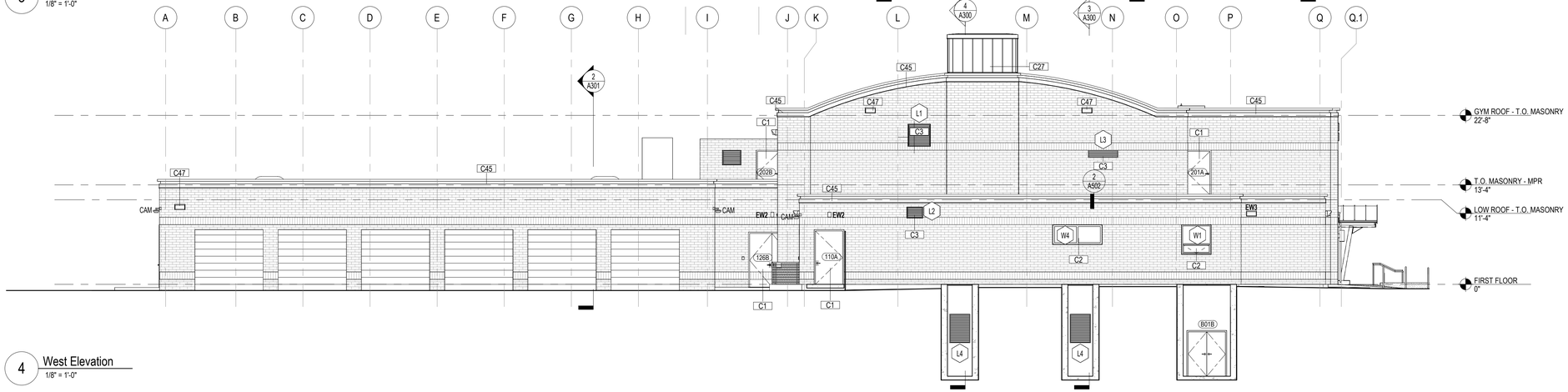
1 North Elevation
1/8" = 1'-0"



2 East Elevation
1/8" = 1'-0"



3 South Elevation
1/8" = 1'-0"



4 West Elevation
1/8" = 1'-0"

Keynote Schedule - Elevations

C1	NEW DOOR AND FRAME IN EXISTING/NEW OPENING.
C2	NEW WINDOW IN EXISTING/NEW OPENING.
C3	NEW LOUVER IN EXISTING OPENING.
C4	NEW RAILING.
C5	NEW SMALLER WINDOW AND INFILL EXISTING OPENING
C7	NEW STANDING SEAM METAL ROOF.
C9	NEW METAL SWING GATE.
C23	NEW TPO ROOFING MEMBRANE, INSULATION AND ASSOCIATED FASTENERS AND TRIM, THROUGHOUT.
C25	NEW THROUGH WALL SCUPPERS.
C27	NEW STANDING SEAM METAL FINISH ON EXISTING CHIMNEY.
C39	NEW EXTERIOR WALL ASSEMBLY AND WINDOWS.
C45	NEW ROOF EDGE FLASHING AND PREFINISHED METAL TRIM.
C46	NEW PREFINISHED ALUMINUM DOWNSPOUT.
C47	NEW LIGHT FIXTURES PER SCHEDULE.
C50	NEW PREFINISHED ALUMINUM GUTTER.

BRICK SCOPE LEGEND

NEW BRICK TO MATCH EXISTING

GENERAL ELEVATION NOTES

1. ALL HIGH DENSITY FIBER CEMENT PANELS TO HAVE COLOR. SEE ELEVATIONS.
2. ALL ALUMINUM LOUVERS TO HAVE COLOR 6 PER FINISH SCHEDULE A700 UNLESS NOTED OTHERWISE.
3. ALL ALUMINUM WINDOWS TO HAVE FRAMES COLOR 7 PER FINISH SCHEDULE A700 UNLESS NOTED OTHERWISE.
4. ALL EIFS TO HAVE COLOR 8 AND COLOR 9 PER FINISH SCHEDULE A700.
5. ALL EXTERIOR HOLLOW METAL DOORS AND FRAMES TO BE PAINTED COLOR 10 PER FINISH SCHEDULE A700.

0' 4' 8' 16'

ARCHITECT

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PROJECT NAME

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REVISIONS

1	Addendum 1	05/16/2025

DATE

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Building Elevations

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05/16/2025
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Author — DRAWN BY
3524 — PROJECT #
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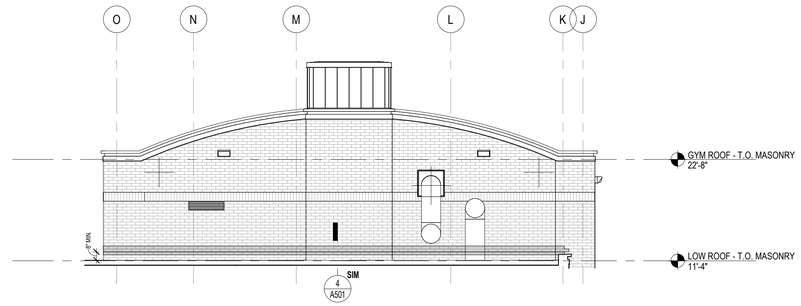
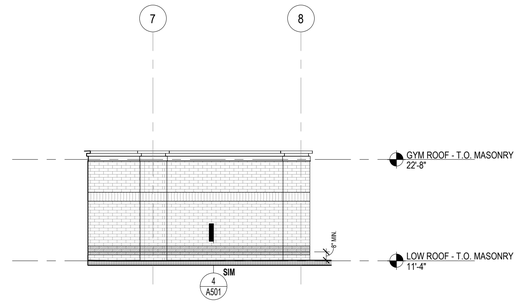
BRICK SCOPE LEGEND

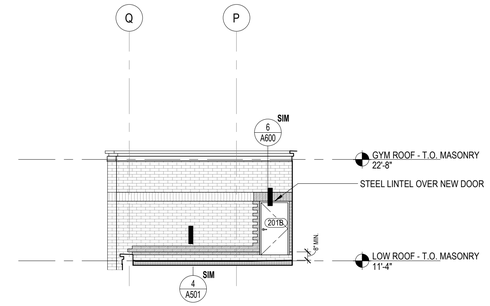
NEW BRICK TO MATCH EXISTING



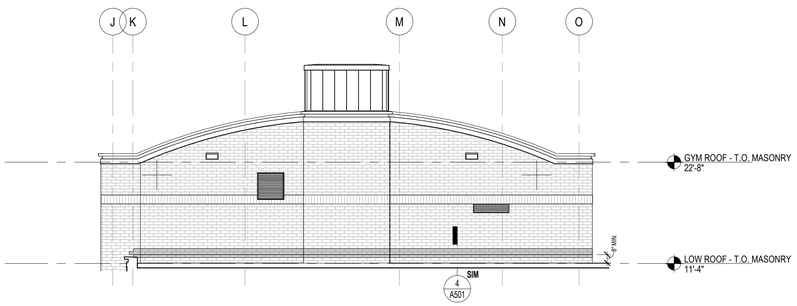
1 Brick Work - Gym - East Elevation
1/8" = 1'-0"



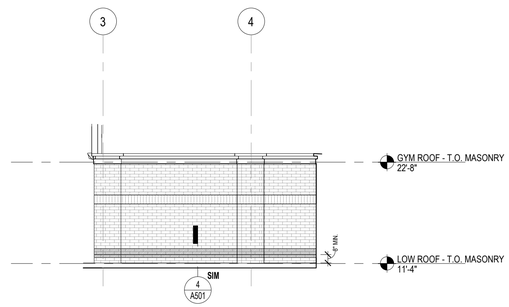
2 Brick Work - Gym - South Elevation 1
1/8" = 1'-0"



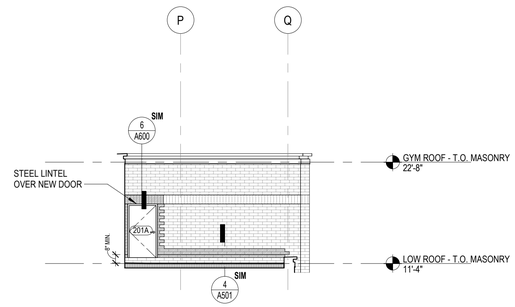
3 Brick Work - Lobby - East Elevation
1/8" = 1'-0"



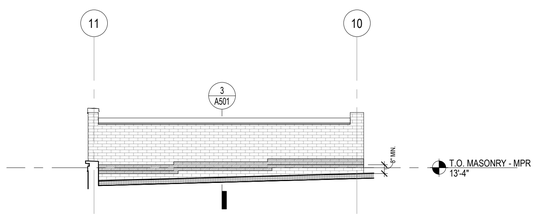
4 Brick Work - Gym - West Elevation
1/8" = 1'-0"



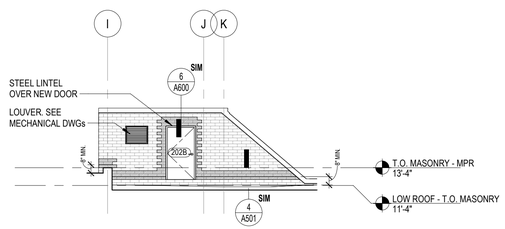
5 Brick Work - Gym - South Elevation 2
1/8" = 1'-0"



6 Brick Work - Lobby - West Elevation
1/8" = 1'-0"



7 Brick Work - Mezzanine - North Elevation
1/8" = 1'-0"



8 Brick Work - Mezzanine - West Elevation
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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Building Elevations - Brick Work

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Construction Documents
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3524	3524 - Davey Lopes v24_Educational.rvt
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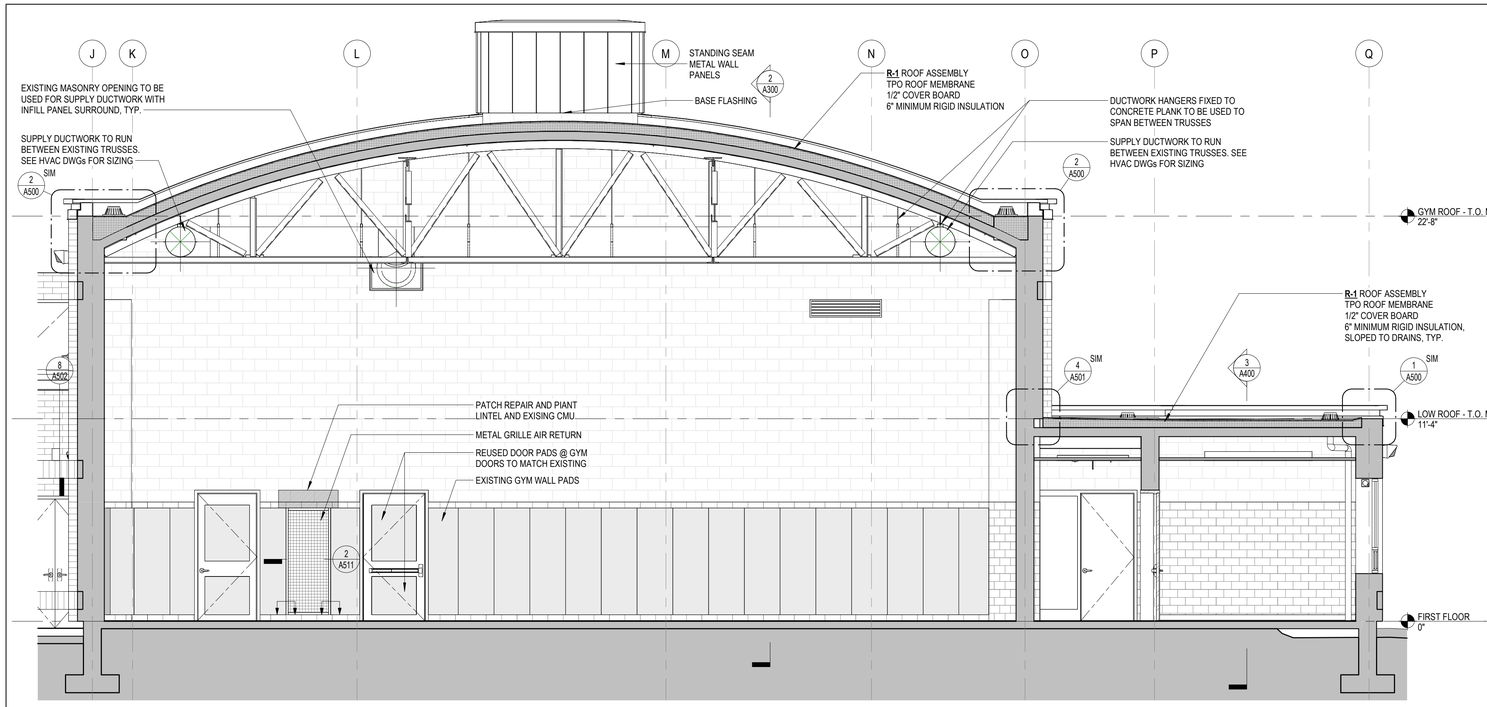
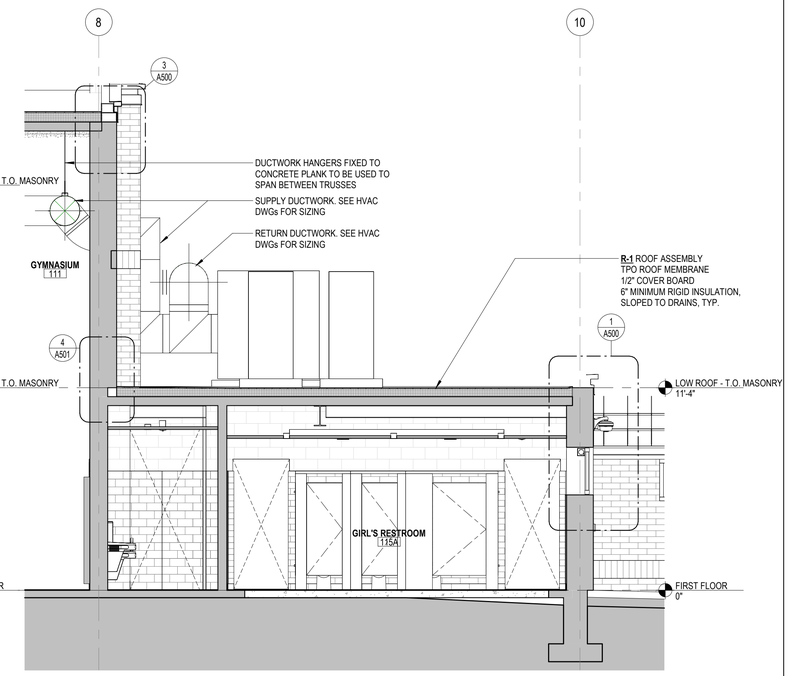
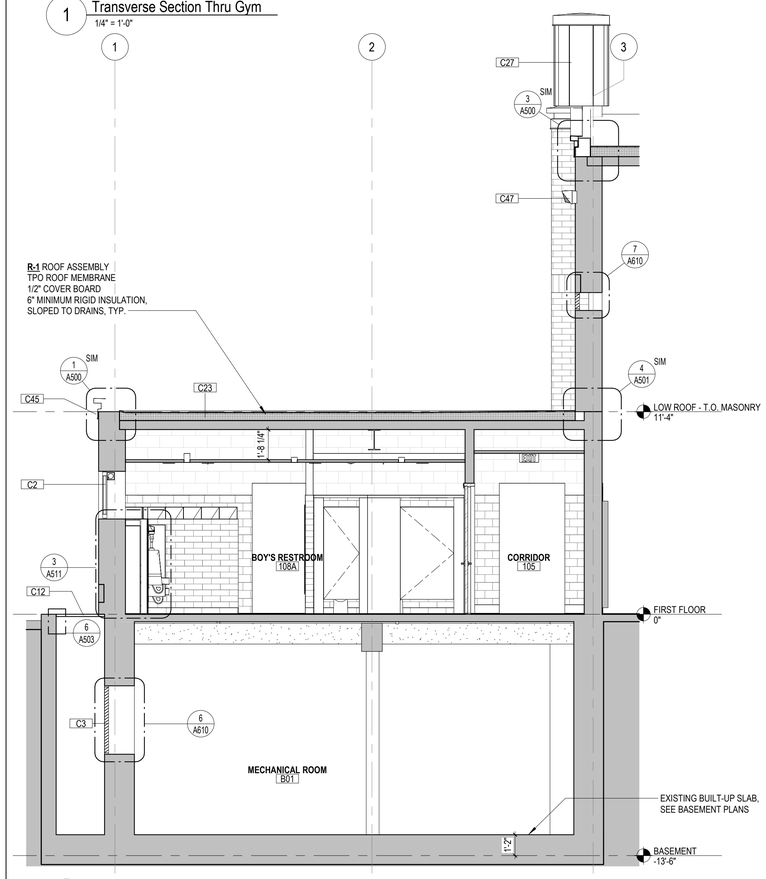


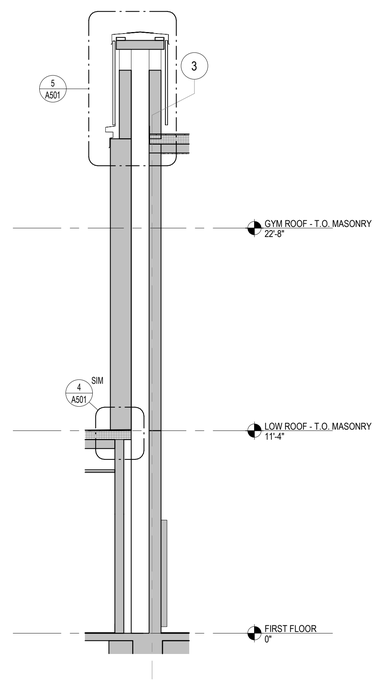
1 Transverse Section Thru Gym
1/4" = 1'-0"



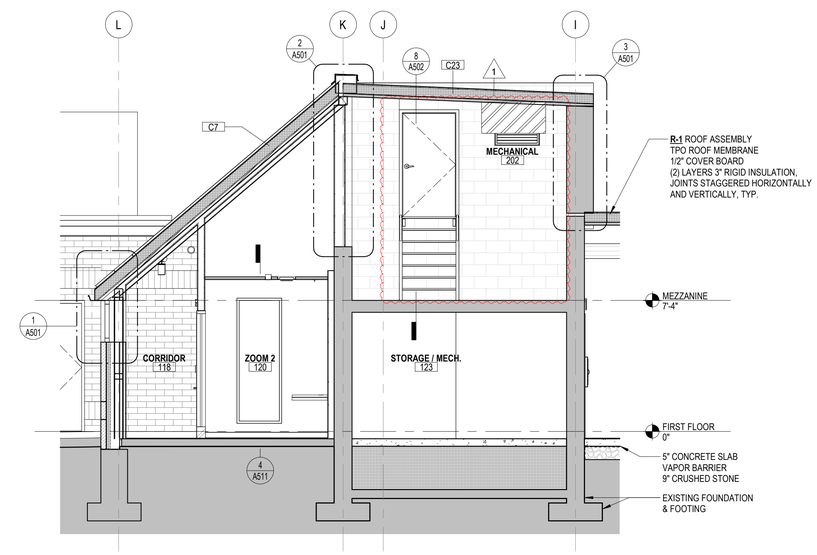
2 Section @ East
1/4" = 1'-0"



3 Section @ West
1/4" = 1'-0"



4 Section Thru Chimney
1/4" = 1'-0"



5 Section @ Zoom Rooms Looking West
1/4" = 1'-0"

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C2	NEW WINDOW IN EXISTING/NEW OPENING.
C3	NEW LOUVER IN EXISTING OPENING.
C7	NEW STANDING SEAM METAL ROOF.
C12	STEEL GRATING OVER EXISTING AREAWAYS.
C23	NEW TPO ROOFING MEMBRANE, INSULATION AND ASSOCIATED FASTENERS AND TRIM, THROUGHOUT.
C27	NEW STANDING SEAM METAL FINISH ON EXISTING CHIMNEY.
C45	NEW ROOF EDGE FLASHING AND PREFINISHED METAL TRIM.
C47	NEW LIGHT FIXTURES PER SCHEDULE.

0' 4' 8' 16'

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5/16/2025 3:59:12 PM
Author

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PROJECT NAME
Davey Lopes Recreation Center
227 Dudley Street
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CLIENT
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25 Dorrance Street
Providence, RI 02903

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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE
Partial Building Sections

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/4" = 1'-0"
SCALE

Author
DRAWN BY

3524
PROJECT #

3524 - Davey Lopes v24_Educational.rvt
FILE NAME

DRAWING NUMBER
A300

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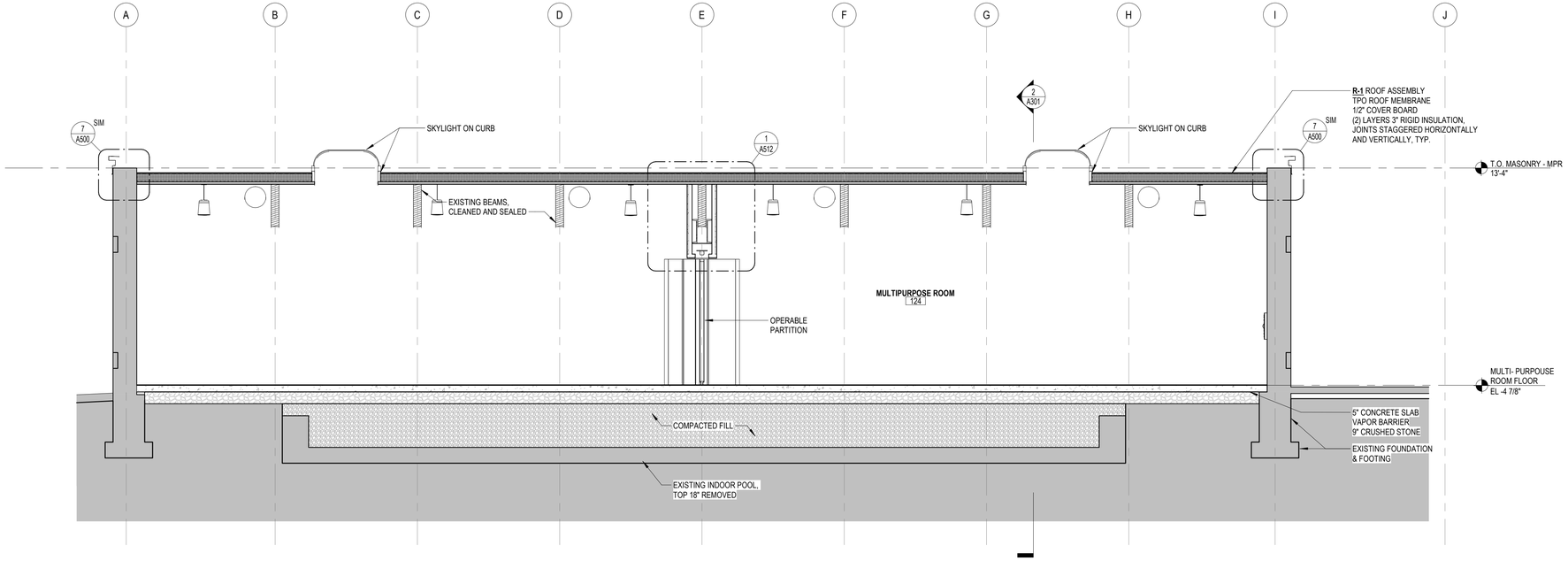
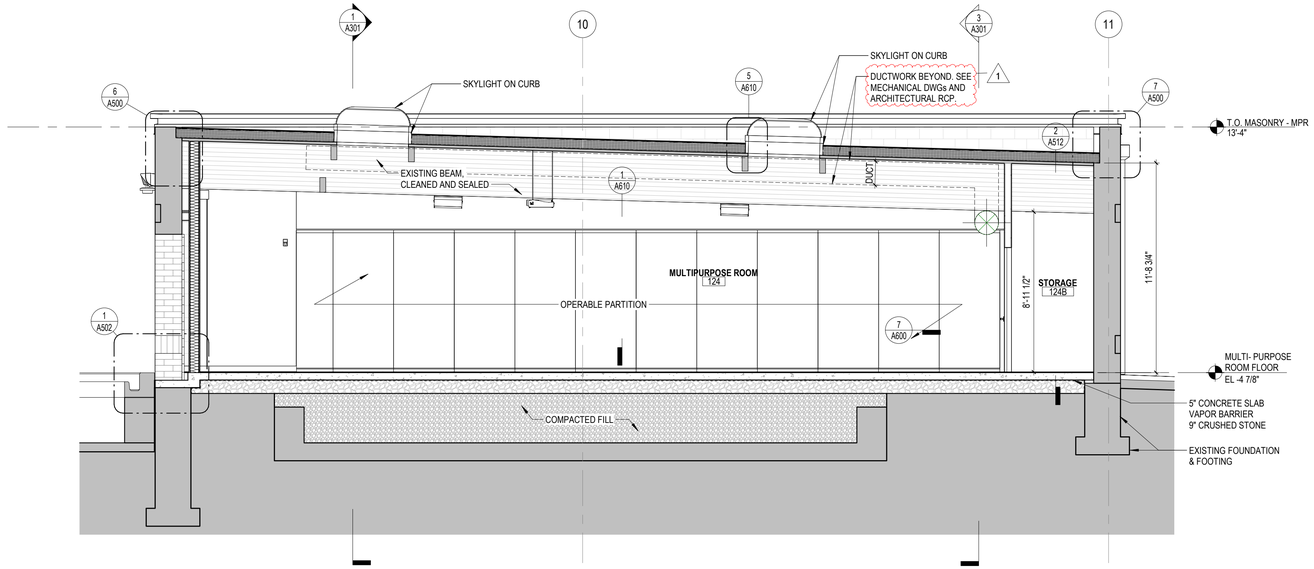
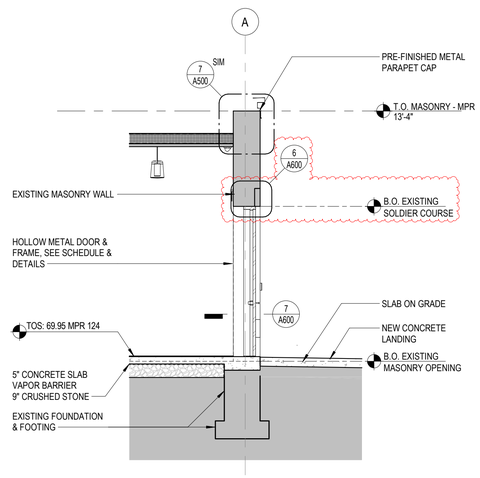


1 Longitudinal Section thru Multi-Purpose Room
1/4" = 1'-0"



2 Cross Section thru Multi-Purpose Room
1/4" = 1'-0"



3 Section @ MPR North
1/4" = 1'-0"

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5/16/2025 3:59:15 PM Author

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PROJECT NAME
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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE
Partial Building Sections

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/4" = 1'-0"	Author
SCALE	DRAWN BY
3524	3524 - Davey Lopes v24_Educational.rvt
PROJECT #	FILE NAME

DRAWING NUMBER
A301

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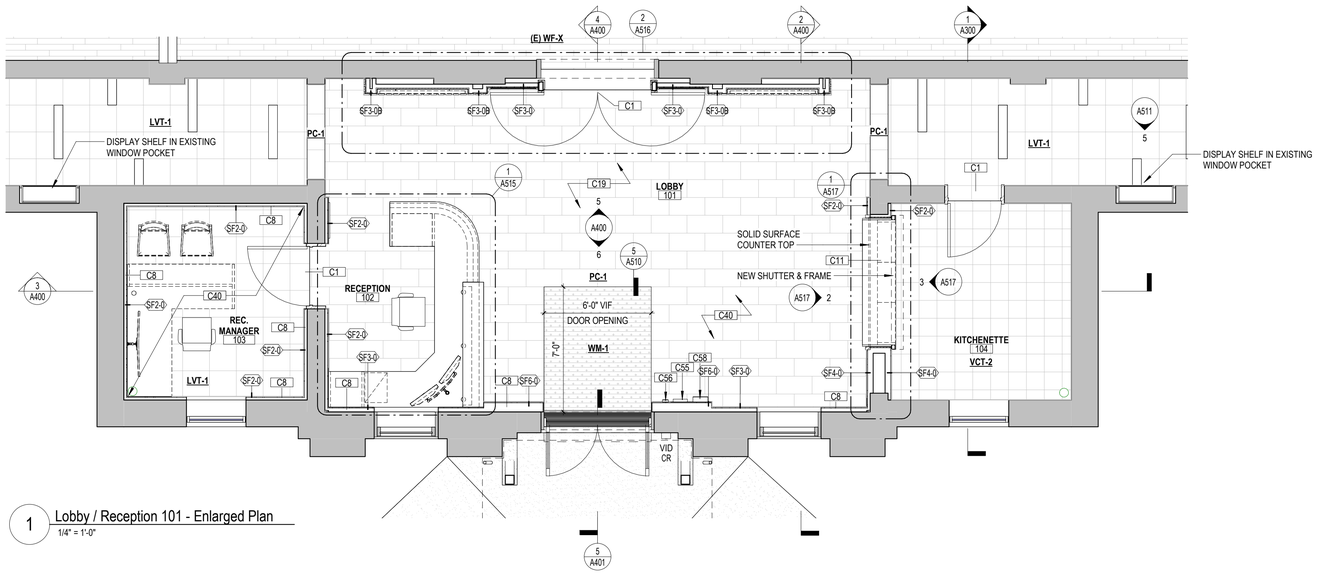
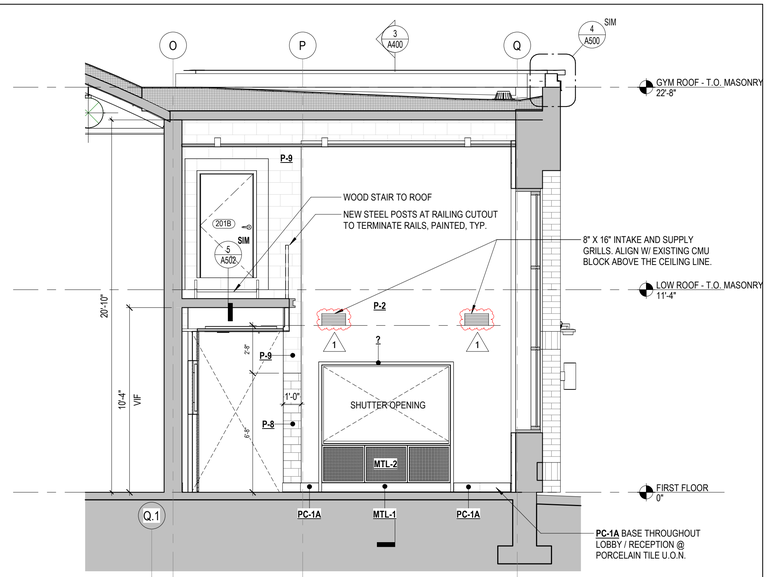
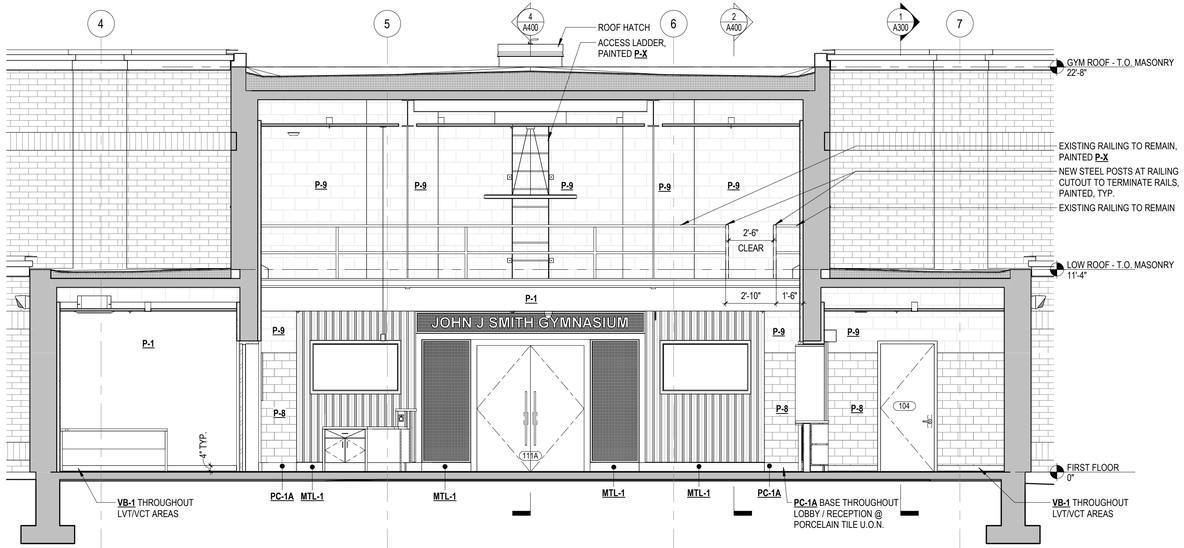


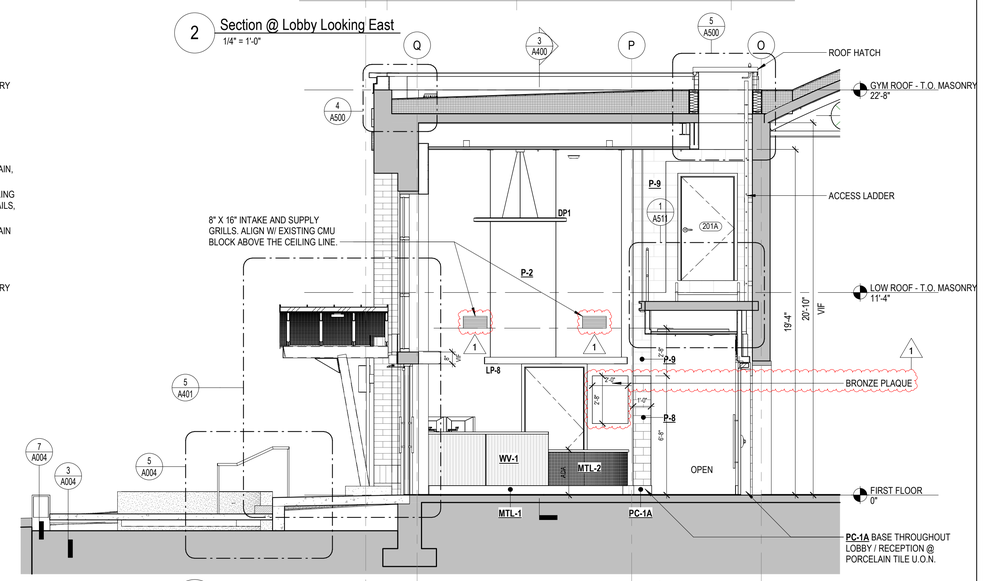
1 Lobby / Reception 101 - Enlarged Plan
1/4" = 1'-0"



2 Section @ Lobby Looking East
1/4" = 1'-0"



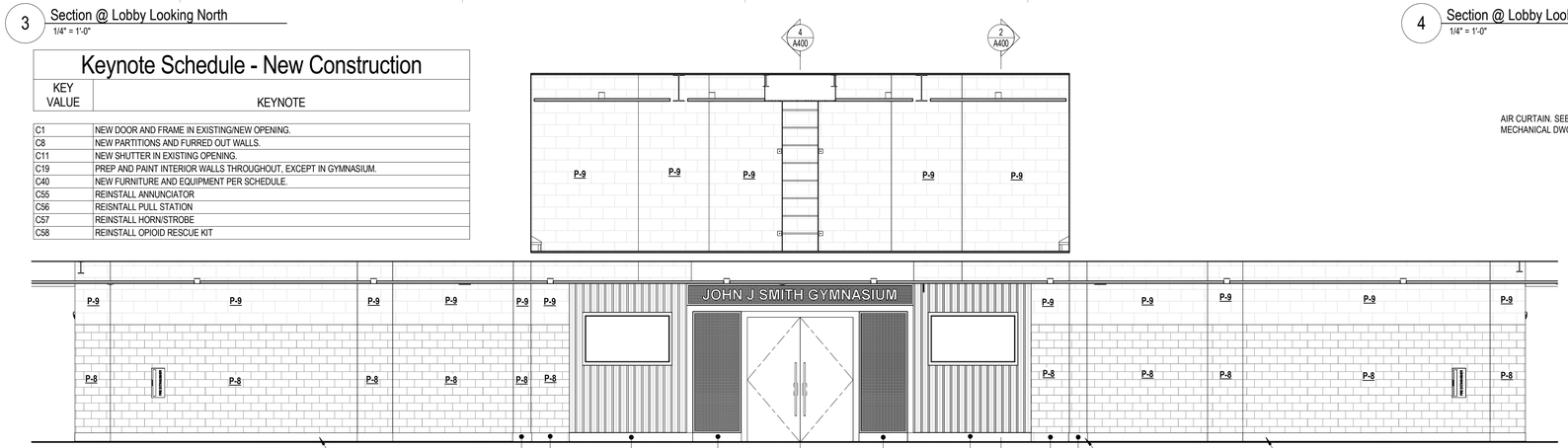
3 Section @ Lobby Looking North
1/4" = 1'-0"



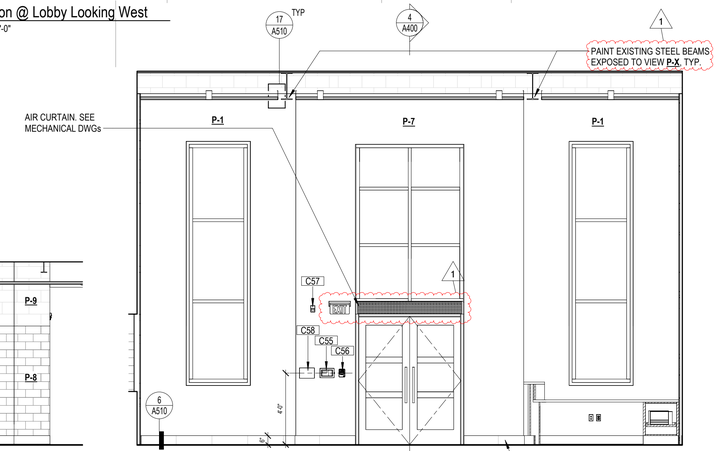
4 Section @ Lobby Looking West
1/4" = 1'-0"

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C1	NEW DOOR AND FRAME IN EXISTING/NEW OPENING.
C8	NEW PARTITIONS AND FURRED OUT WALLS.
C11	NEW SHUTTER IN EXISTING OPENING.
C19	PREP AND PAINT INTERIOR WALLS THROUGHOUT, EXCEPT IN GYMNASIUM.
C40	NEW FURNITURE AND EQUIPMENT PER SCHEDULE.
C55	REINSTALL ANNUNCIATOR
C56	REINSTALL PULL STATION
C57	REINSTALL HORN/STROBE
C58	REINSTALL OPIOID RESCUE KIT



5 Lobby / Reception 101 - Elevation - North
1/4" = 1'-0"



6 Lobby / Reception 101 - Elevation - South
1/4" = 1'-0"

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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE
Enlarged Views - Front Entrance Lobby

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/4" = 1'-0" SCALE
Author DRAWN BY
3524 PROJECT #
3524 - Davey Lopes v24_Educational.rvt FILE NAME

DRAWING NUMBER
A400

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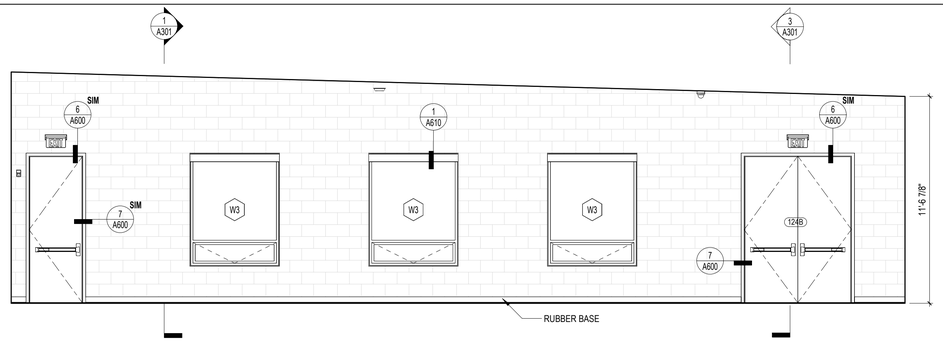
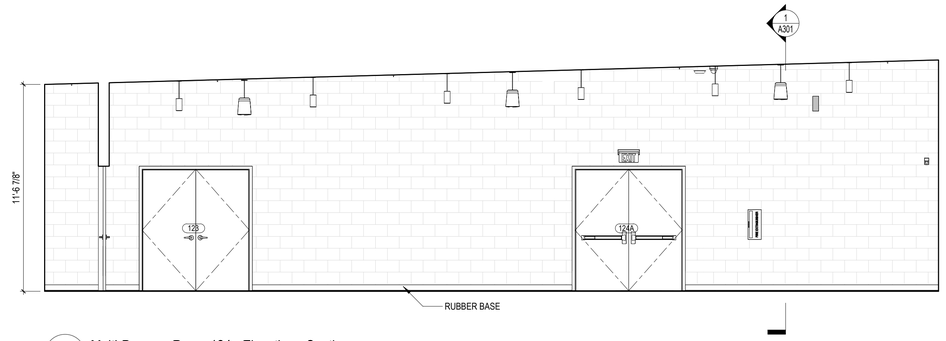
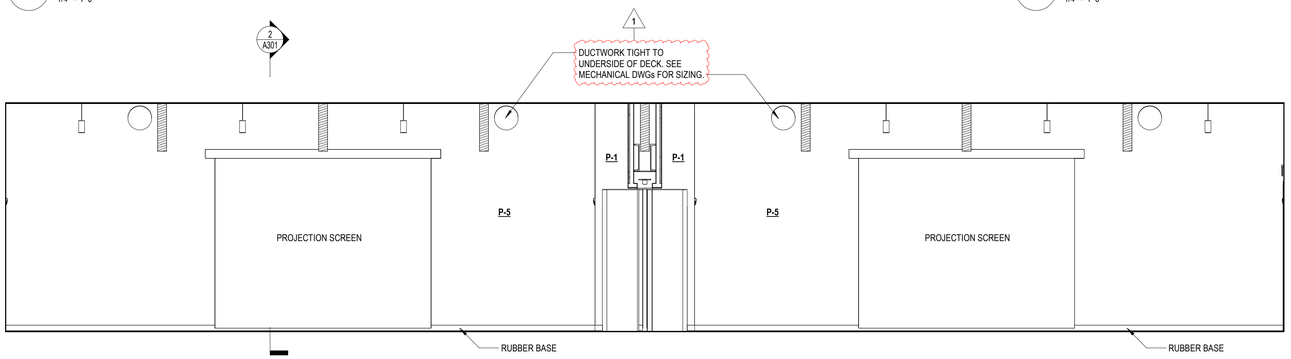


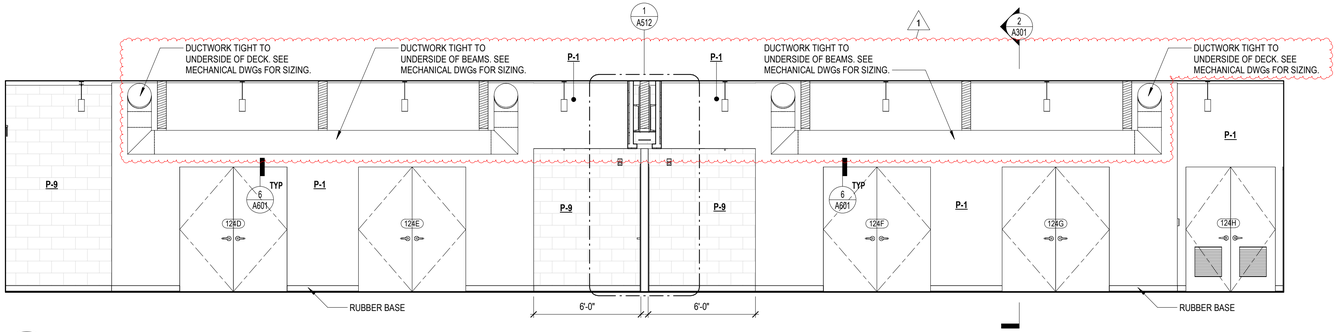
1 Multi-Purpose Room 124 - Elevation - North
1/4" = 1'-0"



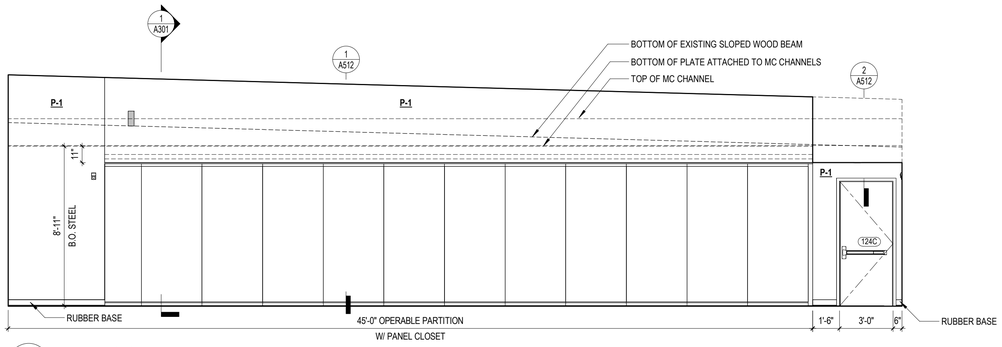
2 Multi-Purpose Room 124 - Elevation - South
1/4" = 1'-0"



3 Multi-Purpose Room 124 - Elevation - West
1/4" = 1'-0"



4 Multi-Purpose Room 124 - Elevation East
1/4" = 1'-0"



5 Elevation @ Operable Partition
1/4" = 1'-0"

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Author

ARCHITECT

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PROJECT NAME

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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE

Enlarged Views - Multi-Purpose Room

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/4" = 1'-0"
SCALE

Author
DRAWN BY

3524
PROJECT #

3524 - Davey Lopes v24_Educational.rvt
FILE NAME

DRAWING NUMBER

A402

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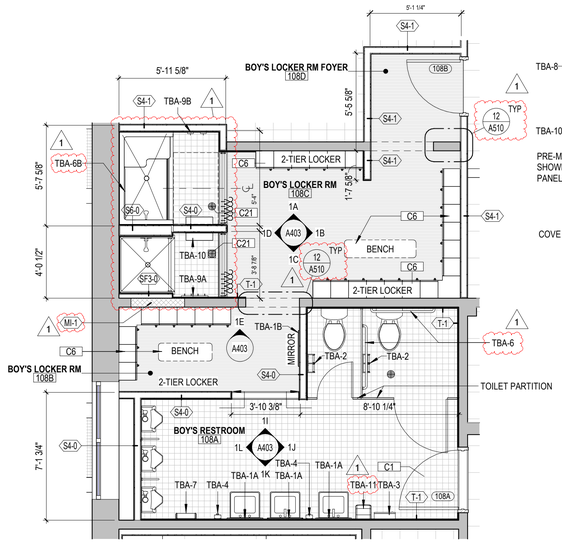
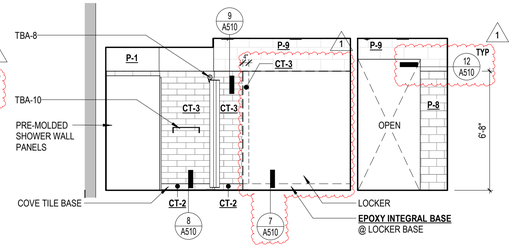
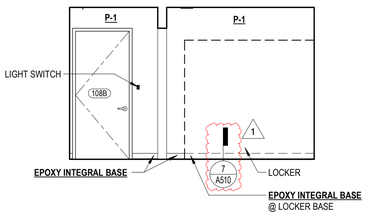


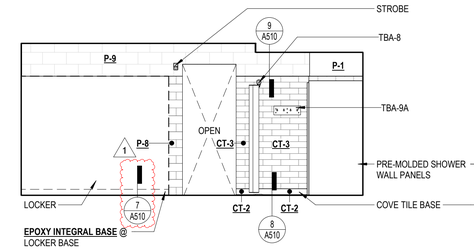
1 Boy's Locker Room 108 - Enlarged Plan
1/4" = 1'-0"



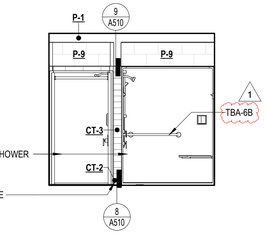
1A Boy's Locker Room 108 - Elevation - North
1/4" = 1'-0"



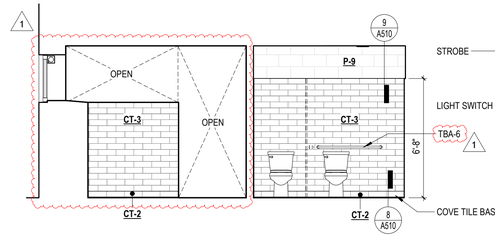
1B Boy's Locker Room 108 - Elevation - East
1/4" = 1'-0"



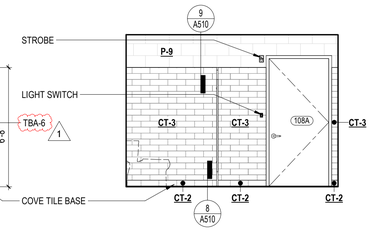
1C Boy's Locker Room 108 - Elevation - South
1/4" = 1'-0"



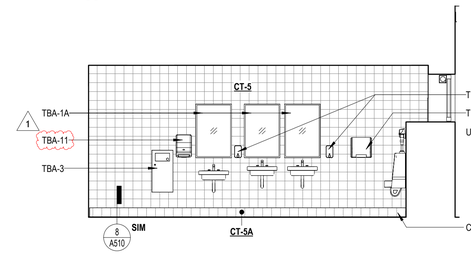
1D Boy's Locker Room 108 - Elevation - West
1/4" = 1'-0"



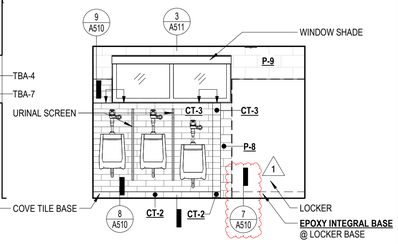
1I Boy's Restroom 108 - Elevation - North
1/4" = 1'-0"



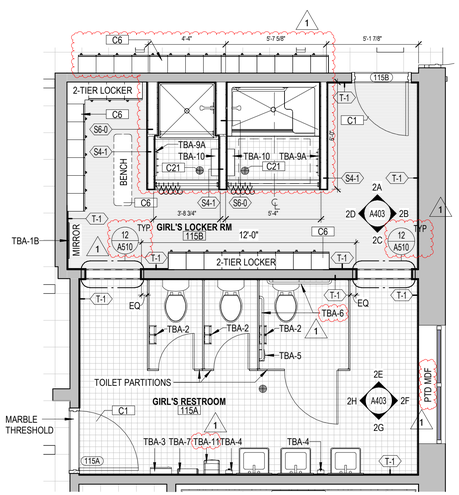
1J Boy's Restroom 108 - Elevation - East
1/4" = 1'-0"



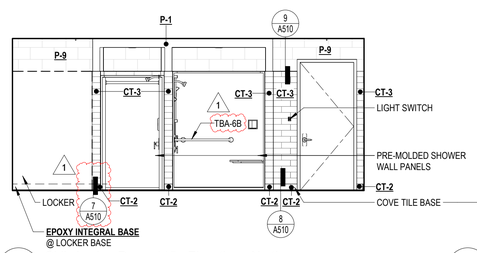
1K Boy's Restroom 108 - Elevation - South
1/4" = 1'-0"



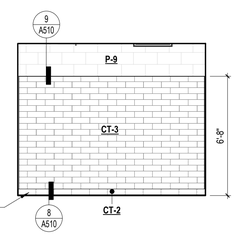
1L Boy's Restroom 108 - Elevation - West
1/4" = 1'-0"



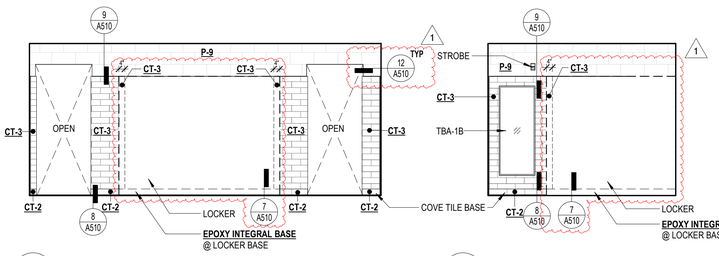
2 Girl's Locker Room 115 - Enlarged Plan
1/4" = 1'-0"



2A Girl's Locker Room 115 - Elevation - North
1/4" = 1'-0"

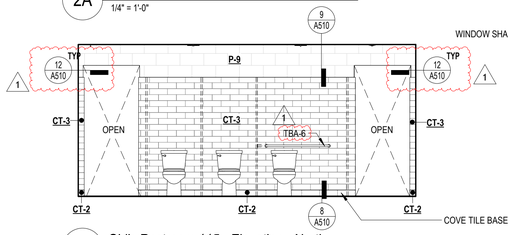


2B Girl's Locker Room 115 - Elevation - East
1/4" = 1'-0"

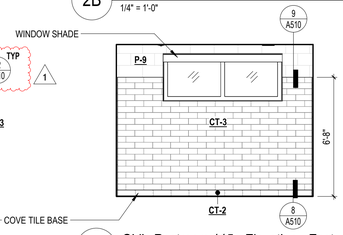


2C Girl's Locker Room 115 - Elevation - South
1/4" = 1'-0"

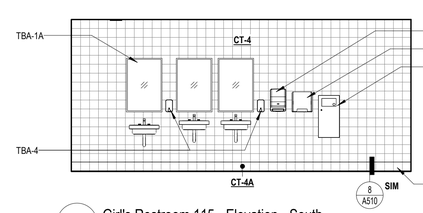
2D Girl's Locker Room 115 - Elevation - West
1/4" = 1'-0"



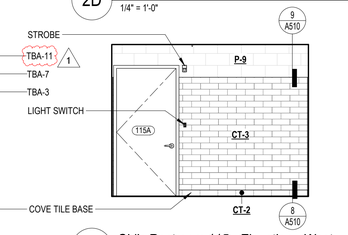
2E Girl's Restroom 115 - Elevation - North
1/4" = 1'-0"



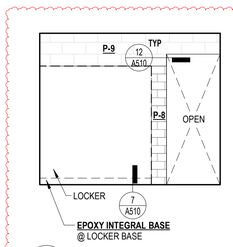
2F Girl's Restroom 115 - Elevation - East
1/4" = 1'-0"



2G Girl's Restroom 115 - Elevation - South
1/4" = 1'-0"



2H Girl's Restroom 115 - Elevation - West
1/4" = 1'-0"



1E Boy's Locker Room 108 - Elevation - North 2
1/4" = 1'-0"

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C1	NEW DOOR AND FRAME IN EXISTING/NEW OPENING.
C6	NEW LOCKERS AND BENCHES.
C21	NEW FLOOR DRAINS AND ASSOCIATED PIPING. SEE PLUMBING.

GENERAL NOTES

1. TILE BACKER BOARD @ NEW TILE WALLS. SEE PARTITION TYPE T-1.

2. REFER TO FINISH LEGEND A700 FOR FINISH DESIGNATIONS.

RESTROOM AND LOCKER ACCESSORIES		MODEL NUMBER
TBA-1A	MIRROR (24" X 36")	BOBRICK - B-290
TBA-1B	MIRROR (24" X 60")	BOBRICK - B-290 1
TBA-2	TOILET PAPER DISPENSER	OWNER FURNISHED OWNER INSTALLED
TBA-3	TRASH RECEPTACLE	BOBRICK - B-35639
TBA-4	SOAP DISPENSER	OWNER FURNISHED OWNER INSTALLED
TBA-5	SANITARY NAPKIN RECEPTACLE	BOBRICK - B-270 1
TBA-6	42" GRAB BAR	BOBRICK - B-5806
TBA-6B	24"X36" TWO-WALL GRAB BAR	BOBRICK B-58616 1
TBA-7	HAND DRYER	BOBRICK - B-7128
TBA-8	SHOWER CURTAIN AND ROD	BOBRICK - B-207
TBA-9A	HOOK STRIP	BRADLEY - SA41
TBA-9B	TOWEL HOOK (SINGULAR)	BRADLEY - SA35
TBA-10	STAINLESS STEEL SHELF	BRADLEY - 9094-18 1
TBA-11	PAPER TOWEL DISPENSERS	OWNER FURNISHED OWNER INSTALLED

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REVISIONS

		DATE
1	Addendum 1	05/16/2025

DRAWING TITLE
Enlarged Views - Locker Rooms & Restrooms

DRAWING INFORMATION

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Construction Documents
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SS — DRAWN BY
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A403

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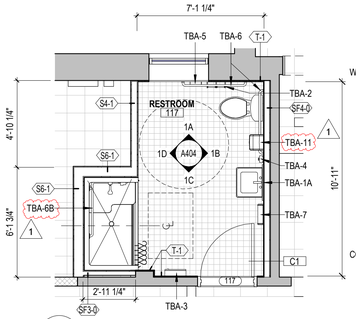
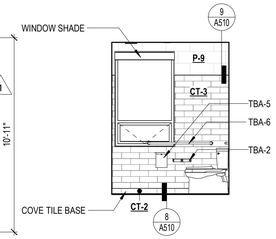
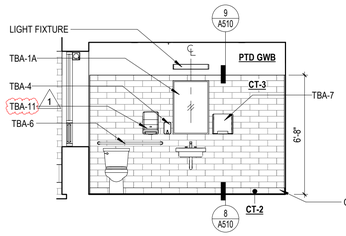


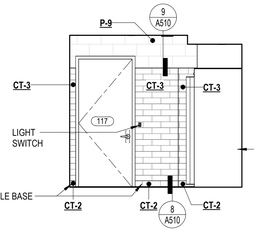
1 Restroom 117 - Enlarged Plan
1/4" = 1'-0"



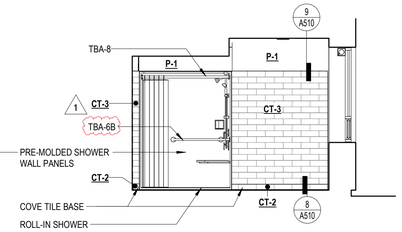
1A Restroom 117 - Elevation - North
1/4" = 1'-0"



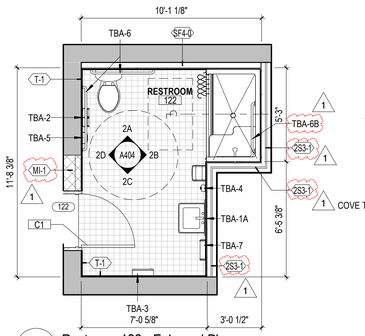
1B Restroom 117 - Elevation - East
1/4" = 1'-0"



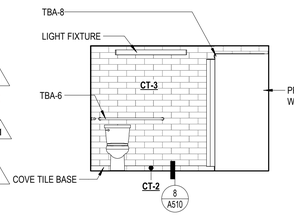
1C Restroom 117 - Elevation - South
1/4" = 1'-0"



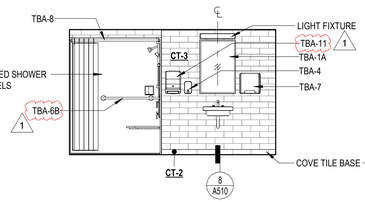
1D Restroom 117 - Elevation - West
1/4" = 1'-0"



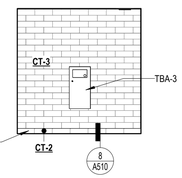
2 Restroom 122 - Enlarged Plan
1/4" = 1'-0"



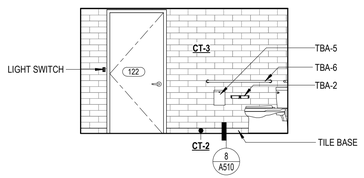
2A Restroom 122 - Elevation - North
1/4" = 1'-0"



2B Restroom 122 - Elevation - East
1/4" = 1'-0"



2C Restroom 122 - Elevation - South
1/4" = 1'-0"



2D Restroom 122 - Elevation - West
1/4" = 1'-0"

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TBA-6	42" GRAB BAR	BOBRICK - B-5806
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TBA-11	PAPER TOWEL DISPENSERS	OWNER FURNISHED OWNER INSTALLED

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C1	NEW DOOR AND FRAME IN EXISTING/NEW OPENING.

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REVISIONS

1	Addendum 1	05/16/2025

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DRAWING TITLE
Enlarged Views - Restrooms

DRAWING INFORMATION

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1/4" = 1'-0"
SCALE

Author
DRAWN BY

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PROJECT #

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FILE NAME

DRAWING NUMBER
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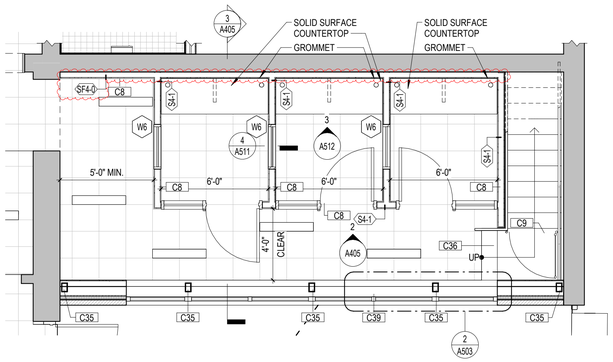
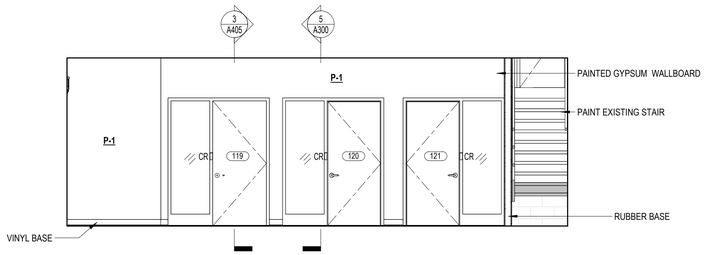
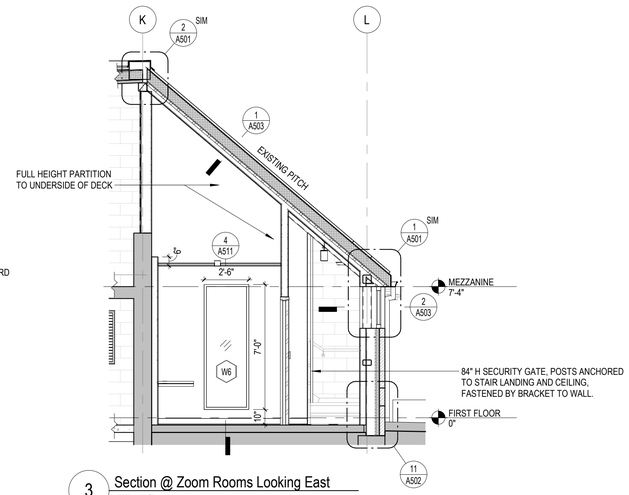


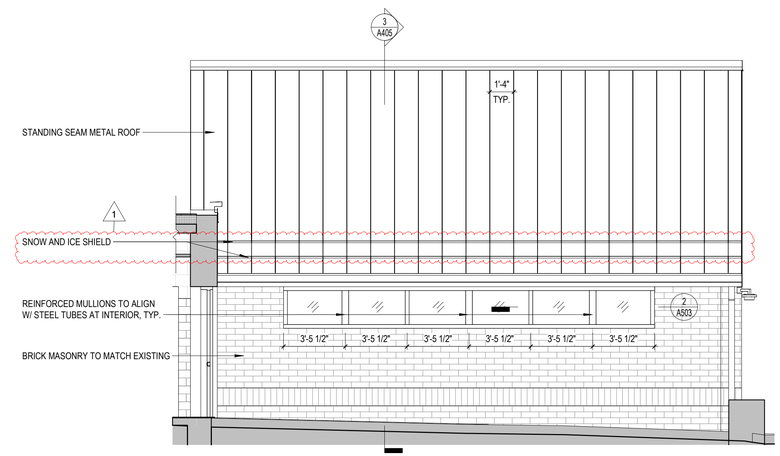
1 Enlarged Plan at Zoom Rooms
1/4" = 1'-0"



2 Elevation @ Zoom Room Office Fronts
1/4" = 1'-0"



3 Section @ Zoom Rooms Looking East
1/4" = 1'-0"



4 Enlarged Elevation at Former Kalwal
1/4" = 1'-0"

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C8	NEW PARTITIONS AND FURRED OUT WALLS.
C9	NEW METAL SWING GATE.
C35	PREP AND PAINT EXISTING STEEL FRAME.
C36	PREP AND PAINT EXISTING STAIR AND RAILING.
C39	NEW EXTERIOR WALL ASSEMBLY AND WINDOWS.

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1	Addendum 1	05/16/2025

DATE

DRAWING TITLE
Enlarged Views - Zoom Rooms & Misc.

DRAWING INFORMATION

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1/4" = 1'-0"
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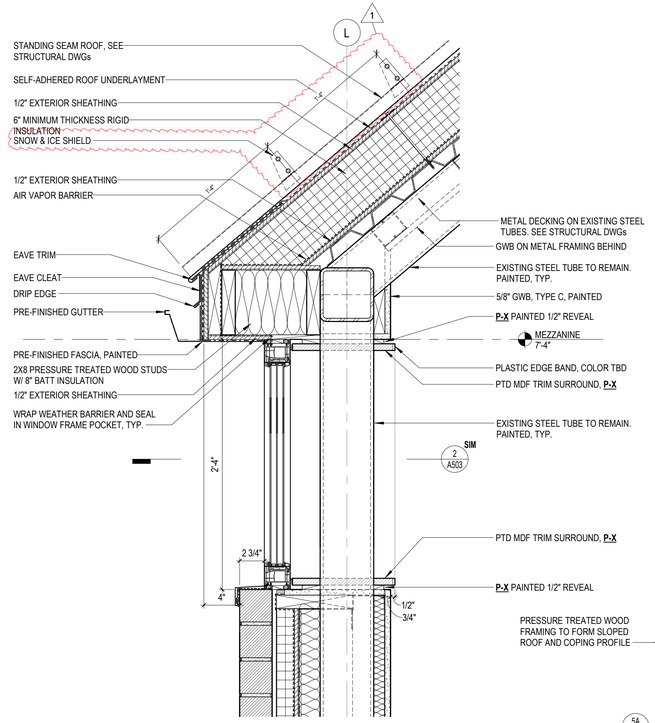
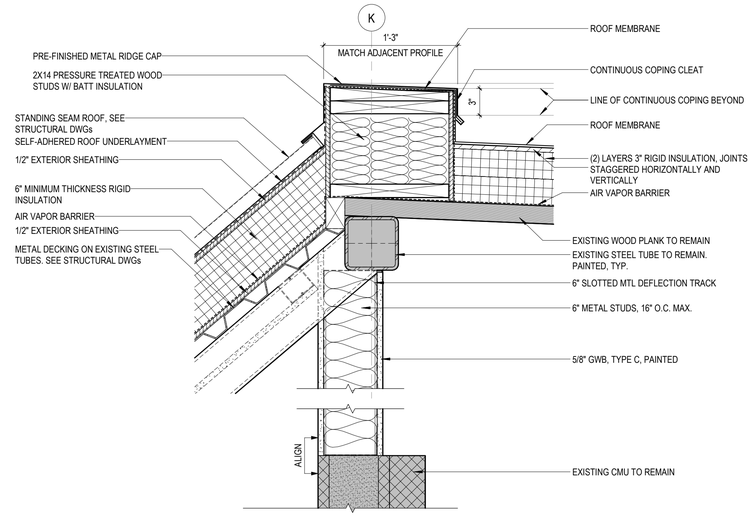
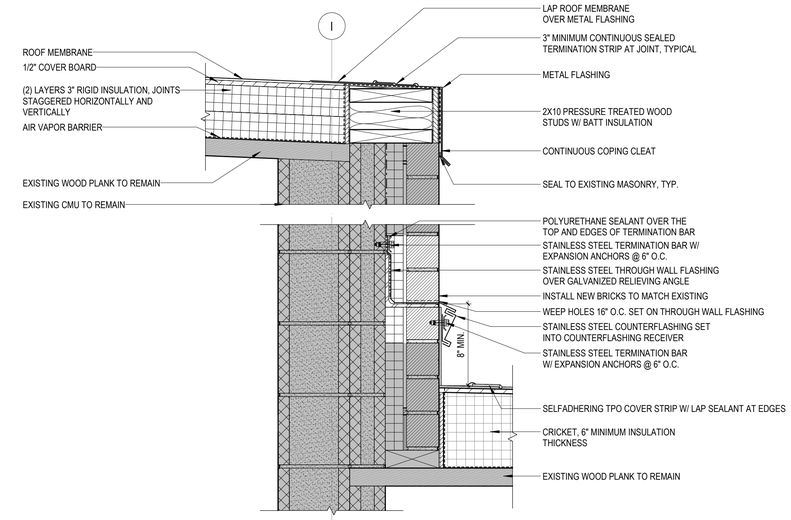


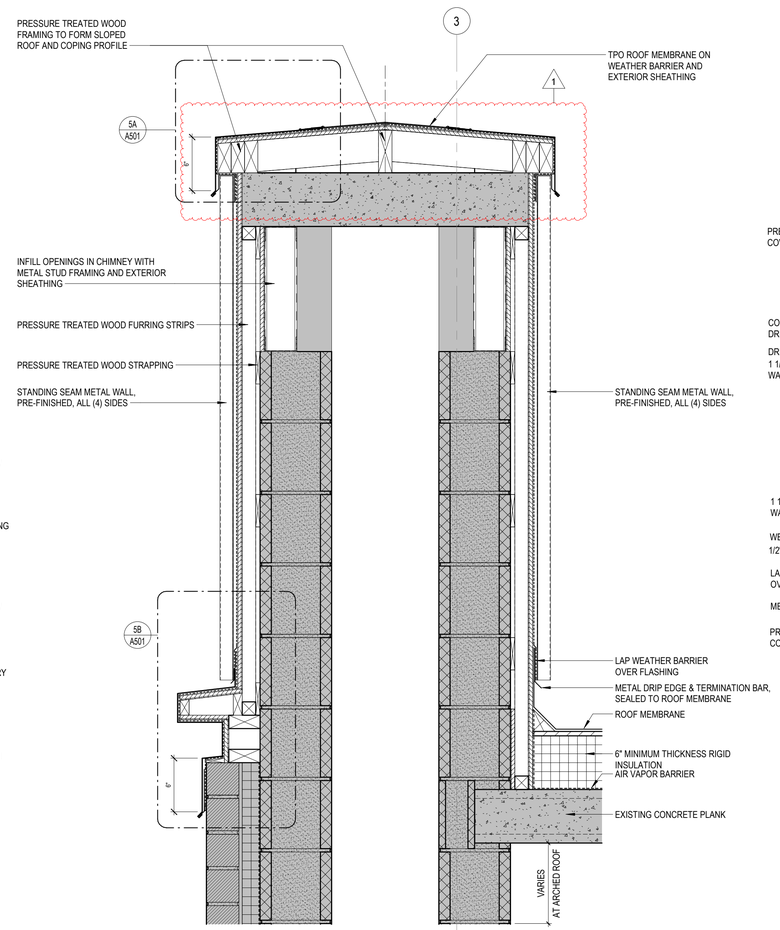
1 Standing Seam Roof Eave @ Existing Column
1 1/2" = 1'-0"



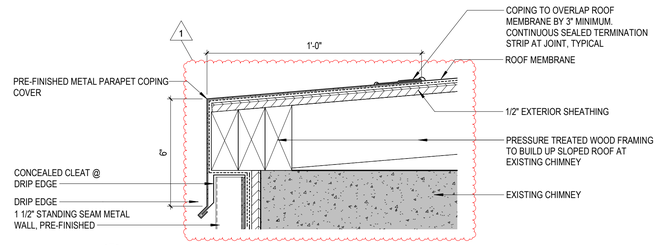
2 Standing Seam Roof Peak @ Existing Column
1 1/2" = 1'-0"



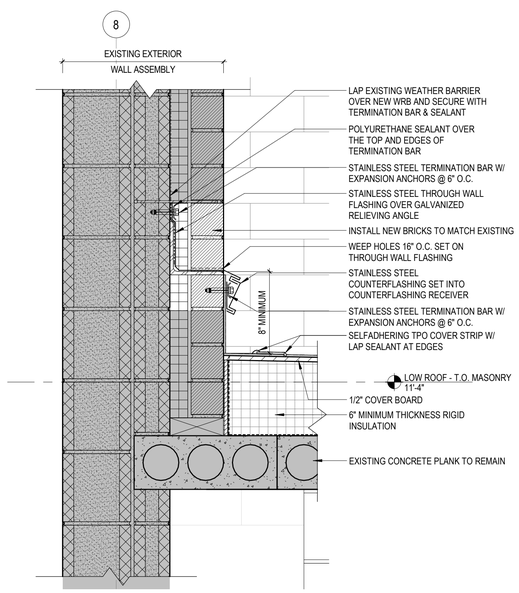
3 Section Detail @ B.O. Mezzanine Roof
1 1/2" = 1'-0"



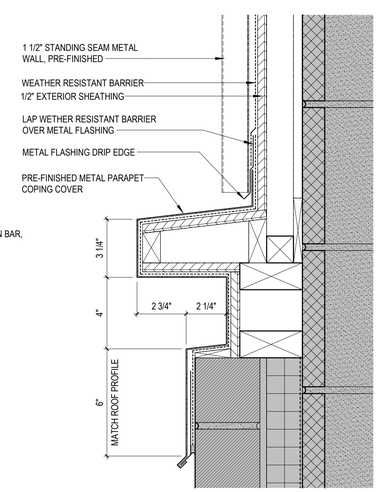
5 Detail Thru Chimney
1 1/2" = 1'-0"



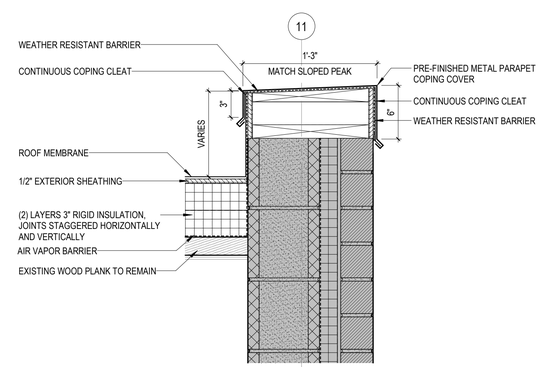
5A Typical Coping Detail At Chimney Top
3" = 1'-0"



4 Typical Detail @ Gym Wall / Low Roof
1 1/2" = 1'-0"



5B Typical Coping Detail At Chimney Bottom
3" = 1'-0"



6 Detail Through Roof Edge at Mezzanine
1 1/2" = 1'-0"

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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE
Exterior Details

DRAWING INFORMATION

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Construction Documents
DESCRIPTION
As indicated — SCALE
Author — DRAWN BY
3524 — PROJECT #
3524 - Davey Lopes v24_Educational.rvt — FILE NAME

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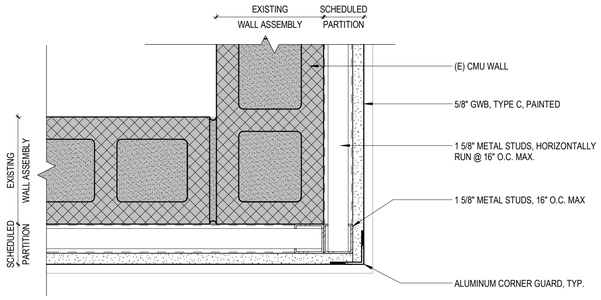
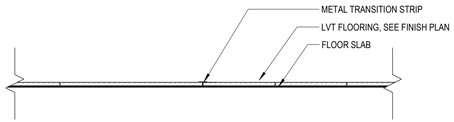
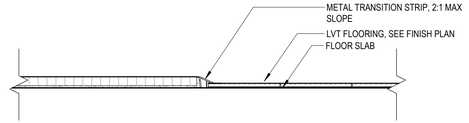


NOTE: ALUMINUM CORNER TRIM OCCURS AT ALL NEW GWB CORNERS

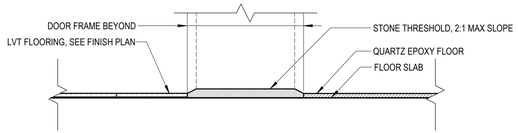
1 Typical Plan Detail @ GWB Corner
3" = 1'-0"



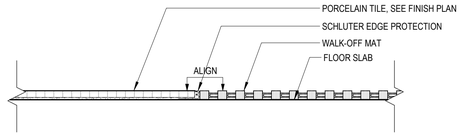
2 Floor Transition - LVT to LVT
3" = 1'-0"



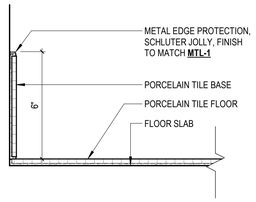
3 Floor Transition - Porcelain Tile to LVT
3" = 1'-0"



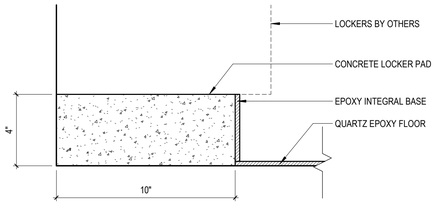
4 Stone Threshold @ LVT & Quartz Epoxy
3" = 1'-0"



5 Floor Transition - Walk-Off Mat to Porcelain Tile
3" = 1'-0"

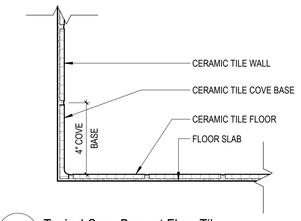


6 Tile Base Detail
3" = 1'-0"

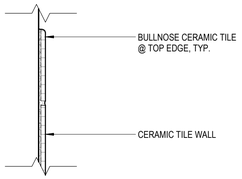


7 Locker Curb Detail
3" = 1'-0"

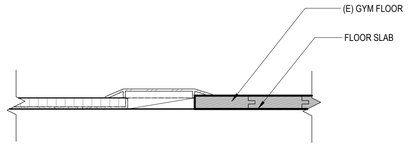
1



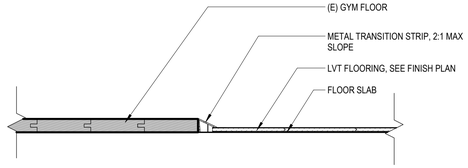
8 Typical Cove Base at Floor Tile
3" = 1'-0"



9 Typical Top & End of Wall Tile
3" = 1'-0"



10 Floor Transition - Porcelain Tile to Existing Wood Floors
3" = 1'-0"



11 Floor Transition - LVT to Existing Wood Floors
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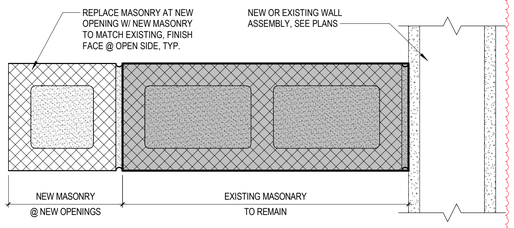
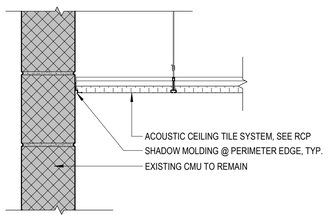
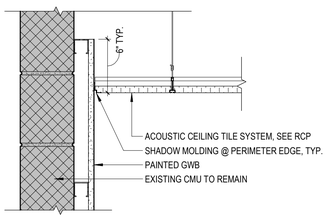


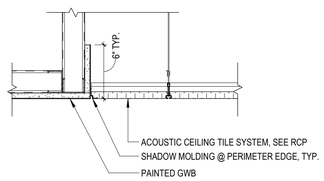
12 Plan Detail @ Existing Block at Locker Rooms
3" = 1'-0"



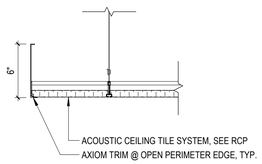
14 ACT Edge @ Existing CMU
1 1/2" = 1'-0"



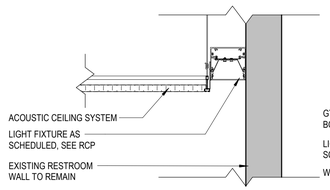
15 ACT Edge @ GWB Partition
1 1/2" = 1'-0"



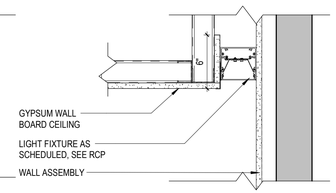
16 Ceiling Transition - ACT to GWB
1 1/2" = 1'-0"



17 Ceiling Detail - ACT Edge Trim
1 1/2" = 1'-0"



18 Recessed Grazer @ ACT Ceiling
1 1/2" = 1'-0"



19 Recessed Grazer @ GWB Ceiling
1 1/2" = 1'-0"

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REVISIONS

1	Addendum 1	05/16/2025

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DRAWING TITLE
Interior Details - Typical

DRAWING INFORMATION

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DATE OF ISSUE

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DESCRIPTION

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SCALE

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3524
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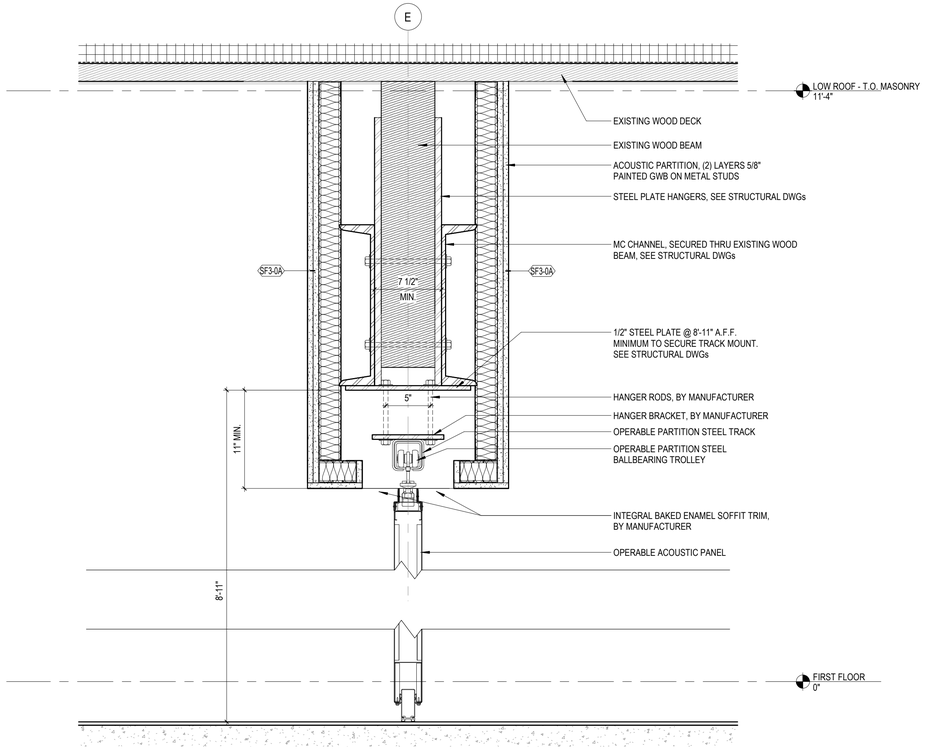
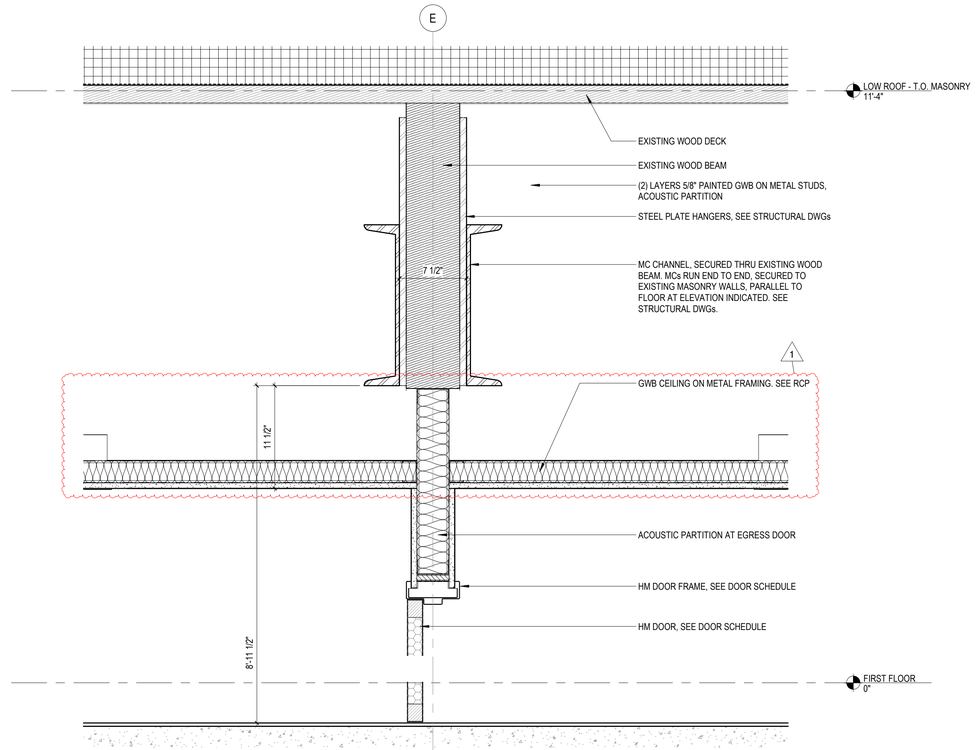
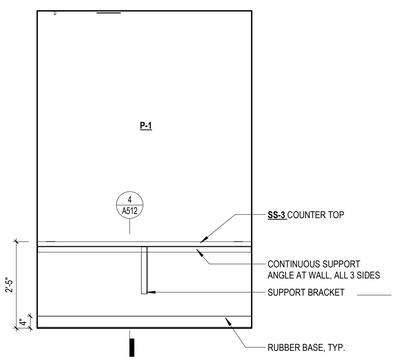


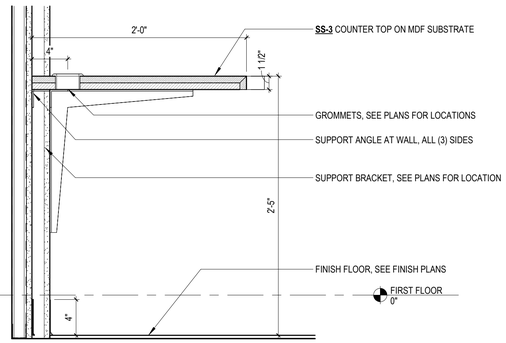
1 Detail @ Operable Partition in MPR
1 1/2" = 1'-0"



2 Detail @ Door at Operable Partition Support
1 1/2" = 1'-0"



3 Elevation @ Zoom Room Counter
1/2" = 1'-0"



4 Section Detail Thru Zoom Room Counter
1 1/2" = 1'-0"

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DRAWING TITLE

Interior Details

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3524	3524 - Davey Lopes v24_Educational.rvt
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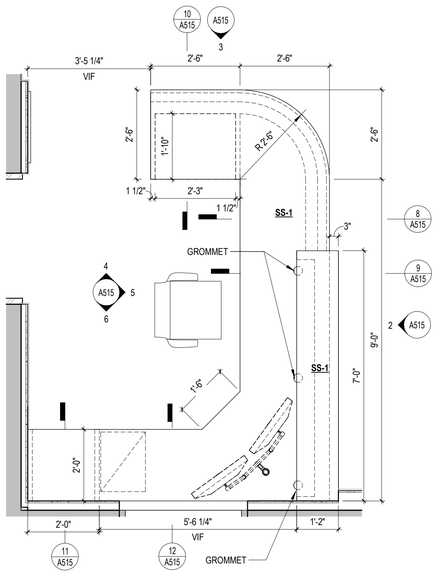
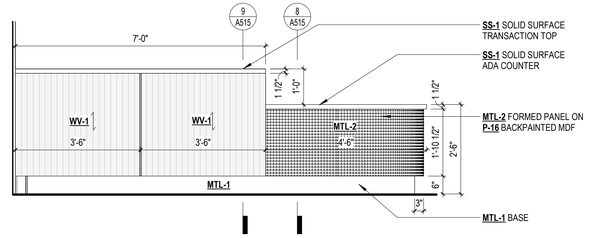
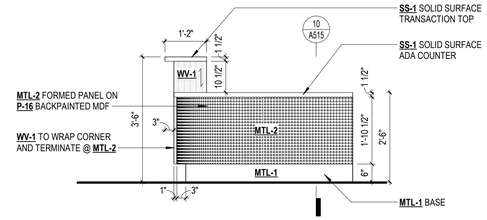


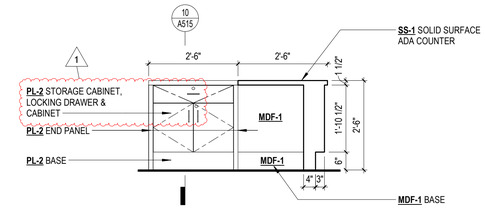
1 Enlarged Plan @ Reception Desk
1/2" = 1'-0"



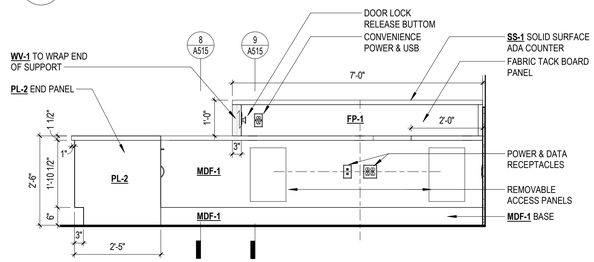
2 Reception Desk - Elevation 1
1/2" = 1'-0"



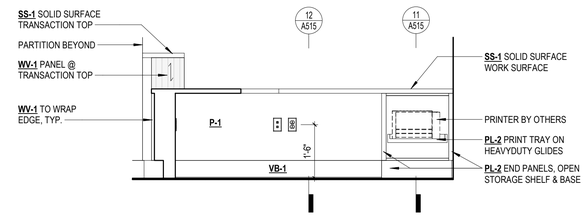
3 Reception Desk - Elevation 2
1/2" = 1'-0"



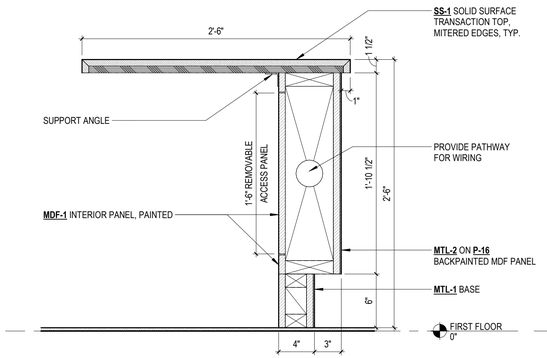
4 Reception Desk - Elevation 3
1/2" = 1'-0"



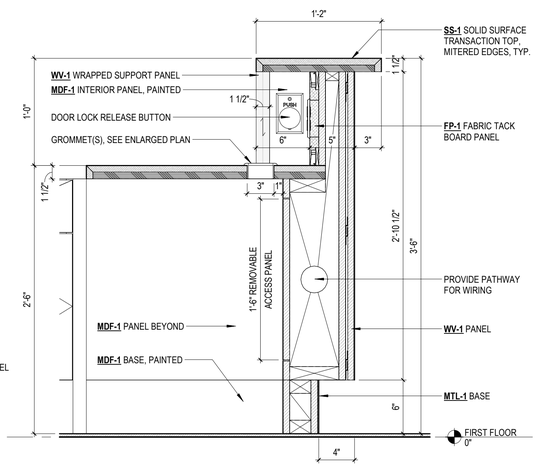
5 Reception Desk - Elevation 4
1/2" = 1'-0"



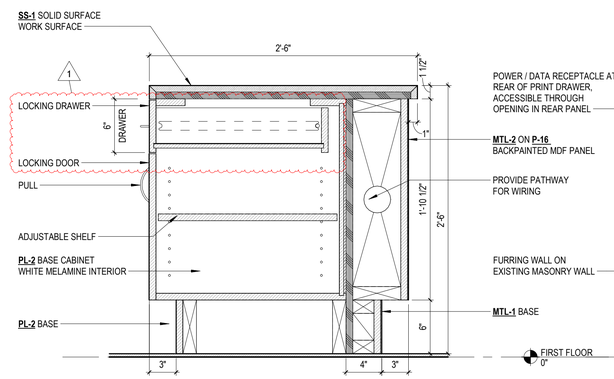
6 Reception Desk - Elevation 5
1/2" = 1'-0"



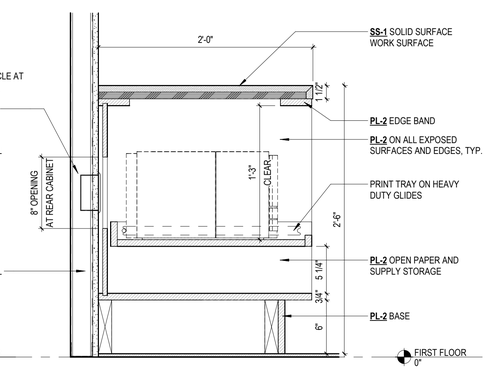
8 Reception Desk Detail @ ADA Counter
1 1/2" = 1'-0"



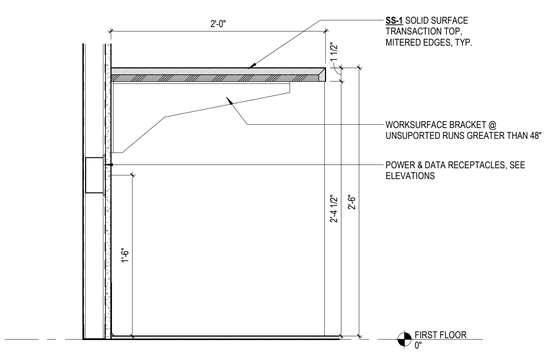
9 Reception Desk Detail @ Transaction Top
1 1/2" = 1'-0"



10 Reception Desk Detail @ Storage Cabinet
1 1/2" = 1'-0"



11 Reception Desk Detail @ Printer Storage
1 1/2" = 1'-0"



12 Reception Desk Detail @ Worksurface
1 1/2" = 1'-0"

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REVISIONS

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DRAWING TITLE
Millwork Details - Reception Desk

DRAWING INFORMATION

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Construction Documents
DESCRIPTION

As indicated	Author
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3524	3524 - Davey Lopes v24_Educational.rvt
PROJECT #	FILE NAME

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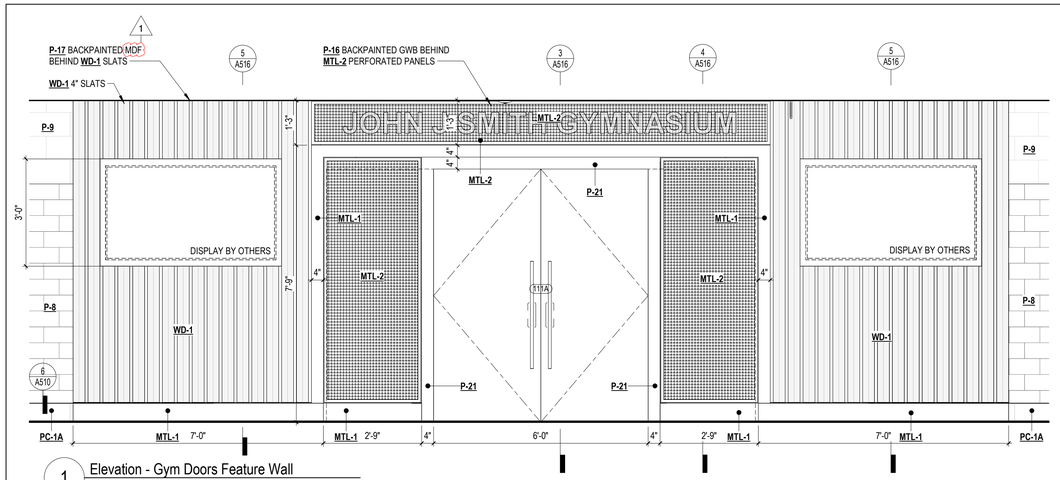
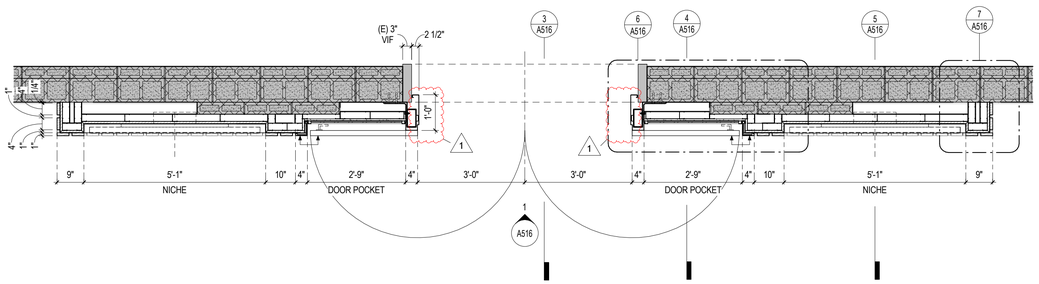
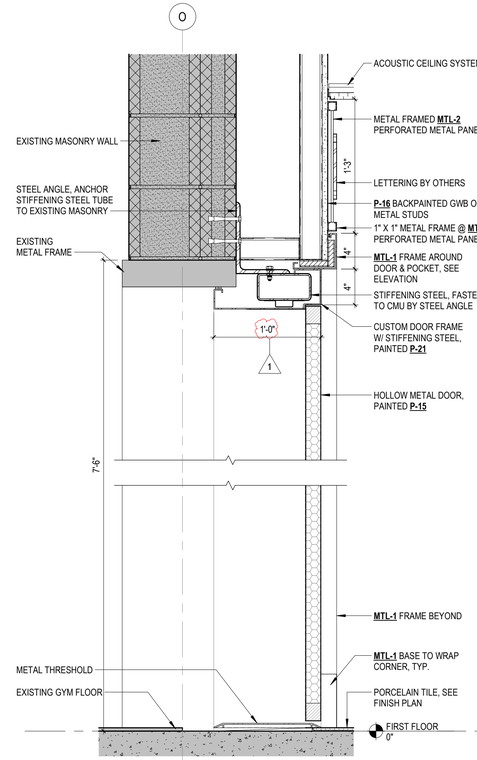


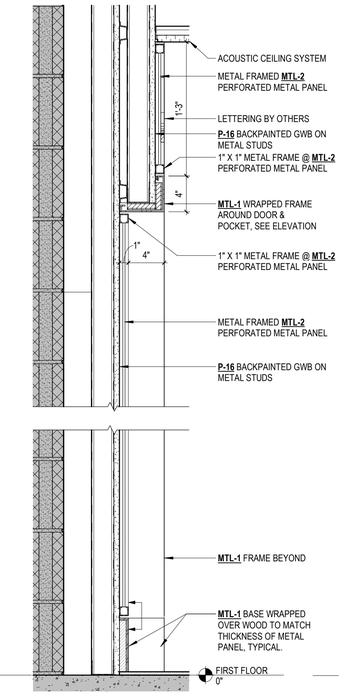
1 Elevation - Gym Doors Feature Wall
1/2" = 1'-0"



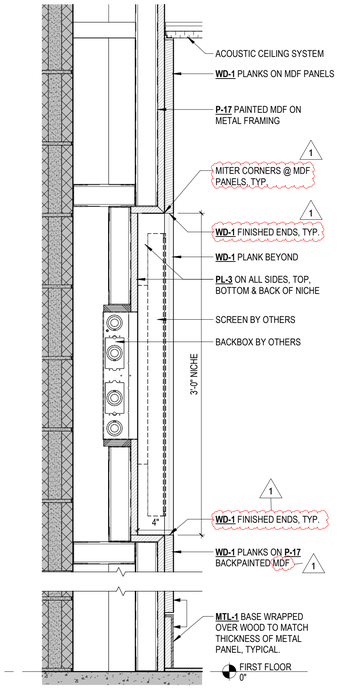
2 Enlarged Plan @ Gym Doors Feature Wall
1/2" = 1'-0"



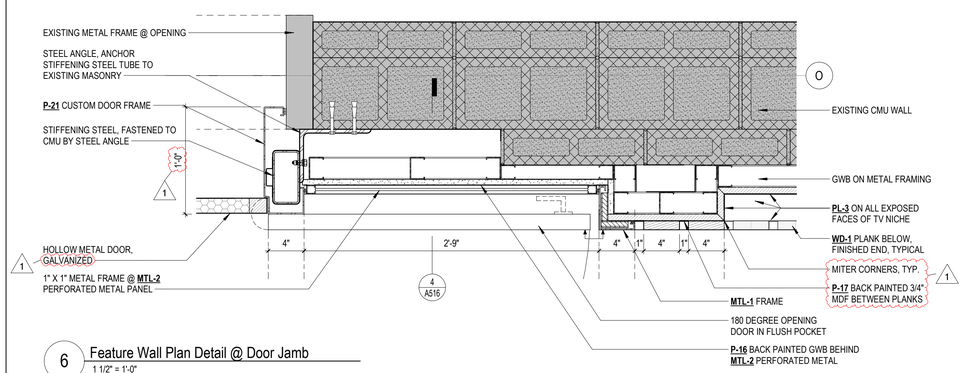
3 Section Detail @ Feature Wall Gym Doors
1 1/2" = 1'-0"



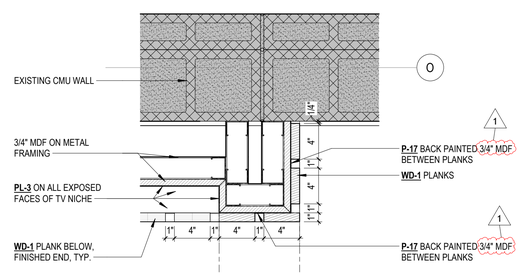
4 Section Detail @ Feature Wall Gym Doors Pocket
1 1/2" = 1'-0"



5 Section Detail @ Feature Wall TV Niche
1 1/2" = 1'-0"



6 Feature Wall Plan Detail @ Door Jamb
1 1/2" = 1'-0"



7 Feature Wall Plan Detail @ Niche
1 1/2" = 1'-0"

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REVISIONS

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DRAWING TITLE
Millwork Details - Feature Wall

DRAWING INFORMATION

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Construction Documents
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3524	3524 - Davey Lopes v24_Educational.rvt
PROJECT #	FILE NAME

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A516

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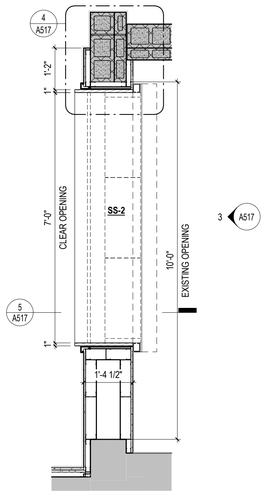
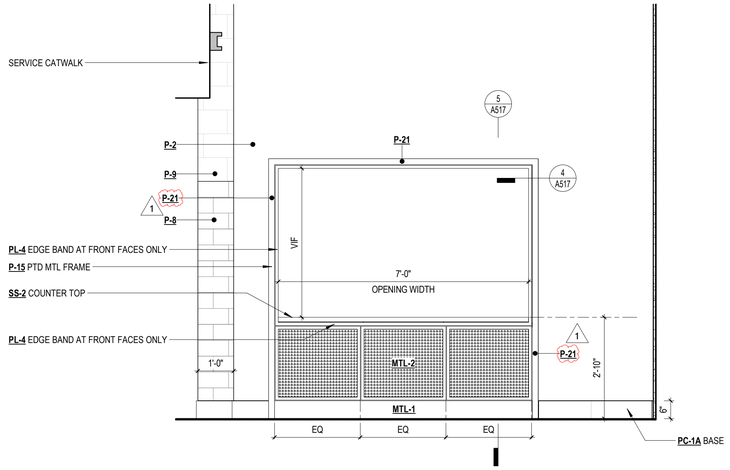
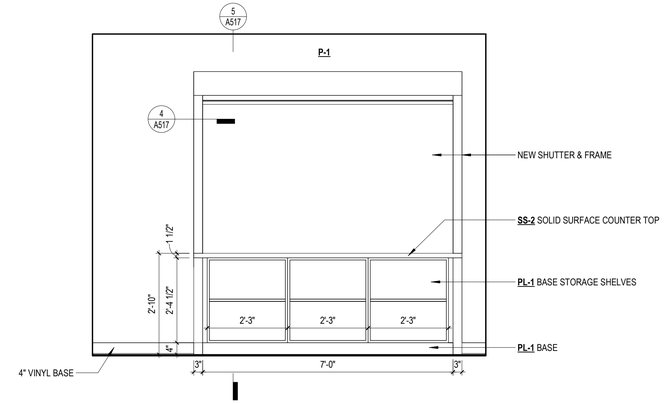


1 Enlarged Plan @ Kitchenette Counter
1/2" = 1'-0"



2 Kitchenette 104 - Vending Elevation 1
1/2" = 1'-0"



3 Kitchenette 104 - Vending Elevation 2
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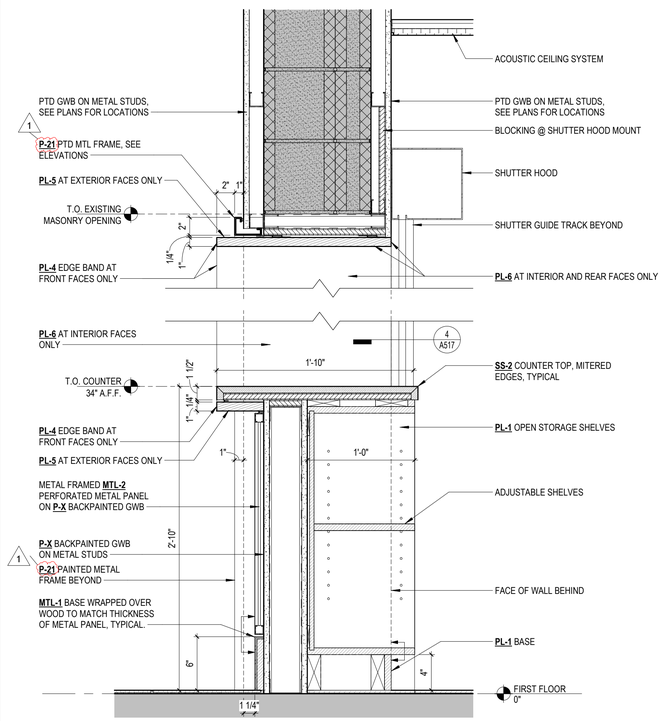
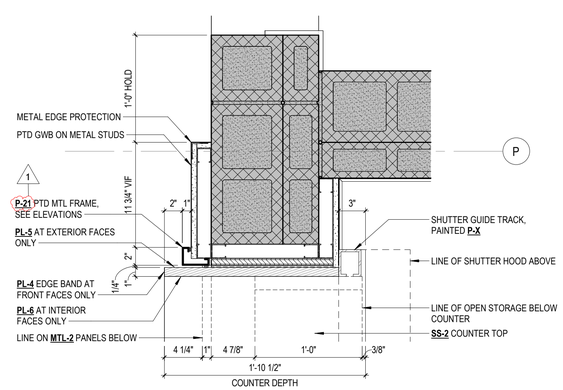


5 Section Detail @ Kitchenette Counter
1 1/2" = 1'-0"



4 Jamb Detail at Kitchenette Counter
1 1/2" = 1'-0"

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Millwork Details - Kitchenette

DRAWING INFORMATION

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Construction Documents
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Author — DRAWN BY
3524 — PROJECT #
3524 - Davey Lopes v24_Educational.rvt — FILE NAME

DRAWING NUMBER
A517

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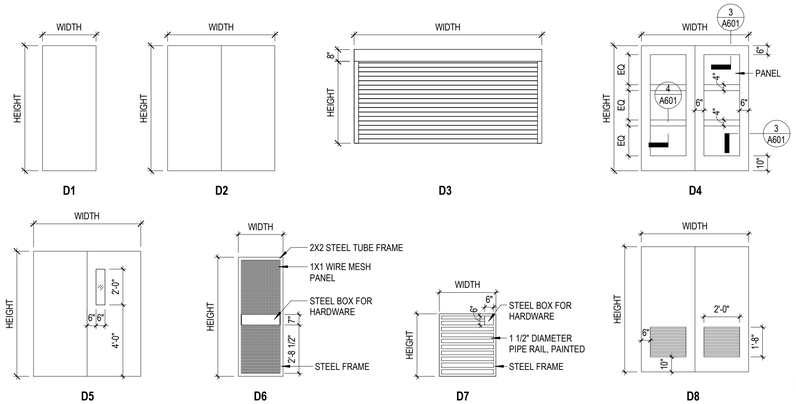
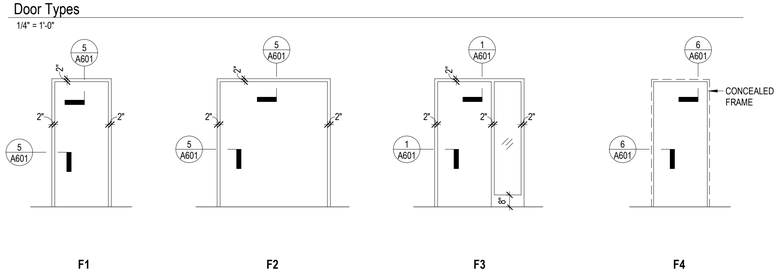
Door Schedule

Mark	DOOR PANEL DOOR TYPE	WIDTH	HEIGHT	THICKNESS	MATERIAL	FINISH	DOOR FRAME FRAME TYPE	MATERIAL	FINISH	HEAD	JAMB	THRESHOLD	HARDWARE SET	COMMENTS
BASEMENT														
B01A	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-22	F1	HM	P-22				3.1	PANIC HARDWARE, CARD READER
B01B	D2	5' - 0"	6' - 0"	1 3/4"	HM	P-22	F2	HM	P-22				8	
B02	D5	6' - 0"	7' - 0"	1 3/4"	HM	P-22	F2	HM	P-22	4/A601	4/A601		14	
FIRST FLOOR														
101	D4	5' - 9"	VIF	2 1/4"	HM	BRNZ	F2	HM	BRNZ	5/A600	5/A600	BRNZ	1.1	CUSTOM DOOR, PANIC HARDWARE, CARD READER
103	D1	3' - 4"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	7/A601	7/A601	3/A510	16	
104	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	5/A601	5/A601	2/A510 Sim	15	
106	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F3	HM	P-19	1/A601	1/A601	2/A510	15	
107	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	2/A601	2/A601	2/A510 Sim	12	
108A	D1	3' - 4"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	3/A601	3/A601	MARBLE	18	
108B	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	4/A601	4/A601	4/A510	18	
109	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	4/A601	4/A601	2/A510 Sim	13	
110A	D1	3' - 8"	7' - 2"	1 3/4"	HM	P-18 / P-22	F1	HM	P-19 / P-22	1/A600	1/A600	ALUMINUM	4.1	PANIC HARDWARE
110B	D1	3' - 4"	7' - 2"	1 3/4"	HM	P-18 / P-22	F1	HM	P-19 / P-22	1/A600	1/A600	ALUMINUM	3.1	CARD READER
111A	D5	6' - 0"	VIF	1 3/4"	HM	P-15	F2	HM	P-21	3/A516	6/A516	10/A510	6	PANIC HARDWARE
111B	D1	3' - 4"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	5/A601	5/A601	11/A510	15	
111C	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	5/A601	5/A601	11/A510	7	PANIC HARDWARE
111D	D1	3' - 4"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	5/A601	5/A601	11/A510 Sim	13	
111E	D1	3' - 6"	7' - 2"	1 3/4"	HM	PTD	F1	HM	PTD	5/A601	5/A601	11/A510	7	PANIC HARDWARE
113	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F3	HM	P-19	1/A601	1/A601	2/A510	15	
114	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	2/A601	2/A601	2/A510 Sim	12	
115A	D1	3' - 4"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	3/A601	3/A601	MARBLE	18	
115B	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	3/A601	3/A601	4/A510	18	
116	D1	3' - 4"	7' - 2"	1 3/4"	HM	P-18 / P-22	F1	HM	P-19 / P-22	1/A600	1/A600	ALUMINUM	5.1	
117	D1	3' - 0"	7' - 2"	1 3/4"	HM	P-18	F1	HM	P-19	3/A601	3/A601	MARBLE	17	
119	D1	3' - 0"	7' - 0"	1 3/4"	HM	P-18	F3	HM	P-19	4/A601	4/A601	N/A	10	CARD READER
120	D1	3' - 0"	7' - 0"	1 3/4"	HM	P-18	F3	HM	P-19	4/A601	4/A601	N/A	10	CARD READER
121	D1	3' - 0"	7' - 0"	1 3/4"	HM	P-18	F3	HM	P-19	4/A601	4/A601	N/A	10	CARD READER
122	D1	3' - 0"	6' - 10"	1 3/4"	HM	P-18	F1	HM	P-19	5A/A601	5A/A601	MARBLE	17	
123	D5	6' - 0"	6' - 10"	1 3/4"	HM	P-18	F2	HM	P-19	5/A601	5/A601	N/A	14	
124A	D2	6' - 0"	6' - 10"	1 3/4"	HM	P-18	F2	HM	P-19	5/A601	5/A601	2/A510	6	PANIC HARDWARE
124B	D2	6' - 0"	SEE ELEV.	1 3/4"	HM	P-18 / P-22	F2	HM	P-19 / P-22	6/A600	6/A600	ALUMINUM	2.1	PANIC HARDWARE, CARD READER
124C	D1	3' - 0"	7' - 0"	1 3/4"	HM	P-18	F1	HM	P-19	4/A601	4/A601	N/A	N/A	PANIC HARDWARE
124D	D2	6' - 0"	7' - 0"	1 3/4"	HM	P-1	F4	HM	-	6/A601	6/A601	2/A510 Sim	11	CONCEALED FRAME
124E	D2	6' - 0"	7' - 0"	1 3/4"	HM	P-1	F4	HM	-	6/A601	6/A601	2/A510 Sim	11	CONCEALED FRAME
124F	D2	6' - 0"	7' - 0"	1 3/4"	HM	P-1	F4	HM	-	6/A601	6/A601	2/A510 Sim	11	CONCEALED FRAME
124G	D2	6' - 0"	7' - 0"	1 3/4"	HM	P-1	F4	HM	-	6/A601	6/A601	2/A510 Sim	11	CONCEALED FRAME
124H	D8	5' - 0"	7' - 0"	1 3/4"	HM	P-1	F4	HM	-	6/A601	6/A601	2/A510 Sim	11	CONCEALED FRAME
124J	D1	3' - 0"	SEE ELEV.	1 3/4"	HM	P-18 / P-22	F1	HM	P-19 / P-22	6/A600	6/A600	ALUMINUM	3.1	PANIC HARDWARE, CARD READER
126A	D1	3' - 6"	7' - 2"	1 3/4"	HM	P-18 / P-22	F1	HM	P-19 / P-22	1/A600	1/A600	ALUMINUM	3.1	PANIC HARDWARE, CARD READER
126B	D2	6' - 0"	VIF	1 3/4"	HM	P-18 / P-22	F2	HM	P-19 / P-22	2/A600	2/A600	ALUMINUM	2.1	PANIC HARDWARE, CARD READER
G1	D6	VIF	6' - 8"	1 1/2"	WIRE MESH	PTD		STEEL	PTD				19	MISC. IRON FRAME
G2	D7	VIF	3' - 6"	1 1/2"	METAL BAR	PTD		STEEL	PTD				19	MISC. IRON FRAME
GD1		9' - 2"	8' - 2"											EXISTING TO REMAIN
GD2		9' - 2"	8' - 2"											EXISTING TO REMAIN
GD3		9' - 2"	8' - 2"											EXISTING TO REMAIN
GD4		9' - 2"	8' - 2"											EXISTING TO REMAIN
GD5		9' - 2"	8' - 2"											EXISTING TO REMAIN
GD6		9' - 2"	8' - 2"											EXISTING TO REMAIN
SH1	D3	7' - 0"	4' - 4"	1/2"	MTL	TBD	-	MTL	TBD	5/A517	4/A517		N/A	
MEZZANINE														
202A	D1	2' - 6"	7' - 0"	1 3/4"	HM	PTD	F1	HM	PTD	4/A601 Sim	4/A601 Sim		13	
LOW ROOF - T.O. MASONRY														
201A	D1	3' - 0"	5' - 10"	1 3/4"	HM	P-X / P-X	F1	HM	P-X / P-X	6/A600	6/A600		5.1	
201B	D1	3' - 0"	5' - 10"	1 3/4"	HM	P-X / P-X	F1	HM	P-X / P-X	6/A600	6/A600		5.1	
202B	D1	3' - 0"	5' - 10"	1 3/4"	HM	P-X / P-X	F1	HM	P-X / P-X	6/A600	6/A600		5.1	

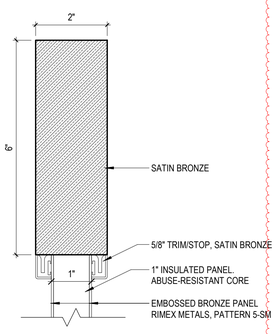


Door Types
1/4" = 1'-0"

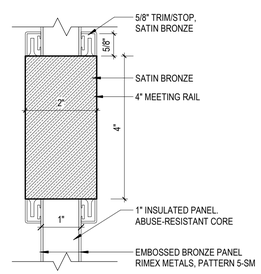


NOTE: COORDINATE FRAME DETAIL W/ PLANS AND WALL TYPES

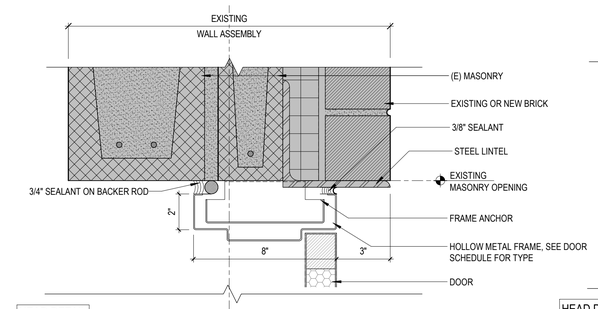
Frame Types
1/4" = 1'-0"

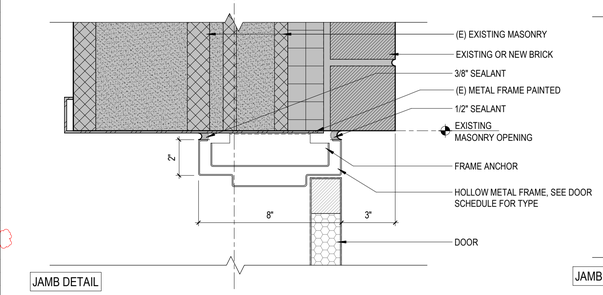


3 Head/Jamb Detail @ Front Entry Door
6" = 1'-0"

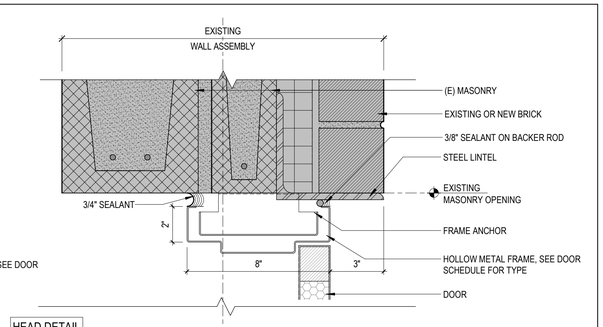


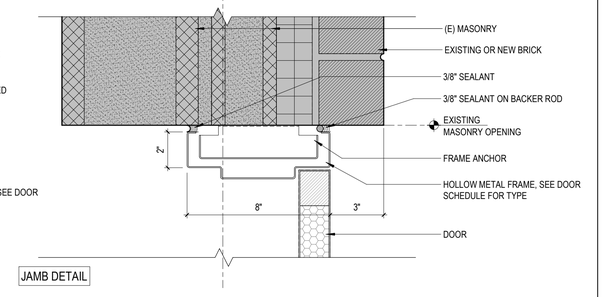
4 Rail Detail @ Front Entry Door
6" = 1'-0"



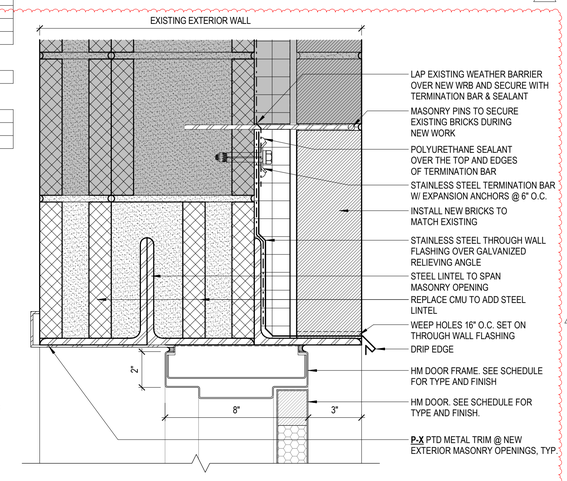


1 Door Frame @ Existing Masonry, Exterior Type A
3" = 1'-0"

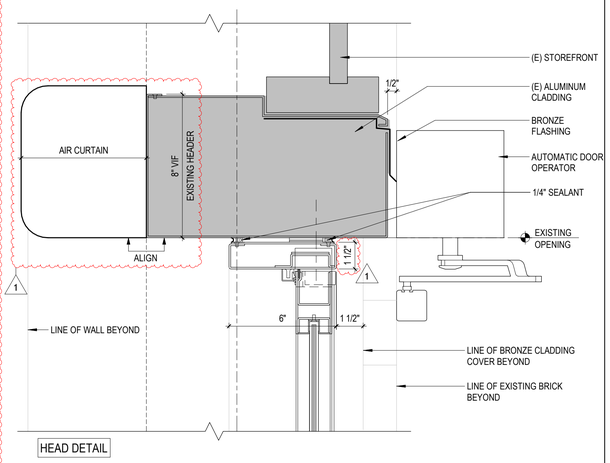


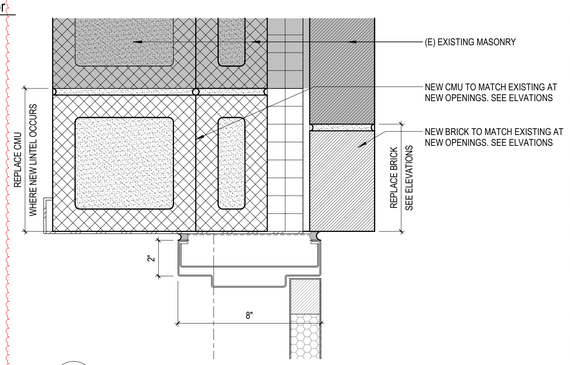


2 Door Frame @ Existing Masonry, Exterior Type B
3" = 1'-0"

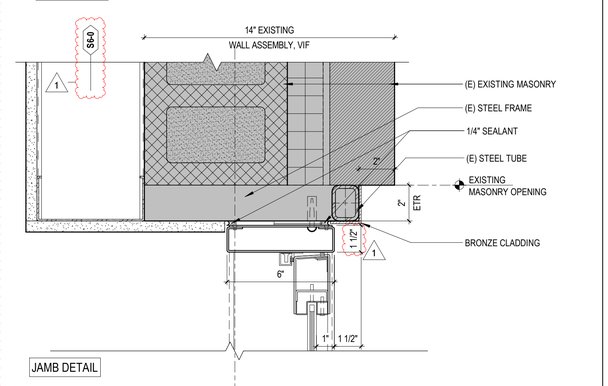


6 Typical Door Head Detail @ New Masonry Opening
3" = 1'-0"





7 Typical Door Jamb Detail @ New Masonry Opening
3" = 1'-0"



5 Door Frame @ Existing Masonry, Front Entry Door
3" = 1'-0"

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Bargmann Hendrie + Archetype, Inc.
9 Channel Center Street, Suite 300
Boston, MA 02210
(617) 350 0450

PROJECT NAME
Davey Lopes Recreation Center
227 Dudley Street
Providence, RI 02907

CLIENT
City of Providence
25 Dorrance Street
Providence, RI 02903

PROJECT TEAM

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Land Surveyor
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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE
Door Schedule & Details

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

As indicated — SCALE
Author — DRAWN BY
3524 — PROJECT #
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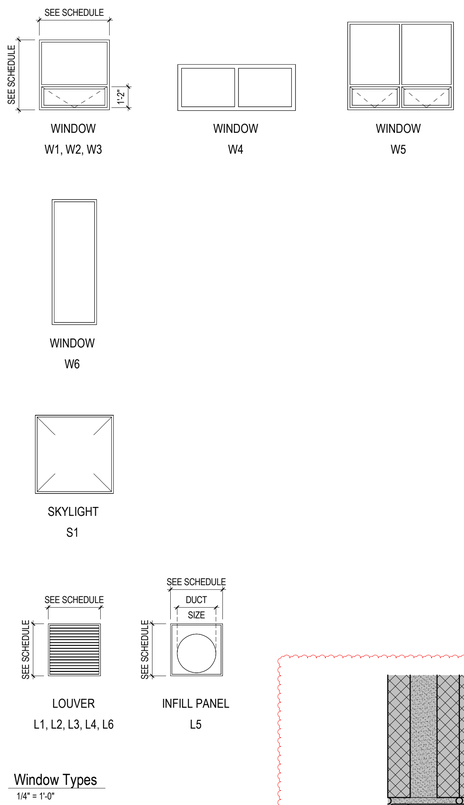
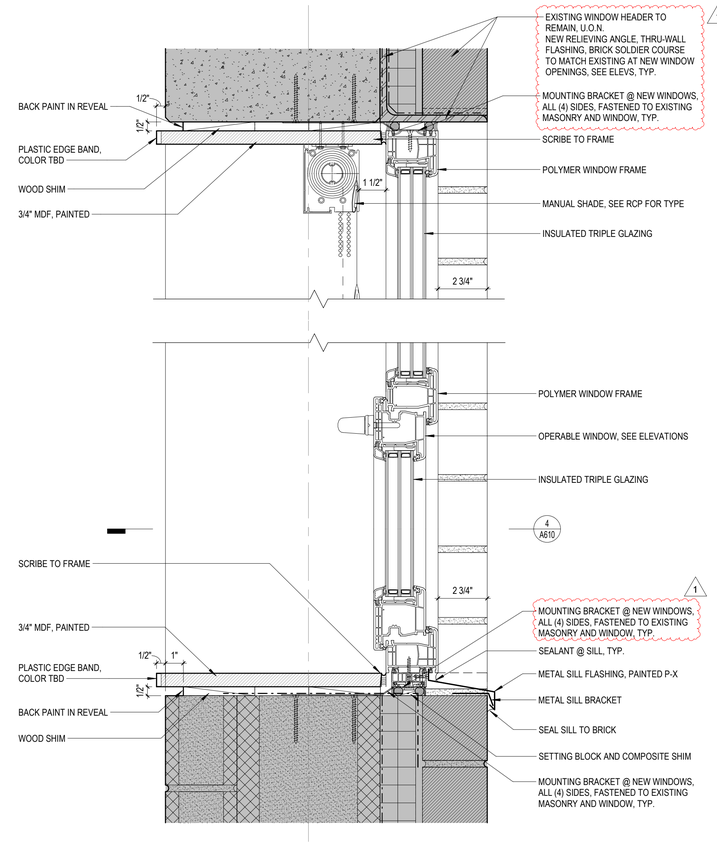
Window & Louver Schedule

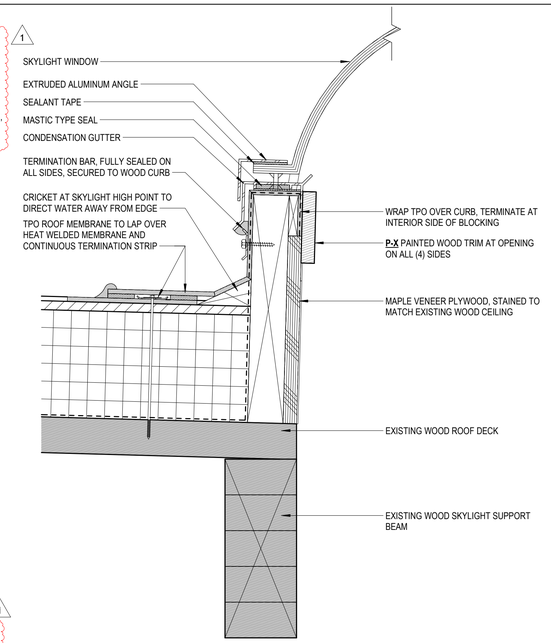
Type Mark	Width	Height	Count	Comments
L1	2'-11"	2'-11"	2	VIF MASONRY OPENING
L2	2'-1"	1'-5"	2	VIF MASONRY OPENING
L3	4'-0"	1'-0"	2	VIF MASONRY OPENING
L4	2'-9"	3'-10"	2	VIF MASONRY OPENING
L5	2'-11"	2'-11"	1	VIF MASONRY OPENING
L6	2'-5"	1'-11"	1	
S1	4'-4"	4'-4"	4	VIF ROOF OPENING
W1	3'-11"	3'-11"	4	VIF MASONRY OPENING
W2	3'-3"	5'-3"	5	VIF MASONRY OPENING
W3	4'-11"	6'-3"	3	CUT NEW OPENING
W4	6'-7"	2'-7"	2	VIF MASONRY OPENING
W5	5'-11"	4'-11"	1	VIF MASONRY OPENING
W6	2'-6"	7'-0"	3	



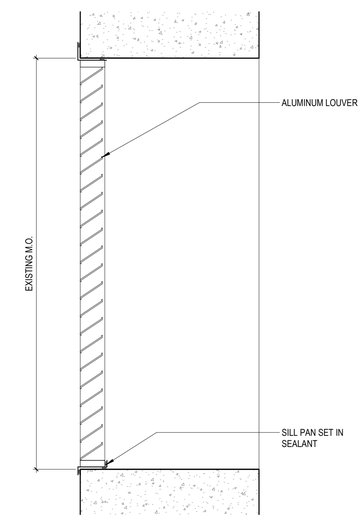
Window Types
1/4" = 1'-0"



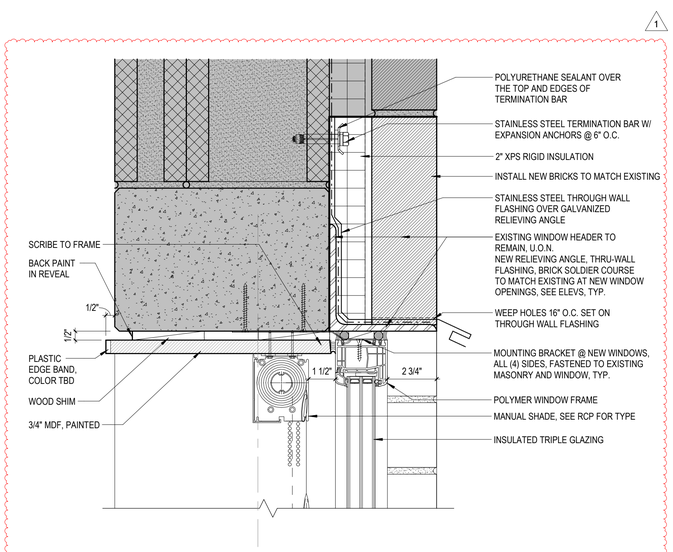
3 Typical Section Detail @ Window Head & Sill
3" = 1'-0"



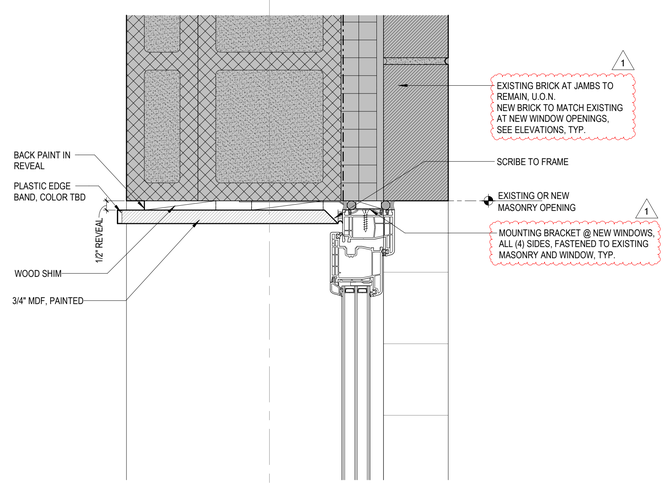
5 Window Detail @ Skylight
3" = 1'-0"



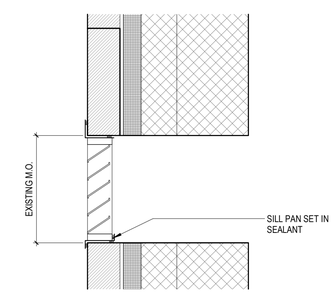
6 Typical Louver Detail @ Concrete Wall
1 1/2" = 1'-0"



1 Section Detail @ Window Head, New Brick
3" = 1'-0"



4 Typical Section Detail @ Window Jamb
3" = 1'-0"



7 Typical Louver Detail @ Masonry Wall
1 1/2" = 1'-0"

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REVISIONS

1	Addendum 1	05/16/2025

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Window Schedule & Details

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Room Finish Schedule

ROOM NUMBER	ROOM NAME	FLOORS	BASE	WALL	CEILING	NOTES
BASEMENT						
B01	MECHANICAL ROOM	EXISTING CONCRETE-SEALED	NO BASE	EXISTING TO REMAIN	EXISTING TO REMAIN	
B02	STORAGE	EXISTING CONCRETE-SEALED	NO BASE	EXISTING TO REMAIN	EXISTING TO REMAIN	
FIRST FLOOR						
101	LOBBY	PC-1	PC-1A	PTD CMU/P-2/P-7	ACT-1	
102	RECEPTION	PC-1	PC-1A	PTD CMU/GWB/P-1/P-2	ACT-1	
103	REC. MANAGER	LVT-1	RB-2	GWB/P-1	ACT-1	
104	KITCHENETTE	VCT-2	RB-3	PTD CMU	ACT-2	
105	CORRIDOR	LVT-1/LVT-2	RB-1	PTD CMU/P-10	ACT-1	
106	COMPUTER ROOM	LVT-4	RB-2	GWB/P-1/P-3	ACT-1	
107	JAN.	VCT-1	RB-3	PTD CMU	EXISTING TO REMAIN	
108A	BOY'S RESTROOM	CT-1	CT-2/CT-5A	CT-3/CT-5	ACT-2	MARBLE THRESHOLD
108B	BOY'S LOCKER RM	EPOXY-1	EPOXY BASE	PTD CMU/GWB/P-1	ACT-2	MARBLE THRESHOLD
108C	BOY'S LOCKER RM	EPOXY-1/CT-1	EPOXY BASE/CT-2	CT-3/GWB/P-1	ACT-2/GWB	MARBLE THRESHOLD
108D	BOY'S LOCKER RM FOYER	EPOXY-1	EPOXY BASE	PTD CMU/GWB/P-1	ACT-2	MARBLE THRESHOLD
109	STORAGE	VCT-2	RB-3	PTD CMU/GWB/P-1	EXISTING TO REMAIN	
110	CORRIDOR	LVT-1/LVT-2	RB-1	PTD CMU	ACT-1	
111	GYMNASIUM	EXISTING TO REMAIN	EXISTING TO REMAIN	EXISTING TO REMAIN	EXISTING TO REMAIN	
112	CORRIDOR	LVT-1/LVT-2	RB-1	PTD CMU/P-10	ACT-1	
113	LOUNGE	LVT-3	RB-2	GWB/P-1/P-4	ACT-1	
114	JAN.	VCT-1	RB-3	PTD CMU	EXISTING TO REMAIN	
115A	GIRL'S RESTROOM	CT-1	CT-2/CT-4A	CT-3/CT-4	ACT-2	MARBLE THRESHOLD
115B	GIRL'S LOCKER RM	EPOXY-1/CT-1	EPOXY BASE/CT-2	CT-3	ACT-2	MARBLE THRESHOLD
116	STORAGE	VCT-2	RB-3	GWB/P-1	EXISTING TO REMAIN	
117	RESTROOM	CT-1	CT-2	CT-3	ACT-2/GWB	MARBLE THRESHOLD
118	CORRIDOR	LVT-1/LVT-2	RB-1	PTD CMU/GWB/P-1	GWB	
119	ZOOM 1	LVT-1	RB-2	GWB/P-1/P-11	ACT-1	
120	ZOOM 2	LVT-1	RB-2	GWB/P-1/P-12	ACT-1	
121	ZOOM 3	LVT-1	RB-2	GWB/P-1/P-13	ACT-1	
122	RESTROOM	CT-1	CT-2	CT-3	EXISTING TO REMAIN	MARBLE THRESHOLD
123	STORAGE / MECH.					
124	MULTIPURPOSE ROOM	LVT-1/LVT-7	RB-1	PTD CMU/GWB/P-1/P-5	EXISTING WOOD DECK	
124A	STORAGE	VCT-2	RB-3	GWB/P-1	EXISTING WOOD DECK	
124B	STORAGE	VCT-2	RB-3	GWB/P-1	EXISTING WOOD DECK	
124C	AV	VCT-2	RB-3	GWB/P-1	EXISTING WOOD DECK	
126	CORRIDOR	LVT-1/LVT-2	RB-1	PTD CMU	EXISTING WOOD DECK	
MEZZANINE						
202	MECHANICAL					
LOW ROOF - T.O. MASONRY						
201	SERVICE CATWALK					

FINISH LEGEND

PAINT

P-1: BENJAMIN MOORE OC-68 DISTANT GRAY 1
TYPICAL WALL COLOR

P-2: BENJAMIN MOORE 824 YIN YANG
LOCATION: MAIN LOBBY ACCENT

P-3: BENJAMIN MOORE 1679 BEDFORD BLUE
LOCATION: COMPUTER ROOM

P-4: BENJAMIN MOORE 1300 TUCSON RED
LOCATION: LOUNGE

P-5: BENJAMIN MOORE 1386 PURPLE RAIN
LOCATION: MULTIPURPOSE ROOM

P-6: BENJAMIN MOORE CEILING WHITE
LOCATION: GWB CEILINGS AND SOFFITS

P-7: BENJAMIN MOORE 2137-60 GRAY OWL
LOCATION: MAIN LOBBY

1

P-8: BENJAMIN MOORE OC-57 WHITE HERON
LOCATION: GLAZED BLOCK

P-9: BENJAMIN MOORE HC-180 CLIFFSIDE GRAY
LOCATION: CMU

P-10: COLOR TBD
LOCATION: GLAZED BLOCK ACCENT

1

P-11: BENJAMIN MOORE CW-670 AZURITE
LOCATION: ZOOM ROOM ACCENT 1

P-12: BENJAMIN MOORE CW-295 HALE ORANGE
LOCATION: ZOOM ROOM ACCENT 2

P-13: BENJAMIN MOORE CSP-475 WILD MULBERRY
LOCATION: ZOOM ROOM ACCENT 3

P-14: COLOR TBD
LOCATION: WINDOW REVEAL

P-15: BENJAMIN MOORE 2134-30 IRON MOUNTAIN
LOCATION: GYM AND KITCHENETTE METAL FRAMES

P-16: COLOR TBD
LOCATION: BACKPAINTED GWB PERFORATED METAL PANELS

1

P-17: COLOR TBD
LOCATION: BACKPAINTED MDF @ WOOD SLATS

P-18: BENJAMIN MOORE 1103 CAMEL BACK
LOCATION: TYPICAL INTERIOR DOOR PANEL COLOR

P-19: BENJAMIN MOORE 1490 COUNTRY LIFE
LOCATION: TYPICAL INTERIOR DOOR FRAME COLOR

P-20: COLOR TBD
LOCATION: WINDOW TRIM

1

P-21: BENJAMIN MOORE 2128-10 BLACK BEAUTY
LOCATION: GYM DOOR PANELS

P-22: COLOR TBD
LOCATION: EXTERIOR DOOR (EXTERIOR SIDE)

CERAMIC TILE

CT-1: BEST TILE
WAVE - ASH
4X4
MATTE FINISH
LOCATION: RESTROOM/LOCKER ROOM FLOORS

CT-2: DALTILE
4X12 TILE COVE BASE TO MATCH WALL COLOR

CT-3: DALTILE
COLOR WHEEL LINEAR - MATTE ARCTIC WHITE
4X12 SUBWAY TILE, BULLNOSE

CT-4: DALTILE
COLOR WHEEL CLASSIC- MUSTARD
6X6 ACCENT TILE
LOCATION: LOCKER ROOMS

CT-4A: DALTILE
FLAT TOP COVE BASE - MUSTARD
6X6
LOCATION: LOCKER ROOMS

CT-5: DALTILE
COLOR WHEEL CLASSIC - ELECTRIC BLUE
6X6 ACCENT TILE
LOCATION: LOCKER ROOMS

CT-5A: DALTILE
FLAT TOP COVE BASE - ELECTRIC BLUE
6X6
LOCATION: LOCKER ROOMS

PORCELAIN TILE

PC-1: DALTILE
12X24 PORCELAIN FLOOR TILE
VOLUME 1.0 - TRUFFLE

PC-1A: DALTILE
6 X12 PORCELAIN BASE COVE BASE

SOLID SURFACE

SS-1: WILSONART - ARCTIC DUNE 9253CM
LOCATION: RECEPTION DESK

SS-2: WILSONART - SOOTHING GRAY 9116GS
LOCATION: KITCHENETTE COUNTER

SS-3: WILSONART - TITANIUM GRAY 9222SS
LOCATION: ZOOM ROOM COUNTERS

EPOXY FLOORING AND BASE

1

EPOXY-1: DUR-A-FLEX
COLOR: Q28-31
LOCATION: LOCKER ROOMS

EPOXY BASE: EPOXY-1 SYSTEM + INTEGRAL BASE

VINYL TILE

LVT-1: SHAW CONTRACT
FUNCTION 5.0 - 86100 SILICA
18" X 18" TILE
5 MM
LOCATION: CORRIDORS

LVT-2: JNJ FLOORING
MAKE YOUR MARK - 1072 MARIGOLD
9" X 48" PLANKS
5 MM
LOCATION: CORRIDOR ACCENT

LVT-3: SHAW CONTRACT
CODED - 43715 FLUENT
6" X 48" PLANKS
5 MM
LOCATION: LOUNGE

LVT-4: SHAW CONTRACT
CODED - 43518 IMPLY
6" X 48" PLANKS
5 MM
LOCATION: COMPUTER ROOM

LVT-5: NOT USED

LVT-6: NOT USED

LVT-7: JNJ FLOORING
MAKE YOUR MARK - 1074 CANDY
9" X 48" PLANKS
5 MM
LOCATION: MPR ACCENT

VINYL COMPOSITE TILE

VCT-1: ARMSTRONG EXCELON IMPERIAL TEXTURE - SOFT WARM GRAY
12" X 12"
LOCATION: JANITOR CLOSETS

VCT-2: ARMSTRONG EXCELON IMPERIAL TEXTURE
SOFT WARM GRAY
12" X 12"
LOCATION: STORAGE, KITCHENETTE, AV

RESILIENT BASE

RB-1: TARKETT
6" RUBBER BASE, COVE PROFILE
24 GREY HAZE
LOCATION: CORRIDORS, MULTIPURPOSE ROOM

RB-2: TARKETT
4" RUBBER BASE, COVE PROFILE
24 GREY HAZE
LOCATION: OFFICES, ZOOM ROOMS, COMPUTER ROOM, LOUNGE

RB-3: TARKETT
4" RUBBER BASE, COVE PROFILE
1 55 SILVER GREY
LOCATION: STORAGE, JANITOR CLOSETS, KITCHENETTE

ACOUSTIC CEILING TILE

ACT-1: 24X24 ACOUSTIC TILE, SQUARE TEGULAR EDGE, 9/16" REVEAL GRID

ACT-2: 24X24 ACOUSTIC TILE, WASHABLE, TAPERED TEGULAR EDGE, 9/16" GRID

WOOD

WV-1: WOOD VENEER - RIFT SLICED, WHITE OAK
OPEN FINISH, SHEEN 50

WD-1: SOLID WOOD - RIFT SLICED, WHITE OAK
OPEN FINISH, SHEEN 50, STAINED TO MATCH WV-1

METALS

MTL-1: X LACQUERED STEEL
LOCATION: BASES AT RECEPTION DESK, FEATURE WALL AND KITCHENETTE

MTL-2: MCNICHOLS - PERFORATED METAL, STAINLESS STEEL,
1/4" ROUND ON 3/8" STG CTRS, 60 DEGREE STAGGERED CENTERS, 40% OPEN
LOCATION: RECEPTION DESK, FEATURE WALL AND KITCHENETTE

MTL-3: X METAL
LOCATION: PORTAL FRAMES AT FEATURE WALL AND KITCHENETTE

1

PLASTIC LAMINATE

PL-1: FORMICA - 459-58 BRITE WHITE, MATTE
LOCATION: RECEPTION DESK, KITCHENETTE BASE CABINETS

PL-2: FORMICA - 927- FOLKSTONE GRAY, MATTE
LOCATION: RECEPTION DESK PANELS

PL-3: FORMICA - 2962-90 CLEMENTINE, GLOSSY
LOCATION: FEATURE WALL TV NICHES

PL-4: FORMICA - 845-58 SPECTRUM RED, GLOSSY
LOCATION: KITCHENETTE SURROUND EDGE BAND

PL-5: FORMICA - 2962-90 CLEMENTINE, GLOSSY
LOCATION: KITCHENETTE SURROUND SURFACES

PL-6: FORMICA - COLOR TBD
LOCATION: REVEAL AT DISPLAY CABINETS

PL-7: FORMICA - COLOR TBD
LOCATION: WINDOW EDGE BAND

1

FABRIC TACK BOARD PANEL

FP-1: KNOLL TEXTILES - CRISS CROSS W305/4 ALUMINUM
LOCATION: RECEPTION DESK

GENERAL PAINTING NOTES:

1. EGGSHELL FINISH ON GWB WALLS.
2. FLAT ON CEILINGS.
3. SEMI-GLOSS ON TRIM AND DOORS AND FRAMES TO RECEIVE PAINT.

ARCHITECT

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PROJECT NAME

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CLIENT

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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE

Room Finish Legend & Schedule

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/2" = 1'-0"
SCALE

Author
DRAWN BY

3524
PROJECT #

3524 - Davey Lopes v24_Educational.rvt
FILE NAME

DRAWING NUMBER

A700

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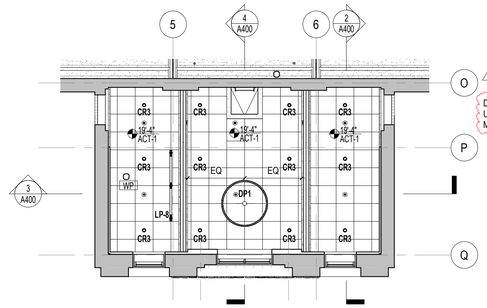
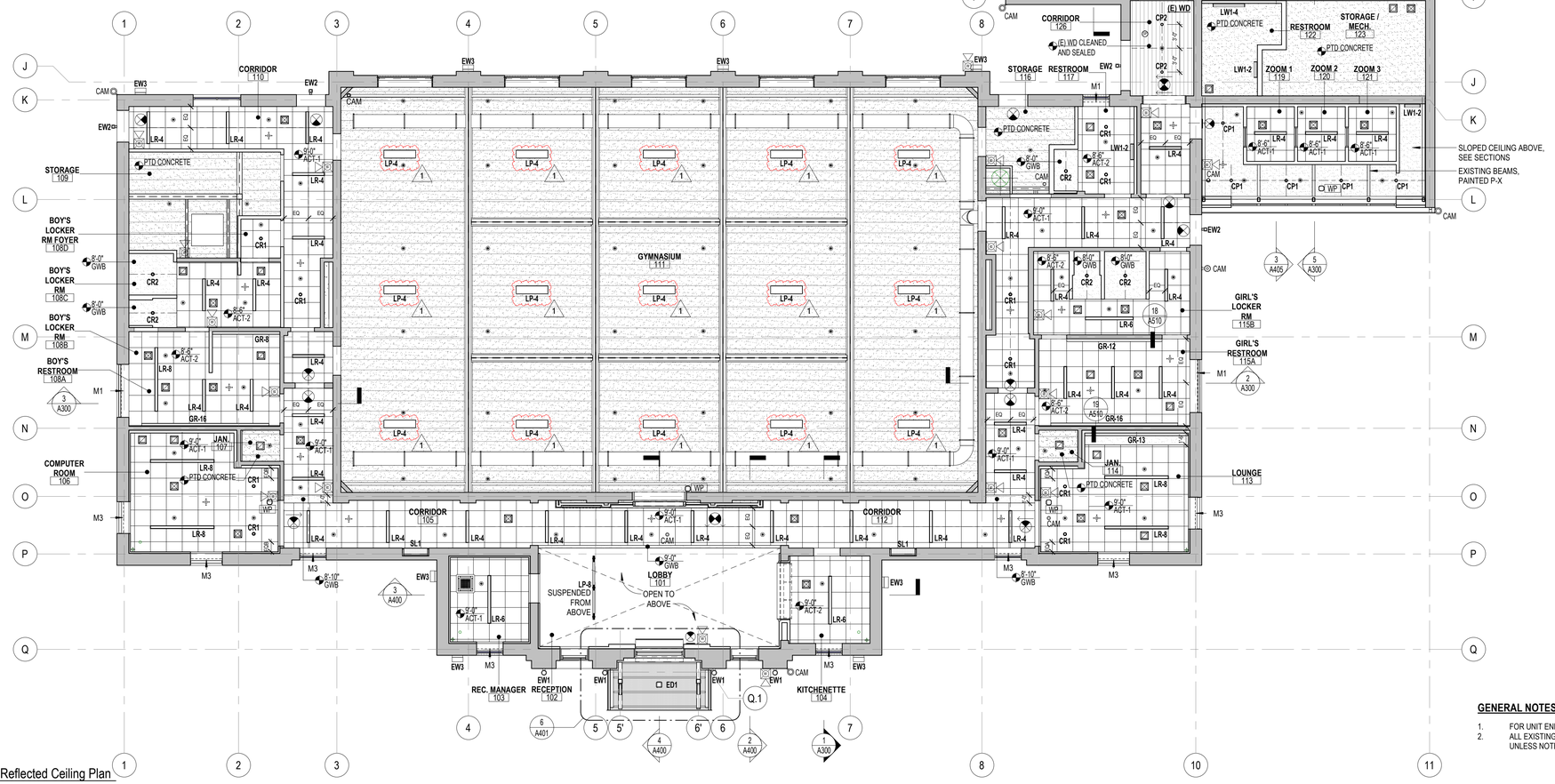


2 Second Floor - Lobby Reflected Ceiling Plan
1/8" = 1'-0"



1 First Floor - Reflected Ceiling Plan
1/8" = 1'-0"

REFLECTED CEILING PLAN LEGEND

(E) CD	EXISTING CONCRETE DECK (SEE GENERAL NOTES FOR CEILING TREATMENT)
(E) WD	EXISTING WOOD DECK (SEE GENERAL NOTES FOR CEILING TREATMENT)
GWB	GYPSUM WALL BOARD
ACT-1 ACT-2	ACOUSTICAL CEILING 2X2 ACOUSTICAL CEILING 2X2 (MOISTURE RESISTANT)
M#	ROLLER SHADE, # INDICATES % OPACITY
CAM	SECURITY CAMERA
	SUPPLY AIR DIFFUSER
	RETURN AIR GRILLE
PS	PROJECTION SCREEN
	SPRINKLER HEAD
	OCCUPANCY SENSOR
	EXIT SIGN
WP	WIRELESS ACCESS POINT
SP	SPEAKER
	CEILING CASSETTE
	FIRE ALARM HORN STROBE

LIGHTING LEGEND

(E)XX#-#
- INDICATES EXISTING TO REMAIN
- FIXTURE TYPE
- FIXTURE MOUNTING
- FIXTURE SUB-TYPE (IF USED)
- FIXTURE LENGTH (LINEAR FIXTURES)

INTERIOR LIGHT FIXTURES:

CP1	CYLINDER PENDANT
CR1	CYLINDER RECESSED
CR2	CYLINDER RECESSED, LENSED, WET LABELED
CR3	CYLINDER RECESSED
CS1	CYLINDER SURFACE MOUNT
DP1	DECORATIVE PENDANT
GR-#	GRAZER RECESSED (# INDICATES LENGTH)
LP-#	LINEAR PENDANT (# INDICATES LENGTH)
LR-#	LINEAR RECESSED (# INDICATES LENGTH)
LW-#	LINEAR WALL MOUNTED (# INDICATES LENGTH)
SL1	SURFACE MOUNTED STRIP LIGHT

EXTERIOR LIGHT FIXTURES:

ED1	EXTERIOR DOWNLIGHT
EW1	EXTERIOR WALL SCONCE
EW2	EXTERIOR WALL DOWNLIGHT
EW3	EXTERIOR WALL PACK

GENERAL NOTES

1. FOR UNIT ENLARGED REFLECTED CEILING PLAN SEE **SHEET A401, A402, A403, A404.**
2. ALL EXISTING PRECAST CONCRETE DECK TO RECEIVE TEXTURE CEILING FINISH PER FINISH SCHEDULE UNLESS NOTED OTHERWISE. (SEE SPEC SECTION 009000 TEXTURED CEILING).

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REVISIONS

1	Addendum 1	05/16/2025

DATE

DRAWING TITLE
First Floor Reflected Ceiling Plan

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

As indicated	Author
SCALE	DRAWN BY
3524	3524 - Davey Lopes v24_Educational.rvt
PROJECT #	FILE NAME

DRAWING NUMBER
A721

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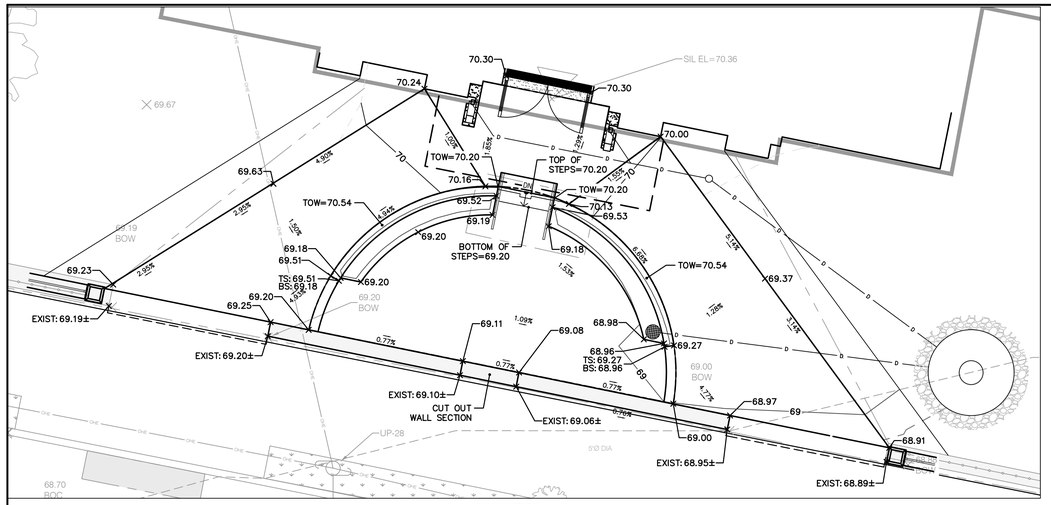

INSET
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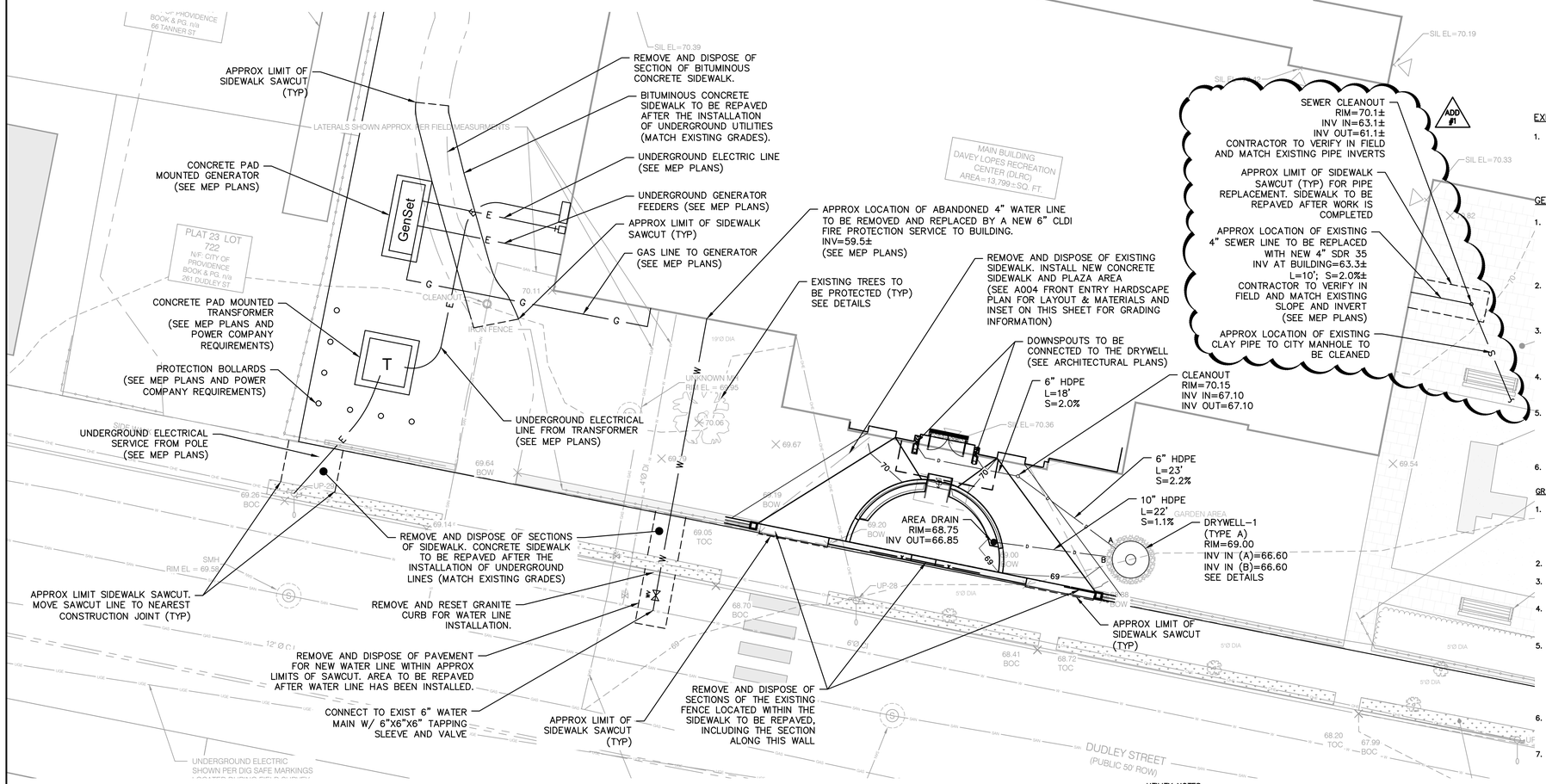

N

GRAPHIC SCALE

10 0 5 10 20 40

(IN FEET)
1 INCH = 10 FT.

EXISTING CONDITIONS/SURVEY NOTES:

1. EXISTING CONDITIONS, INCLUDING TOPOGRAHIC AND UTILITY INFORMATION, IS BASED ON A PLAN PREPARED BY NARRAGANSETT ENGINEERING, INC., ENTITLED "DAVEY LOPES RECREATION CENTER LIMITED CONTENT BOUNDARY SURVEY, DATED NOVEMBER 4, 2024, REVISED 12-23-24, AND MARKED "DRAFT FOR REVIEW ONLY". SEE SURVEY PLAN FOR EXISTING CONDITION AND OTHER RELATED SURVEY NOTES.

GENERAL CONSTRUCTION AND DEMOLITION NOTES:

1. PRIOR TO THE START OF CONSTRUCTION. NOTIFY "DIG-SAFE" AT 1-888-344-7233 AT LEAST 72 HOURS PRIOR TO ANY SITE DEMOLITION OR EXCAVATION. THE CONTRACTOR IS ADVISED THAT THE LOCATIONS OF ALL EXISTING UTILITIES ARE APPROXIMATE AND THAT ALL UTILITIES MAY NOT BE SHOWN. PRIOR TO THE START OF CONSTRUCTION THE CONTRACTOR SHALL FIELD VERIFY THE LOCATIONS OF ALL EXISTING UTILITIES. THE CONTRACTOR IS RESPONSIBLE FOR ALL DAMAGE TO EXISTING UTILITIES NOT SCHEDULED FOR DEMOLITION.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR WHEEL CLEANING OF ALL CONSTRICTION VEHICLES BEFORE EXISTING THE SITE. ANY TRACKED DIRT FROM CONTRACTOR OR SUBCONTRACTOR VEHICLES ONTO THE ACCESS ROAD OR PUBLIC RIGHTS OF WAY SHALL BE SWEPT UP AT THE CONTRACTORS EXPENSE.
3. REMOVAL OF ANY WORK OR ITEM SHALL INCLUDE OFFSITE LEGAL DISPOSAL OF SAME. ALL REMOVAL AND DISPOSAL WORK SHALL BE PERFORMED IN A SAFE AND LEGAL MANNER. THE CONTRACTOR'S DISPOSAL PRACTICE OF ANY EXCESS MATERIAL SHALL COMPLY WITH ALL FEDERAL, STATE, AND MUNICIPAL WASTE MANAGEMENT LAWS AND REGULATION.
4. ALL EXISTING STRUCTURES, INCLUDING BUT NOT LIMITED TO BUILDINGS, UTILITIES, WALKWAYS, RETAINING WALLS, PLANTING BEDS, TREES, FENCES, BENCHES, AND PLANTING GRATES NOT SUBJECTED TO THE SCOPE OF WORK SHALL BE PROTECTED DURING THE WORK.
5. THE CONTRACTOR SHALL RESTORE ALL LANDSCAPING AND HARDSCAPING AFFECTED BY THE DEMOLITION AND CONSTRUCTION ACTIVITIES IN KIND. THE CONTRACTOR SHALL PROVIDE LOAM AND SEED TO THE AREA AFFECTED BY THE INSTALLATION OF TRANSFORMER, GENERATOR, DRYWELLS, AND TRENCHING FOR ASSOCIATED UNDERGROUND PIPING THROUGH THE LAWN AREA. MATCH ALL EXISTING GRADES IN THE AFFECTED AREA.
6. ANY ITEM OR STRUCTURE DAMAGED BEYOND THE LIMITS OF WORK SHALL BE REPLACED IN KIND BY THE CONTRACTOR, AT HIS OWN EXPENSE.

GRADING AND DRAINAGE NOTES

1. ALL SITE WORK SHALL MEET OR EXCEED THE SITE WORK SPECIFICATIONS PREPARED FOR THIS PROJECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THAT THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS DO NOT CONFLICT WITH ANY KNOWN EXISTING OR OTHER PROPOSED IMPROVEMENTS. IF ANY CONFLICTS ARE DISCOVERED, THE CONTRACTOR SHALL NOTIFY THE ARCHITECT AND THE DESIGNER PRIOR TO ANY SITE WORK WHICH WOULD BE AFFECTED.
2. ALL DRAIN PIPES WITHIN THE SITE SHALL BE HDPE, UNLESS NOTED OTHERWISE.
3. ALL EXCESS EXCAVATED MATERIAL SHALL BE REMOVED FROM THE SITE BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
4. CONTRACTOR SHALL GRADE AND CONSTRUCT ALL ACCESSIBLE HANDICAP SIDEWALKS IN ACCORDANCE WITH THE MASSACHUSETTS STATE CODE AND THE AMERICANS WITH DISABILITIES ACT (ADA) ACCESSIBILITY GUIDELINES (WHICHEVER IS MORE STRINGENT).
5. THE CONTRACTOR SHALL VERIFY EXISTING GRADES IN THE FIELD AND REPORT ANY DISCREPANCIES IMMEDIATELY TO THE DESIGNER. THE CONTRACTOR SHALL MAKE ALL ARRANGEMENTS FOR THE ALTERATION AND ADJUSTMENT OF GAS, ELECTRIC, TELEPHONE AND ANY OTHER PRIVATE UTILITIES BY THE UTILITY COMPANIES, AS REQUIRED. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED TO THE OWNER AND ENGINEER FOR RESOLUTION.
6. CONTRACTOR SHALL PROTECT ALL UNDERGROUND DRAINAGE, SEWER AND UTILITY FACILITIES FROM EXCESSIVE VEHICULAR LOADS DURING CONSTRUCTION. ANY DAMAGE TO THESE FACILITIES RESULTING FROM CONSTRUCTION LOADS WILL BE RESTORED TO ORIGINAL CONDITION.
7. AT ALL LOCATIONS WHERE EXISTING CURBING OR PAVEMENT ABUTS NEW CONSTRUCTION, THE EDGE OF THE EXISTING CURB OR PAVEMENT SHALL BE SAW CUT TO A CLEAN, SMOOTH EDGE. BLEND NEW PAVEMENT, CURBS AND EARTHWORK SMOOTHLY INTO EXISTING BY MATCHING LINES, GRADES AND JOINTS.
8. PITCH EVENLY BETWEEN SPOT GRADES. GRADE ALL AREAS TO DRAIN.
9. SEE LA DRAWINGS FOR FRONT ENTRY HARDSCAPE LAYOUT AND MATERIALS INFORMATION.
10. PIPE LENGTHS AND SLOPES IN THE DRAINAGE STRUCTURE LABELS ARE BASED ON CENTER TO CENTER LENGTHS AND SLOPES.
11. IN ACCORDANCE WITH RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT (RIDEM) REQUIREMENTS, THE DESIGN AND INSTALLATION OF ALL DRYWELLS, AS SHOWN IN THE PLANS AND DETAILS, IS SUBJECT TO CONFIRMATION OF GROUNDWATER ELEVATIONS AND SOIL CLASSIFICATIONS BASED ON DEEP HOLE TESTS CONDUCTED IN THE DRYWELL AREAS. WITHOUT CONFIRMATION OF THESE PARAMETERS, THE DRYWELL DESIGNS WILL BE CONSIDERED PRELIMINARY, AS COMPLIANCE WITH RIDEM REGULATIONS AND GROUNDWATER OFFSET REQUIREMENTS HAS NOT BEEN VALIDATED. UPON COMPLETION OF THE DEEP HOLE TESTS, THE DRYWELL DESIGNS/DETAILS MAY REQUIRE ADJUSTMENTS, INCLUDING, AS NECESSARY, LARGER OR SHALLOWER DRYWELLS AND/OR ADDITIONAL DRYWELLS.

UTILITY NOTES

1. ALL SITE CONSTRUCTION SHALL BE IN CONFORMANCE WITH THE RHODE ISLAND DEPARTMENT OF TRANSPORTATION (DOT) STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, AND THE CITY OF PROVIDENCE PUBLIC WORKS.
2. EXCAVATION REQUIRED WITHIN THE PROXIMITY OF EXISTING UTILITY LINES SHALL BE DONE BY HAND. CONTRACTOR SHALL REPAIR ANY DAMAGE TO EXISTING UTILITY LINES OR STRUCTURES INCURRED DURING CONSTRUCTION OPERATIONS AT NO COST TO THE OWNER.
3. INSTALL ALL UTILITIES (INCLUDING CONCRETE PADS) PER UTILITY COMPANY AND DPW STANDARDS.
4. THE LOCATIONS OF THE TRANSFORMER, BOLLARDS, GENERATOR PAD, AND NEW UNDERGROUND UTILITIES, INCLUDING CONCRETE PAD SIZES ARE BASED ON A PLAN PROVIDED BY ALLIED CONSULTING ENGINEERING SERVICES, INC.
5. ALL SANITARY PIPE SHALL BE SDR-35 PVC UNLESS OTHERWISE NOTED.

ARCHITECT

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ERIC WILHELMSEN
No. 11457
REGISTERED PROFESSIONAL ENGINEER CIVIL
5-14-2025

REVISIONS

ADDENDUM #1	5/16/2025

DATE

DRAWING TITLE

Civil Site Plan

DRAWING INFORMATION

04/18/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1" = 10'-0"	PS
SCALE	DRAWN BY
	2171.0 BH+A DAVEY LOPES CD.dwg
3524	
PROJECT #	FILE NAME

DRAWING NUMBER

C101

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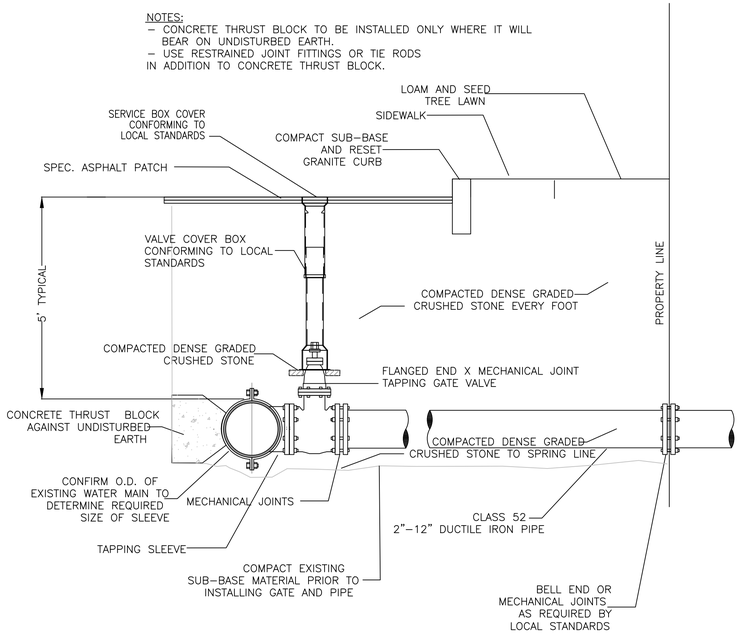
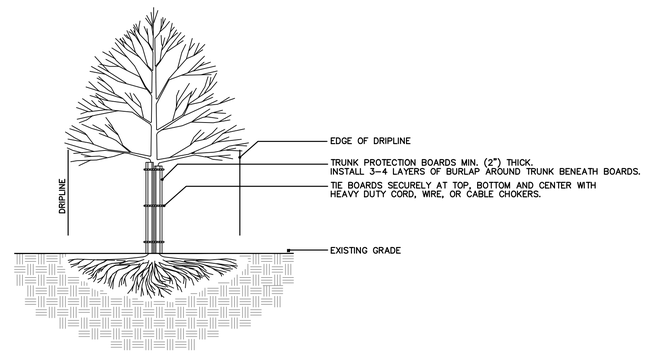
3/26/2025 1:03:36 PM Author

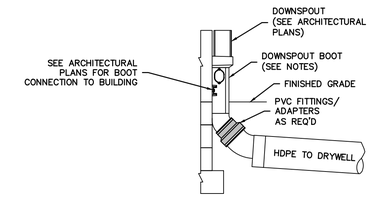
NOTES:
– CONCRETE THRUST BLOCK TO BE INSTALLED ONLY WHERE IT WILL BEAR ON UNDISTURBED EARTH.
– USE RESTRAINED JOINT FITTINGS OR TIE RODS IN ADDITION TO CONCRETE THRUST BLOCK.



1 TYPICAL TAPPING SLEEVE AND GATE VALVE WATER PIPE CONNECTION
(NOT TO SCALE)



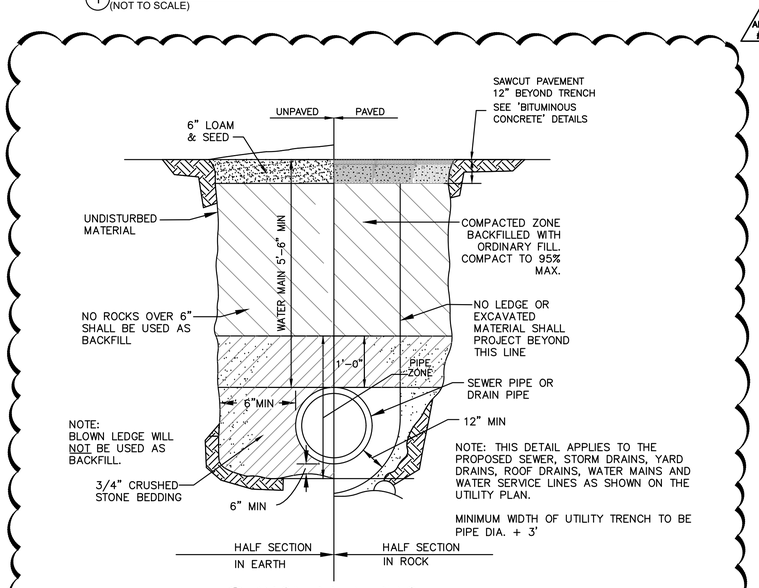
2 TYPICAL TREE PROTECTION
(NOT TO SCALE)



NOTES:
1. SEE ARCHITECTURAL PLANS FOR DOWNSPOUT AND BOOT CONNECTION TO THE BUILDING.

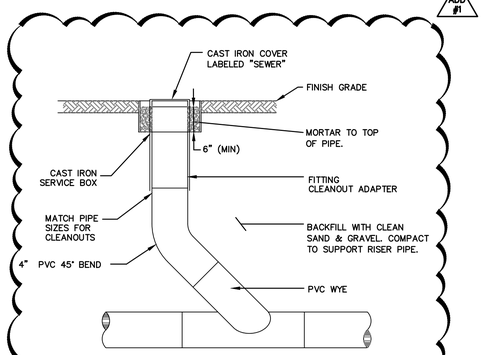
3 DOWNSPOUT BOOT CONNECTION TO DRAINAGE
(NOT TO SCALE)

ADD #1



4 TYPICAL PIPE IN TRENCH
(NOT TO SCALE)

ADD #1



5 SEWER CLEANOUT
(NOT TO SCALE)

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ERIC WILHELMSEN
No. 11457
REGISTERED PROFESSIONAL ENGINEER CIVIL
5-14-2025

REVISIONS

ADDENDUM #1	5/16/2025

DATE

DRAWING TITLE
Construction Details

DRAWING INFORMATION

04/18/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1" = 10'-0"	PS
SCALE	DRAWN BY
3524	2171.0 BH+A DAVEY LOPES CD.dwg
PROJECT #	FILE NAME

DRAWING NUMBER
C103

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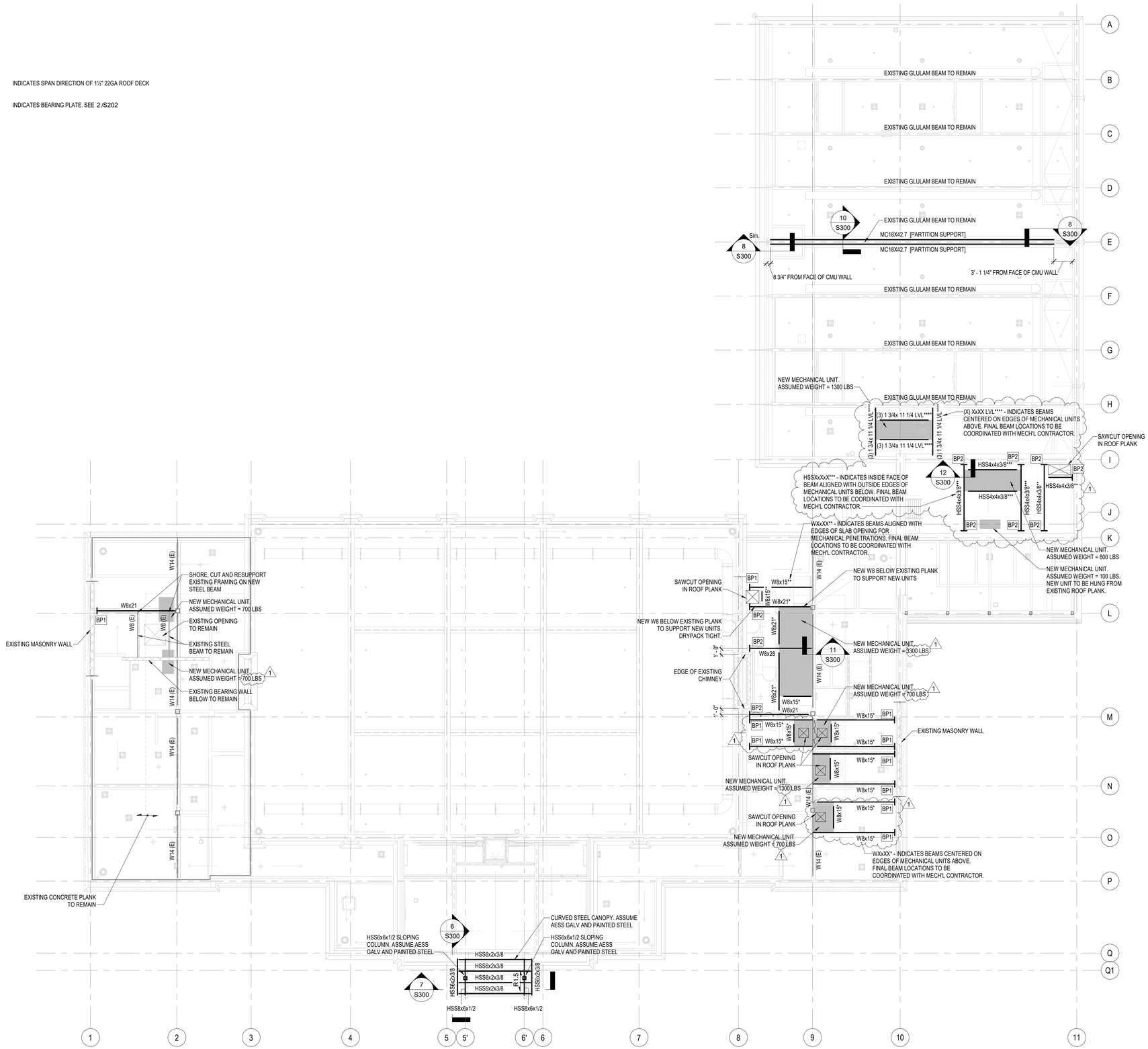
C:\Users\sshetler\OneDrive - Bargmann Hendrie + Archetype, Inc\Documents\3524 - Davey Lopes \24_Educational_\sshetler6N7ZZ.rvt
3/26/2025 1:03:36 PM Author

LEGEND:

R1.5 — INDICATES SPAN DIRECTION OF 1½" 22GA ROOF DECK

BPx — INDICATES BEARING PLATE. SEE 2/S202



SECOND FLOOR FRAMING PLAN 1

1/8" = 1'-0"

ARCHITECT

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REVISIONS

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DRAWING TITLE

SECOND FLOOR FRAMING PLAN

DRAWING INFORMATION

04/18/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/8" = 1'-0"
SCALE

EC, AB
DRAWN BY

3524
PROJECT #

3524 - Davey Lopes v24_Educational.rvt
FILE NAME

DRAWING NUMBER

S102

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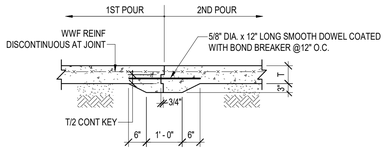
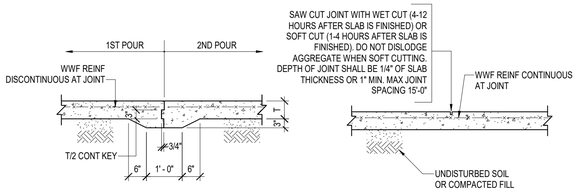


CONSTRUCTION JOINT AT HEAVY LOADING



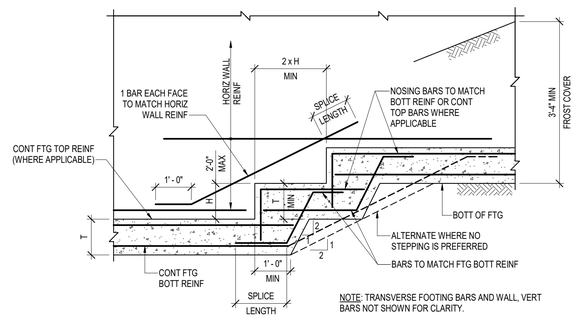
CONSTRUCTION JOINT

CONTROL JOINT

NOTE:

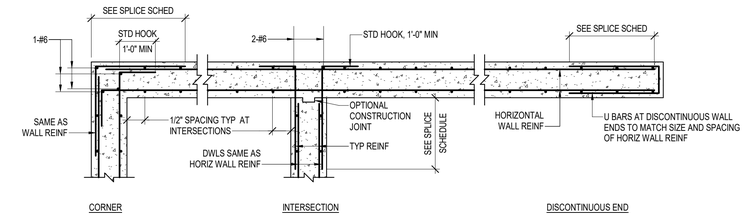
1. FILL SAW CUTS WITH RIGID OR SEMI RIGID JOINT FILLER WHERE REQUIRED BY ARCHITECT TO HIDE OR PROTECT JOINT.
2. SEE LAYOUT DETAIL FOR LOCATIONS OF SLAB ON GRADE JOINTS.
3. WWF REINFORCEMENT SHALL BE LOCATED WITHIN UPPER THIRD OF SLAB THICKNESS, OR 2" MAX FROM TOP OF SLAB.

SLAB ON GRADE JOINTS 1
1/2" = 1'-0"



NOTE: TRANSVERSE FOOTING BARS AND WALL, VERT BARS NOT SHOWN FOR CLARITY.

TYPICAL STEPPED FOOTING DETAIL AT FOUNDATION WALLS 2
1/2" = 1'-0"

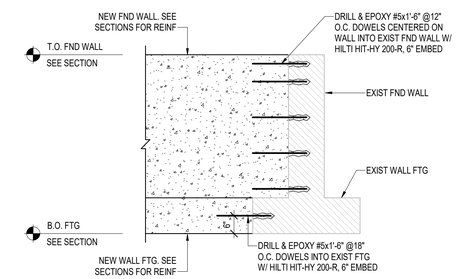


DOUBLE LAYER

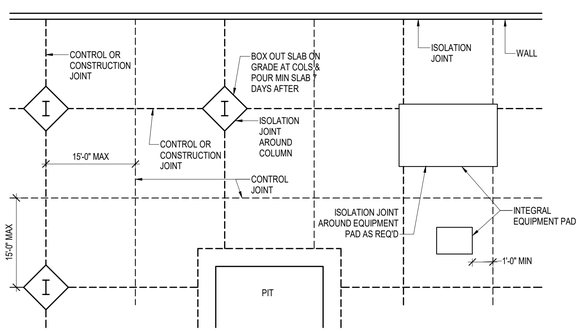
NOTES:

1. FOR WALL REINFORCEMENT, SEE FOUNDATION SECTIONS.
2. IF SPANS ARE LESS THAN 7 FEET, EXTEND REINFORCEMENT INTO ADJACENT SPAN.
3. ALL SPLICE LENGTHS ARE TENSION SPLICES PER CHARTS IN TYPICAL DETAILS.

TYPICAL WALL REINFORCEMENT DETAIL 4
1/2" = 1'-0"

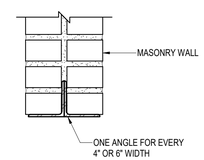


TYPICAL DETAIL AT NEW & EXISTING FOUNDATION WALL JOINT 3
1/2" = 1'-0"



PROVIDE SHOP DRAWINGS INDICATING PROPOSED JOINT LAYOUTS

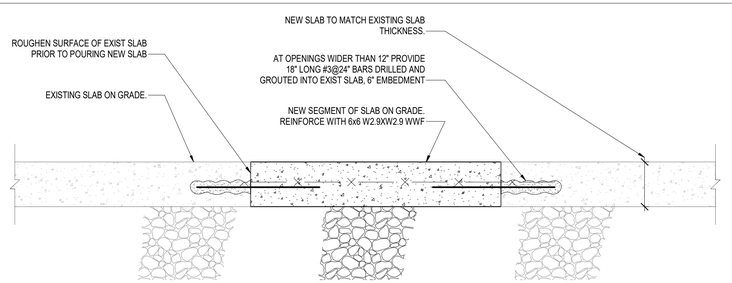
LAYOUT OF CONTROL AND CONSTRUCTION JOINTS IN CONCRETE SLABS ON GRADE 5
1/2" = 1'-0"

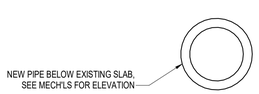


SECTION

1. PROVIDE AND INSTALL LINTEL ANGLES FOR MASONRY OPENINGS IN ACCORDANCE WITH THE SCHEDULE IN GENERAL NOTES. INSTALL LONG LEG VERTICAL. SEE ARCHT & MECHANICAL PLANS FOR LOCATIONS.
2. TO INSTALL LINTELS IN EXISTING MASONRY WALLS, SAWCUT MASONRY ON ONE SIDE AND PLACE FIRST ANGLE. THEN SAWCUT SECOND SIDE AND PLACE SECOND ANGLE. WHEN BOTH ANGLES ARE IN PLACE, PROCEED WITH REMAINING DEMOLITION.
3. PROVIDE 8" MIN BEARING AT EACH END BUT NOT LESS THAN 1" PER FOOT OF SPAN. FILL 2 COURSES OF MASONRY BELOW BEARING WITH MORTAR WHERE POSSIBLE.
4. WHERE MINIMUM BEARING CANNOT BE PROVIDED, ATTACH SECURELY TO ADJACENT STRUCTURAL MEMBERS OR PROVIDE SEPARATE SUPPORTS.
5. WHERE LINTELS OCCUR IN EXTERIOR WALLS MINIMUM THICKNESS SHALL BE 5/16" AND ANGLES SHALL BE HOT DIP GALVANIZED.

STEEL ANGLE LINTEL 7 1
1 1/2" = 1'-0"





INSTALLATION PROCEDURE:

1. SAW-CUT EXISTING SLAB ON GRADE TO CREATE TRENCH
2. AFTER PIPE PLACEMENT, FILL TRENCH WITH COMPACTED STRUCTURAL FILL UP TO LEVEL OF BOTTOM OF SLAB. USE ¾" CRUSHED STONE FOR LAST 12" LAYER.
3. ROUGHEN VERTICAL SURFACES OF EXISTING SLAB TO ¼" AMPLITUDE
4. POUR NEW SLAB ON GRADE, THICKNESS TO MATCH EXISTING.

TYPICAL EXISTING SLAB ON GRADE INFILL 6
1 1/2" = 1'-0"

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REVISIONS

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DRAWING TITLE

TYPICAL DETAILS

DRAWING INFORMATION

04/18/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

As indicated — SCALE
AB — DRAWN BY
3524 — PROJECT #
3524 - Davey Lopes v24_Educational.rvt — FILE NAME

DRAWING NUMBER

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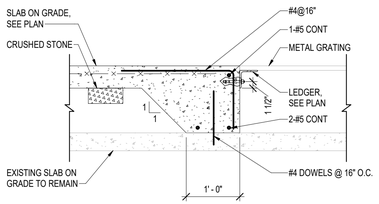
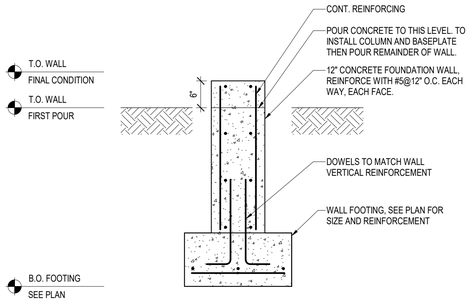
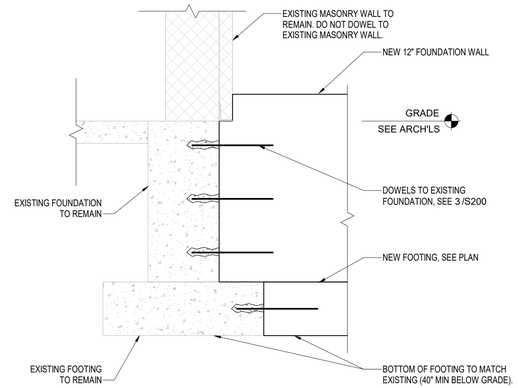


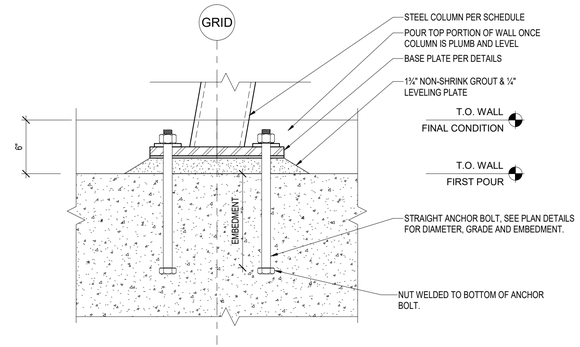
METAL GRATING SECTION 1
3/4" = 1'-0"



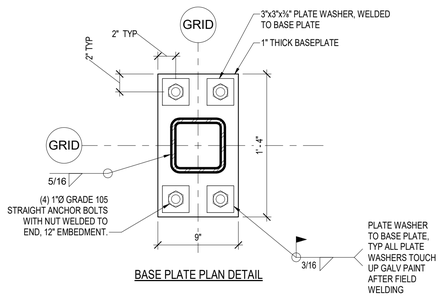
FOUNDATION SECTION 2
3/4" = 1'-0"



NEW FOUNDATION WALL SECTION 3
3/4" = 1'-0"

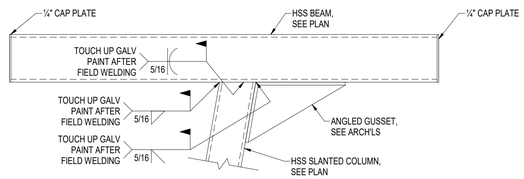


TYPICAL BASEPLATE SECTION 4
1 1/2" = 1'-0"

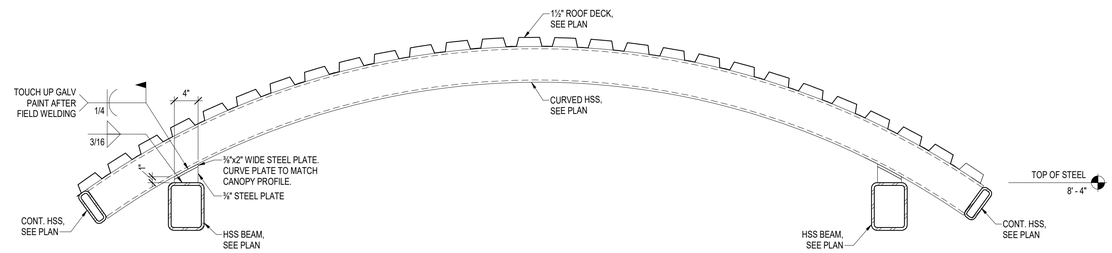


BASE PLATE PLAN DETAIL

BASEPLATE DETAIL 5
1 1/2" = 1'-0"



CANOPY SECTION 1 6
1" = 1'-0"



CURVED CANOPY SECTION 7
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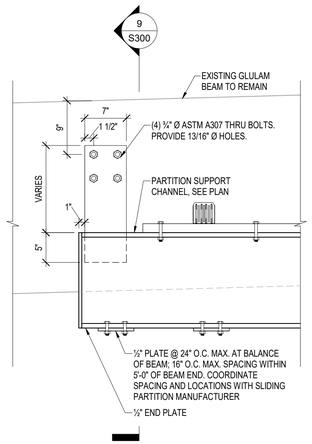
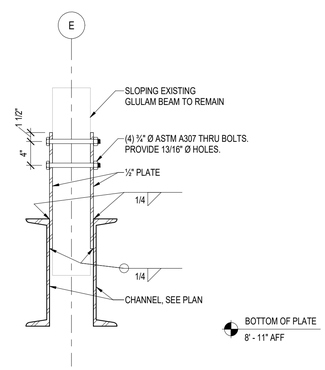
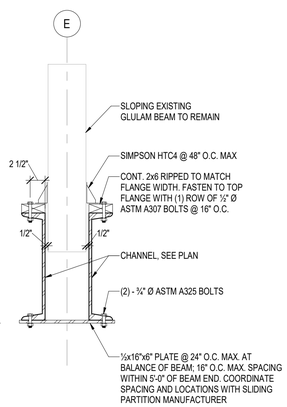


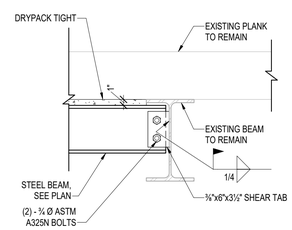
PARTITION BEAM CONNECTION 8
1" = 1'-0"



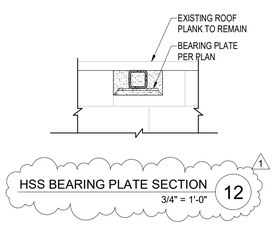
PARTITION BEAM CONNECTION 9
1" = 1'-0"



PARTITION BEAM SECTION 10
1" = 1'-0"



NEW W8 TO EXISTING BEAM 11
1" = 1'-0"



HSS BEARING PLATE SECTION 12
3/4" = 1'-0"

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1	ADDENDUM #1	05/16/2025

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DRAWING TITLE
SECTIONS

DRAWING INFORMATION

04/18/2025
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3524
PROJECT #

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S300

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PIPING LEGEND

- HVAC PIPE DEMO
- HVAC CH/HWR
- HVAC CH/HWS
- HVAC CHR
- HVAC CHS
- HVAC HWR
- HVAC HWS
- SMS — HVAC SMS
- HVAC CWR
- HVAC CWS
- HVAC REFS
- HVAC REFL
- HVAC COND
- DIRECTION OF PIPE PITCH (DOWN)
- DIRECTION OF FLOW
- PIPE DOWN
- PIPE UP

VALVE LEGEND

- 2-WAY MODULATING VALVE
- 3-WAY MODULATING VALVE
- 2-WAY SOLENOID VALVE
- 3-WAY SOLENOID VALVE
- STRAP-ON AQUASTAT
- LOCK SHIELD VALVE
- PRESSURE GAUGE W/ GAGE COCK
- PRESSURE REGULATING VALVE
- PRESSURE SENSOR
- PUMP A
- PUMP B
- RELIEF VALVE
- SHOT FEEDER
- STRAINER
- STRAINER W/ VALVE & CAP
- TEMPERATURE SENSOR
- THERMOSTAT
- UNION
- FS — FLOW SWITCH
- GLYCOL FEEDER
- SPIROVENT AIR ELIMINATOR
- AIR VENT MANUAL
- BALL VALVE
- BOILER
- BUTTERFLY VALVE
- CHECK VALVE
- CIRCUIT SETTER
- EXPANSION TANK
- FLEX PIPE CONNECTION
- PLATE & FRAME HEAT EXCHANGER

DUCTWORK LEGEND

- NEW SUPPLY/RETURN/EXHAUST DUCTWORK - SINGLE LINE
- EXISTING SUPPLY/RETURN/EXHAUST DUCTWORK - SINGLE LINE
- EXISTING DUCTWORK TO BE REMOVED - SINGLE LINE
- SUPPLY DUCT UP - SINGLE LINE
- RETURN DUCT UP - SINGLE LINE
- EXHAUST DUCT UP - SINGLE LINE
- SUPPLY DUCT DOWN - SINGLE LINE
- RETURN DUCT DOWN - SINGLE LINE
- EXHAUST DUCT DOWN - SINGLE LINE
- ROUND DUCT UP - SINGLE LINE
- ROUND DUCT DOWN - SINGLE LINE
- FLEX DUCT - SINGLE LINE
- 12x10 / 8x6 — DUCT TRANSITION - RECTANGULAR
- 12x10 / 8x6 — DUCT TRANSITION - RECTANGULAR TO SINGLE LINE
- 12x10 / 10"ø — DUCT TRANSITION - RECTANGULAR TO ROUND
- INSULATED DUCTWORK
- ACOUSTICALLY LINED DUCTWORK
- MITERED ELBOW W/ TURNING VANES
- SUPPLY AIR DIFFUSER BELOW DUCT
- RETURN / EXHAUST REGISTER BELOW DUCT
- R — CHANGE OF ELEVATION IN DIRECTION OF AIRFLOW (R)RISE,(D)DROP

AIR DEVICE LEGEND

SG	SIDEWALL SUPPLY GRILLE
SD	SUPPLY DIFFUSER
RG	RETURN GRILLE
EG	EXHAUST GRILLE
RG/EG	SIDEWALL RETURN/EXHAUST GRILLE
LD/RG/EG	LINEAR SUPPLY/RETURN/EXHAUST DIFFUSER
SD	SUPPLY DIFFUSER 4-WAY BLOW
SD	SUPPLY DIFFUSER 3-WAY BLOW
SD	SUPPLY DIFFUSER 2-WAY BLOW

DAMPERS

MD	MOTORIZED DAMPER
BDD	BACK DRAFT DAMPER
FD	FIRE DAMPER
FSD	FIRE & SMOKE DAMPER
VD	VOLUME DAMPER
CRD	CEILING RADIANT DAMPER

CONTROL SCHEMATIC LEGEND

CO2	CO2 SENSOR
T	THERMOSTAT
H	HUMIDITY SENSOR
S	SWITCH CONTROLLER
DS F	DUCT SMOKE DETECTOR
TS	TEMPERATURE SENSOR
	CONTROL LINE

DRAWING NOTES

- FCU / CC01 / 104 — EQUIPMENT DESIGNATION / SIZE / ROOM NUMBER
- FCU / 1 — EQUIPMENT DESIGNATION / TYPE
- SD1 / 16D-S / 100 — EQUIPMENT DESIGNATION / SIZE / CFM
- SD / 1 — EQUIPMENT DESIGNATION / CFM
- 1 — KEYED NOTE
- P.O.D. — POINT OF DEMOLITION
- CONNECT TO EXISTING
- 1 — REVISION TAG
- REVISION CLOUD

EQUIPMENT TAGS

AC	AIR CURTAIN
ACCU	AIR COOLED CONDENSING UNIT
AE	AIR ELIMINATOR
AHU	AIR HANDLING UNIT
ARC	AIR COOLED REFRIGERANT CONDENSER
B	BOILER
BCC	BRANCH CIRCUIT CONTROLLER
CD	CEILING DIFFUSER
CP	CONDENSATE PUMP
CT	COOLING TOWER
CU	CONDENSING UNIT
CUH	CABINET UNIT HEATER
CV	CONVECTOR
CVR	CONSTANT VOLUME REGULATOR
DEF	DRYER EXHAUST BOOSTER FAN
DH	DUCT HEATING COIL
EAL	EXHAUST AIR LOUVER
EBB	ELECTRIC BASEBOARD
ECH	ELECTRIC CEILING HEATER
EDH	ELECTRIC DUCT HEATER
EF	EXHAUST FAN
EG	EXHAUST GRILLE
ERV	ENERGY RECOVERY VENTILATOR
ET	EXPANSION TANK
EUH	ELECTRIC UNIT HEATER
EWH	ELECTRIC WALL HEATER
FCU	FAN COIL UNIT
FPT	FAN POWERED AIR TERMINAL
FTR	FIN TUBE RADIATION
GF	GLYCOL FEEDER
H	HUMIDIFIER
HP	HEAT PUMP
HTX	HEAT EXCHANGER
IAL	INTAKE AIR LOUVER
KEX	KITCHEN EXHAUST FAN
L	LOUVER
MUA	MAKE-UP AIR UNIT P PUMP
RG	RETURN GRILLE
RH/IH	RELIEF HOOD/INTAKE HOOD
RTU	ROOFTOP UNIT
SA	SOUND ATTENUATOR
SD	SUPPLY DIFFUSER
SG	SUPPLY GRILLE
TG	TRANSFER GRILLE
UH	UNIT HEATER
UV	UNIT VENTILATOR
VAV	VARIABLE AIR VOLUME BOX

ABBREVIATIONS

°F	DEGREES FAHRENHEIT
ø	DIAMETER
ø	PHASE
"	INCHES
'	FEET
ACD	AUTOMATIC CONTROL DAMPER
AD	ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
AP	ACCESS PANEL
APD	AIR PRESSURE DROP
ARCH	ARCHITECT
ATC	AUTOMATIC TEMPERATURE CONTROLS
BDD	BACK DRAFT DAMPER
BHP	BRAKE HORSE POWER
BTU	BRITISH THERMAL UNIT
BTUH	BTU PER HOUR
BOD	BOTTOM OF DUCT
CAP	CAPACITY
CD	CEILING DIFFUSER
CD	CONDENSATE DRAIN
CFM	CUBIC FEET PER MINUTE
CG	CEILING GRILLE
CH	CHILLER
CD	CEILING DIFFUSER
CO	CARBON MONOXIDE
CO2	CARBON DIOXIDE
CO	CLEANOUT
COND	CONDENSATE
COP	COEFFICIENT OF PERFORMANCE
CP	CONTROL PANEL
CTE	CONNECT TO EXISTING
CU	CONDENSING UNIT
CV	CONTROL VALVE
CVR	CONSTANT VOLUME REGULATOR
D	DEPTH
D	DROP
DAT	DISCHARGE AIR TEMPERATURE
DB	DRY BULB TEMPERATURE
DIA	DIAMETER
DN	DOWN
DOA	DEDICATED OUTSIDE AIR
DWG	DRAWING
DX	DIRECT EXPANSION
EA	EXHAUST AIR
EAL	EXHAUST AIR LOUVER
EAT	ENTERING AIR TEMPERATURE
EBB	ELECTRIC BASEBOARD HEATER
ECH	ELECTRIC CABINET HEATER
ECH	ELECTRIC CEILING HEATER
EDH	ELECTRIC DUCT HEATER
EER	ENERGY EFFICIENCY RATING
EF	EXHAUST FAN
EFF	EFFICIENCY
EG	EXHAUST GRILLE
ELV	ELEVATION
ER	EXHAUST REGISTER
ERU	ENERGY RECOVERY UNIT
ERV	ENERGY RECOVERY VENTILATOR
ESP	EXTERNAL STATIC PRESSURE
ET	ENTERING TEMPERATURE
ETR	EXISTING TO REMAIN
EUH	ELECTRIC UNIT HEATER
EWB	ENTERING WET BULB
EWH	ELECTRIC WALL HEATER
EWT	ENTERING WATER TEMPERATURE
EXF	EXHAUST FAN
EXH	EXHAUST
EXIST	EXISTING
FA	FREE AREA
FC	FLEX CONNECTOR
FCU	FAN COIL UNIT
FD	FIRE DAMPER
FLA	FULL LOAD AMPS
FPI	FINS PER INCH
FPM	FEET PER MINUTE
FSD	FIRE/SMOKE DAMPER
FT	FEET
FTR	FINNED TUBE RADIATION
GAL	GALLONS
GALV	GALVANIZED
GC	GENERAL CONTRACTOR
GPM	GALLONS PER MINUTE
H	HEIGHT
HP	HORSE POWER
HP	HEAT PUMP
HR	HOUR
HVAC	HEATING, VENTILATION & AIR CONDITIONING
HWC	HOT WATER COIL
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HZ	HERTZ
IAL	INTAKE AIR LOUVER
ID	INSIDE DIMENSION
IN	INCHES
KEF	KITCHEN EXHAUST FAN
KEXH	KITCHEN EXHAUST
KW	KILOWATT
LAT	LEAVING AIR TEMPERATURE
L	LENGTH
LBS	POUNDS
LD	LOUVERED DOOR
LF	LINEAR FEET
LWB	LEAVING WET BULB
LWT	LEAVING WATER TEMPERATURE
MAX	MAXIMUM
MBH	THOUSAND BTU PER HOUR
MCA	MINIMUM CIRCUIT AMPS
MCC	MOTOR CONTROL CENTER
MFA	MAXIMUM FUSE AMPS
MIN	MINIMUM
MOCP	MINIMUM OVER CURRENT PROTECTION
MOD	MOTOR OPERATED DAMPER
MUA	MAKE-UP AIR
N/A	NOT APPLICABLE
NC	NORMALLY CLOSED
NCR	NOISE CRITERIA
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OAL	OUTSIDE AIR LOUVER
OAT	OUTSIDE AIR TEMPERATURE
OBD	OPPOSED BLADE DAMPER
OD	OUTSIDE DIAMETER
OD	OUTSIDE DIMENSION

ABBREVIATIONS

PAD	PRIMARY AIR DEVICE
PD	PRESSURE DROP
PH	PHASE
PRV	PRESSURE REDUCING VALVE
PSI	POUNDS PER SQUARE INCH
R	RISE
RA	RETURN AIR
RG	RETURN GRILLE
RM	ROOM
RPM	REVOLUTIONS PER MINUTE
RR	RETURN REGISTER
RTU	ROOF TOP UNIT
S	SENSOR
SA	SUPPLY AIR
SAT	SUPPLY AIR TEMPERATURE
SC	SPEED CONTROL
SD	SMOKE DAMPER
SEER	SEASONAL ENERGY EFFICIENCY RATING
SF	SQUARE FEET
SP	STATIC PRESSURE
SQFT	SQUARE FEET
SR	SUPPLY REGISTER
SS	STAINLESS STEEL
SST	SATURATED SUCTION TEMPERATURE
T	THERMOSTAT
TEMP	TEMPERATURE
TG	TRANSFER GRILLE
TS	TEMPERATURE SENSOR
TSP	TOTAL STATIC PRESSURE
TYP	TYPICAL
UCD	UNDERCUT DOOR
UH	UNIT HEATER
V	VOLTS
VAV	VARIABLE AIR VOLUME
VD	MANUAL VOLUME DAMPER
VFD	VARIABLE FREQUENCY DRIVE
VIB	VIBRATION
W	WATTS
W	WIDTH
W/	WITH
W/O	WITHOUT
WB	WET BULB TEMPERATURE
WG	WATER GAUGE
WMS	WIRE MESH SCREEN

GENERAL NOTES

1. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID IN ORDER TO VIEW THE EXISTING CONDITIONS.
2. ALL EXISTING WORK REQUIRED TO REMAIN BUT INTERFERING WITH PROPOSED NEW MECHANICAL WORK (AS WELL AS ELECTRICAL AND GENERAL CONSTRUCTION WORK) SHALL BE RELOCATED AND RECONNECTED USING MATERIALS CONFORMING TO STANDARDS OF THIS CONTRACT.
3. CONTRACTOR SHALL COORDINATE ANY NECESSARY BUILDING SHUTDOWNS WITH THE BUILDING MANAGEMENT AND CONFORM TO ALL BUILDING STANDARDS AND PROCEDURES.
4. THE HVAC CONTRACTOR SHALL COORDINATE ALL ITEMS WITH ALL TRADES.
5. PROVIDE FLEX CONNECTORS IN ALL DUCT CONNECTIONS TO EQUIPMENT.
6. ALL REFRIGERANT PIPING SHALL BE SIZED PER EQUIPMENT MANUFACTURER'S REQUIREMENTS.
7. ALL REFRIGERANT PIPING SHALL PENETRATE TO THE ROOF THROUGH PITCH POCKETS OR TALL CONE FLASHINGS PROVIDED BY THE ROOFING CONTRACTOR.
8. ALL REFRIGERANT PIPE HANGERS & SUPPORTS SHALL BE INSTALLED AROUND THE INSULATION & JACKETING.
9. ALL EXTERIOR REFRIGERANT PIPING & INSULATION TO HAVE A PVC JACKET. JOHNS MANVILLE ZESTON 2000 SERIES OR EQUAL.

MECHANICAL DRAWING LIST

DRAWING No.	DRAWING TITLE
H000	HVAC LEGEND
HD100	HVAC DEMOLITION BASEMENT PLAN
HD101	HVAC DEMOLITION FIRST FLOOR PLAN
HD102	HVAC DEMOLITION SECOND FLOOR PLAN
HD103	HVAC DEMOLITION ROOF PLAN
~~H100~~	~~HVAC BASEMENT PLAN~~
1 H101	HVAC FIRST FLOOR DUCTWORK PLAN
HP101	HVAC FIRST FLOOR PIPING PLAN
~~H102~~	~~HVAC SECOND FLOOR PLAN~~
H103	HVAC ROOF PLAN
H200	HVAC SCHEDULES
H201	HVAC SCHEDULES
H300	HVAC DETAILS
H301	HVAC DETAILS
H400	HVAC SCHEMATICS
H401	HVAC PIPING DIAGRAMS

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REVISIONS

1	Addendum 1	05/16/2025

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DRAWING TITLE

HVAC Legend

DRAWING INFORMATION

05/16/2025
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Construction Documents
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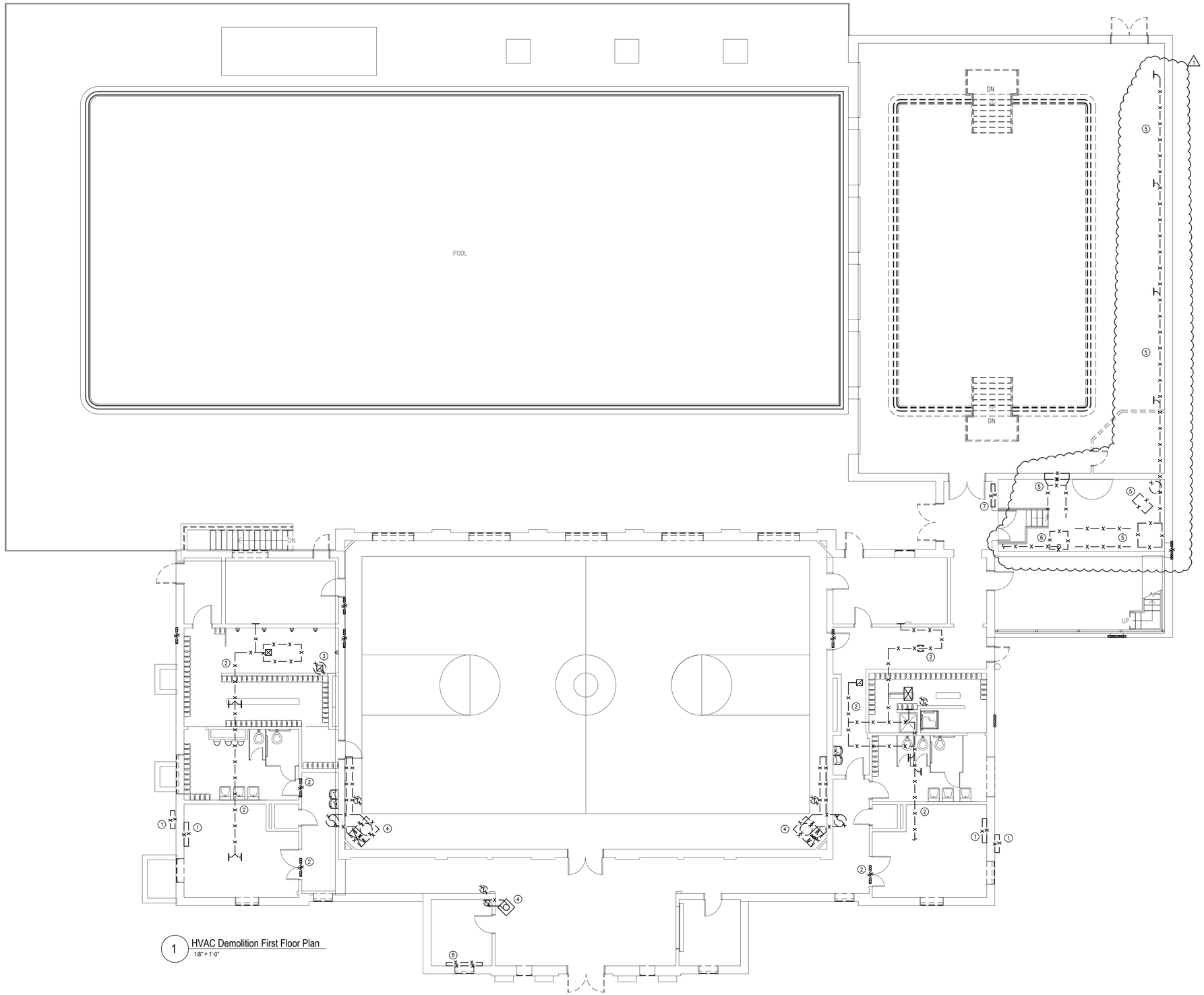

1 HVAC Demolition First Floor Plan
1/8" = 1'-0"

HVAC DEMO KEYED NOTES:

1. DISCONNECT & REMOVE EXISTING DUCTLESS SPLIT SYSTEM & TURN EQUIPMENT OVER TO THE OWNER.
   - RECOVER REFRIGERANT & SEAL PIPING CONNECTIONS AT INDOOR & OUTDOOR UNITS.
   - COORDINATE WITH ELECTRICAL CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING POWER WIRING.
   - REMOVE ALL PIPING (REFRIGERANT & CONDENSATE), LOW VOLTAGE CONTROLS & WIRING, INSULATION & HANGERS.
2. DISCONNECT & REMOVE EXISTING ROOF MOUNTED GAS FIRED MAKE-UP UNIT & ALL ASSOCIATED DUCTWORK, REGISTERS/GRILLES, HANGERS & LOW VOLTAGE CONTROLS.
   - COORDINATE WITH ELECTRICAL CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING POWER WIRING.
   - COORDINATE WITH PLUMBING CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING GAS PIPING.
3. DISCONNECT & REMOVE EXISTING ROOF MOUNTED EXHAUST FAN & ALL ASSOCIATED DUCTWORK, HANGERS & LOW VOLTAGE CONTROLS.
   - COORDINATE WITH ELECTRICAL CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING POWER WIRING.
4. DISCONNECT & REMOVE EXISTING GAS FIRED UNIT HEATER & ALL ASSOCIATED FLUE PIPING, DUCTWORK, HANGERS & LOW VOLTAGE CONTROLS.
   - COORDINATE WITH ELECTRICAL CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING POWER WIRING.
   - COORDINATE WITH PLUMBING CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING GAS PIPING.
   - DISCONNECT & REMOVE OUTSIDE AIR INTAKE DUCTS & PROVIDE INSULATED SHEETMETAL CAP AT LOUVER (GYM UNITS). LOBBY UNIT – TURN EQUIPMENT OVER TO THE OWNER.
5. DISCONNECT & REMOVE EXISTING HYDRONIC AIR HANDLER & HYDRONIC UNIT HEATER & ALL ASSOCIATED DUCTWORK, PIPING, PIPING SPECIALTIES, INSULATION, REGISTERS/GRILLES, HANGERS & LOW VOLTAGE CONTROLS.
   - COORDINATE WITH ELECTRICAL CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING POWER WIRING.
6. DISCONNECT & REMOVE EXISTING NON FUNCTIONAL POOL BOILER SYSTEM & ALL ASSOCIATED PUMPS, TANKS, PIPING, PIPING SPECIALTIES, INSULATION, HANGERS & LOW VOLTAGE WIRING.
   - COORDINATE WITH ELECTRICAL CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING POWER WIRING.
   - COORDINATE WITH PLUMBING CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING GAS PIPING.
7. DISCONNECT & REMOVE EXISTING HYDRONIC CONVECTOR & ALL ASSOCIATED PIPING, INSULATION & HANGERS.
8. DISCONNECT & REMOVE EXISTING ELECTRIC BASEBOARD HEATER.
   - COORDINATE WITH ELECTRICAL CONTRACTOR TO DISCONNECT & MAKE SAFE THE EXISTING POWER WIRING.

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REVISIONS

1	Addendum 1	05/16/2025

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DRAWING TITLE

HVAC Demolition First Floor Plan

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05/16/2025
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1/8" = 1'-0"	PL/CD
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PROJECT #	FILE NAME

DRAWING NUMBER

HD101

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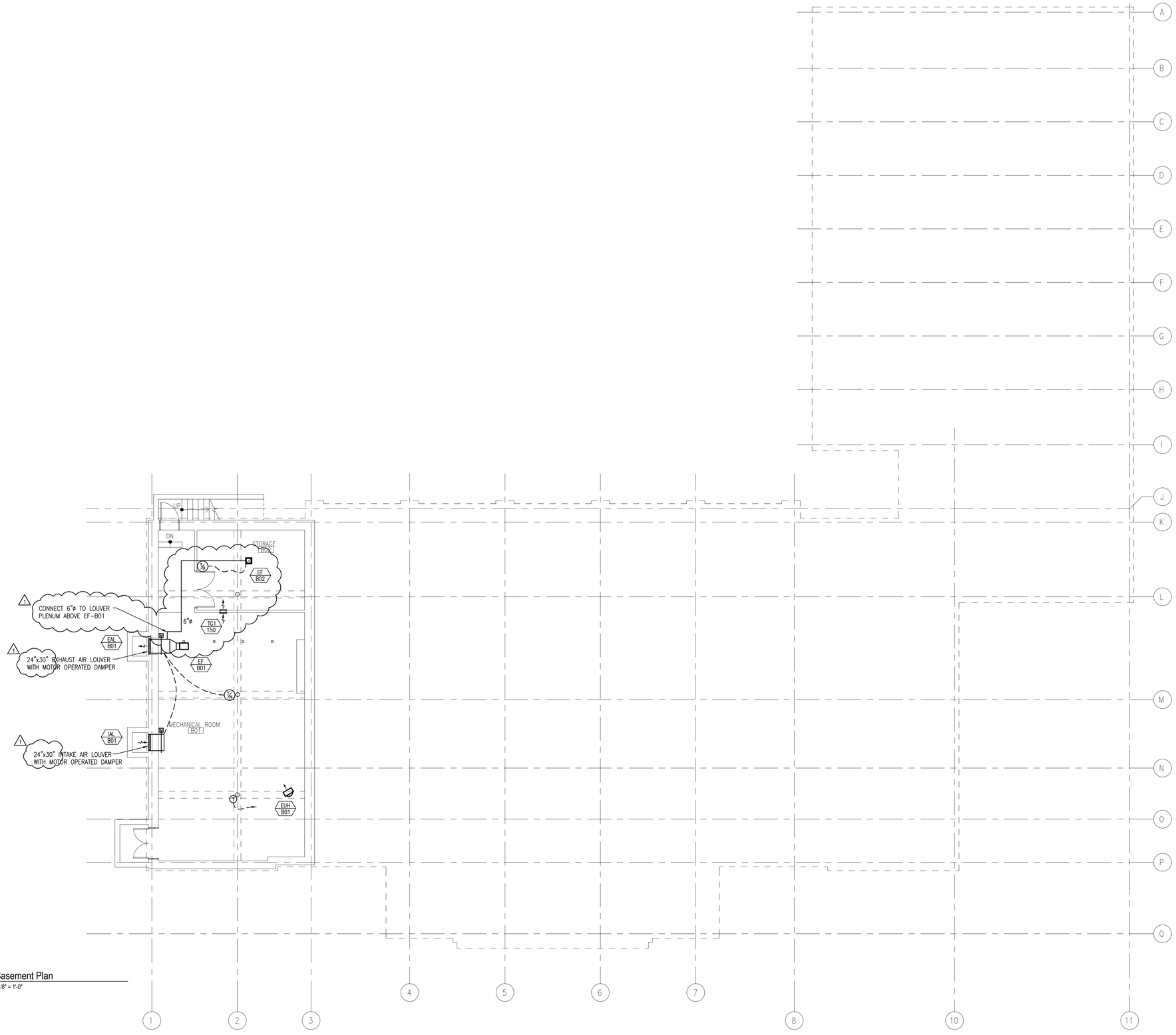

1 Basement Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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DRAWING TITLE

HVAC Basement Plan

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05/16/2025
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64076-H100.dwg — FILE NAME

DRAWING NUMBER

H100

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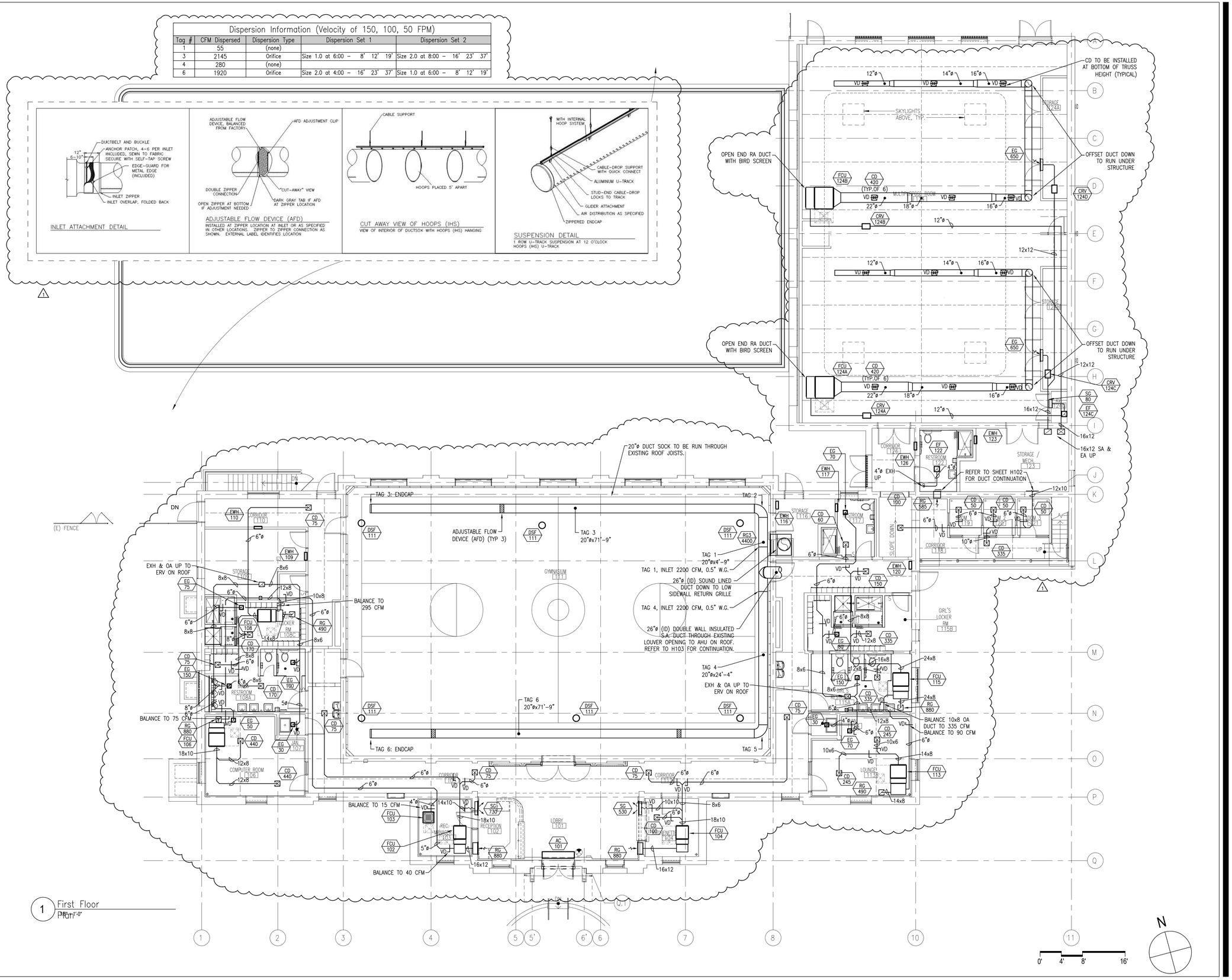
Dispersion Information (Velocity of 150, 100, 50 FPM)				
Tag #	CFM Dispersed	Dispersion Type	Dispersion Set 1	Dispersion Set 2
1	55	(none)		
3	2145	Orifice	Size 1.0 at 6:00 – 8' 12' 19'	Size 2.0 at 8:00 – 16' 23' 37'
4	280	(none)		
6	1920	Orifice	Size 2.0 at 4:00 – 16' 23' 37'	Size 1.0 at 6:00 – 8' 12' 19'



1 First Floor Plan
Scale: 1'-0"

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HVAC First Floor Ductwork Plan

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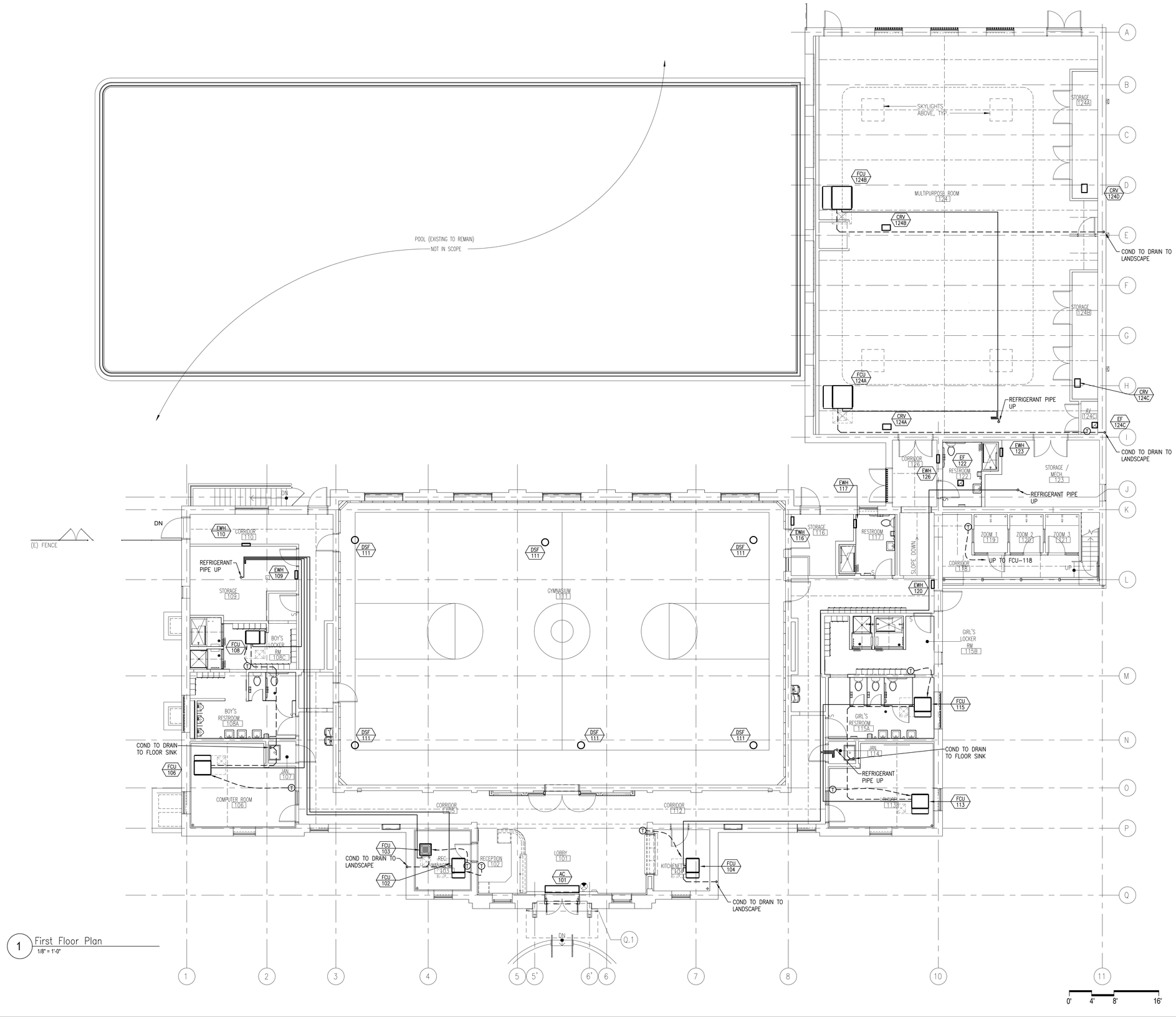

1 First Floor Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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HVAC First Floor Piping Plan

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64076-HP101.dwg — FILE NAME

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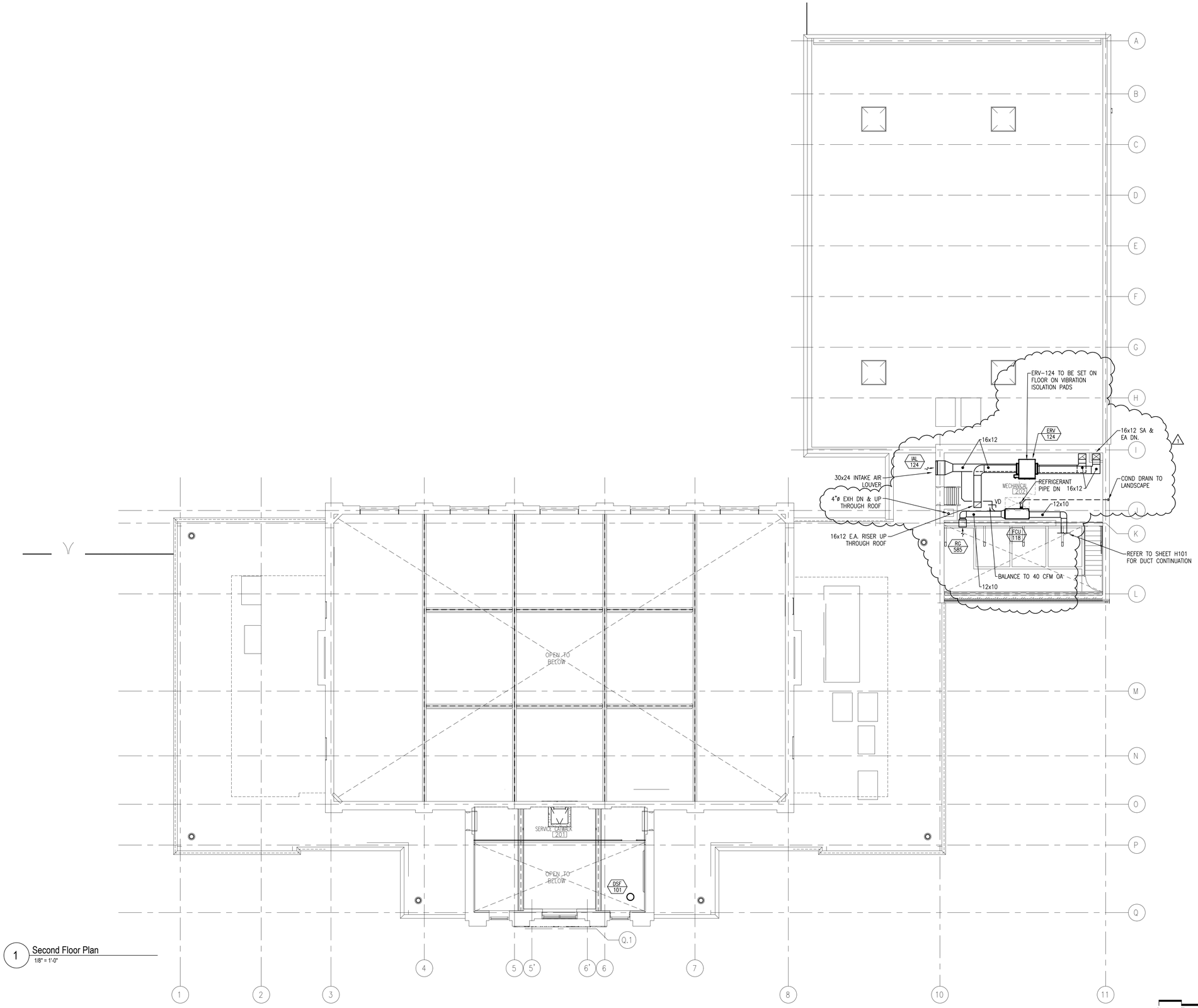

1 Second Floor Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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DRAWING TITLE

HVAC Second Floor Plan

DRAWING INFORMATION

05/16/2025
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DESCRIPTION

1/8" = 1'-0"
SCALE

PL/CD
DRAWN BY

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PROJECT #

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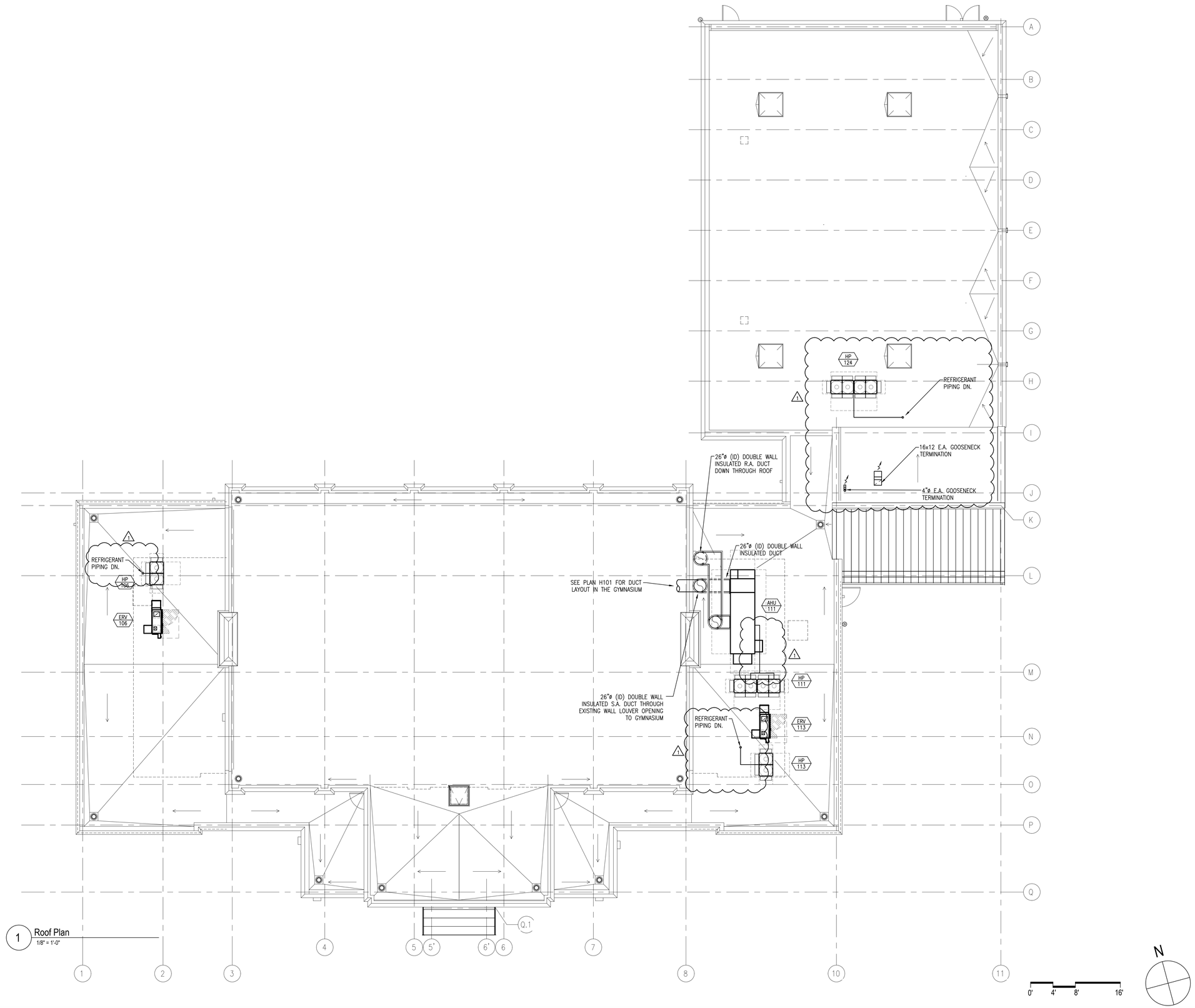

1 Roof Plan
1/8" = 1'-0"

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REVISIONS

1	Addendum 1	05/16/2025

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DRAWING TITLE

HVAC Roof Plan

DRAWING INFORMATION

05/16/2025
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Construction Documents
DESCRIPTION

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64076	64076-H103.dwg
PROJECT #	FILE NAME

DRAWING NUMBER

H103

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AIR HANDLER WITH INTEGRAL ENERGY RECOVERY VENTILATOR & SPLIT HEAT PUMP DX HEAT/COOL COIL SCHEDULE

TAG	SERVICE	LOCATION	SUPPLY				EXHAUST			SUMMER O.A. TEMP. (DB/WB) (°F)	WINTER O.A. TEMP. (DB/WB) (°F)	ENERGY WHEEL PERFORMANCE				HEATING PERFORMANCE, TYPE: MITSUBISHI HEAT PUMP			ELECTRIC HEATING COIL		COOLING PERFORMANCE, TYPE: MITSUBISHI HEAT PUMP					ELECTRICAL			MANUFACTURER / MODEL	WEIGHT	REMARKS
			TOTAL CFM	O.A. CFM (MAX.)	ESP (IN)	HP	CFM (MAX.)	ESP (IN)	HP			SUMMER EAT DB/WB (°F)	SUMMER LAT DB/WB (°F)	WINTER EAT DB/WB (°F)	WINTER LAT DB/WB (°F)	CAPACITY (MBH)	EAT DB (°F)	LAT DB (°F)	KW	CONTROL	EAT (DB/WB)	LAT (DB/WB)	TOTAL MBH	SENSIBLE MBH	REFRIGERANT	POWER	MCA	MOCP			
AHU-111	GYMNASIUM 111	ROOF	4400	1450	0.5	5	4400	0.5	3	90.8/76.2	5.0/2.9	90.8/76.2	79.7/67.4	5.0/2.9	50.0/42.0	179.6	64.7	–	20.4	SCR	76.5/64.1	49.5/48.8	190.4	128.2	410A	208/3/60	101.4	110	GREENHECK / RVE-40-30D-##-1-J1	3300	SEE NOTES

NOTES:
1. SYSTEM FEATURES: UL/cUL 1995, GALVANIZED STEEL EXTERIOR HOUSING CONSTRUCTION, ENERGY RECOVERY CASSETTE WITH A DESICCANT WHEEL, DIRECT-DRIVE AIRFOIL PLENUM BLOWERS WITH FACTORY MOUNTED VFDs, BALL BEARING MOTORS, CORROSION RESISTANT FASTENERS, INTERNALLY LINED WITH GALVANIZED STEEL DOUBLE WALL CASING WITH 2" 2.4# R13 DENSITY FOAM INSULATION, INTERNALLY MOUNTED CONTROL CENTER WITH MOTOR STARTERS, 24VAC CONTROL TRANSFORMERS, & CONTROL CIRCUIT FUSING, EXHAUST DISCHARGE GRAVITY BACK DRAFT DAMPER.
2. MICROPROCESSOR CONTROLS INTERFACE, SUPPLY FAN VFD CONTROL (DUCT STATIC– BY DDC CONTRACTOR), SPACE THERMOSTAT (TEMP AND RH ONLY – BY DDC CONTRACTOR),
3. PROVIDE RETURN AIR INTAKE (SAME SIDE AS SUPPLY), FROST CONTROL (MODULATING WHEEL), DOWNTURNED WEATHERHOOD, ELECTROFIN COIL COATING (ALL COILS), MERV 8 OUTDOOR AIR AND EXHAUST AIR FILTERS, 2" PLEATED MERV 8 & MERV 13 SUPPLY AIR FILTERS, MOTORIZED LOW LEAKAGE OUTDOOR AIR CONTROL DAMPERS, PAINTED EXTERIOR (SILK GRAY, RAL 7044), SUPPLY FAN VFD CONTROL (CONSTANT VOLUME – ADJUSTABLE SETPOINT – BY OTHERS), EXHAUST FAN VFD CONTROL (O.A. DAMPER TRACKING) O.A./R.A. DAMPER CONTROLS (CO2 SENSOR BY OTHERS), ECONOMIZER MODE (TEMPERATURE CONTROL), WHEEL CONTROL (IDLE WHEEL), ENERGY WHEEL BYPASS DAMPER, DIRTY FILTER SENSORS (OUTDOOR, EXHAUST & FINAL), ROTATION SENSOR, PHASE & BROWN OUT PROTECTION, BRANCH CIRCUIT FUSING, UNIT DISCONNECT (MOUNTED BY FACTORY), SHORT CIRCUIT CURRENT (5KA), AND WEB BASED INTERFACE.
4. PROVIDE VIBRATION ISOLATION CURB, REFER TO SPECIFICATIONS FOR REQUIREMENTS.
5. DX COIL SELECTION TO BE DONE BY THE VRF MANUFACTURER. FOR SPECIFIED MITSUBISHI VRF SYSTEM CONTACT ERIC TOBIASSEN, 781-325-6149, FOR SELECTION VERIFICATION.

FAN COIL UNITS SCHEDULE (DX HEATING AND COOLING)

TAG	SYSTEM	SERVICE	TYPE	CFM	ESP (IN)	COOLING PERFORMANCE (CORRECTED)				HEAT PUMP HEATING PERFORMANCE (CORRECTED)			REFR. TYPE	MOTOR POWER (WATTS)	ELECTRICAL			MANUFACTURER / MODEL	DIMENSIONS (HxWxL)	WEIGHT (LBS)	REMARKS
						TOTAL CAPACITY (MBH)	SENSIBLE CAPACITY (MBH)	EAT DB/WB (°F)	LAT DB (°F)	HEATING CAPACITY (MBH)	EAT DB (°F)	LAT DB (°F)			V/PH/HZ	MCA	MOCP				
FCU-102	HP-106	RECEPTION 102, LOBBY 101, CORRIDOR 105	CEILING-CONCEALED	880	0.6	18.0	17.0	80 / 67	61.9	19.9	70	90.9	410A	–	208/1/60	2.88	15	MITSUBISHI / PEFY-P18NMAU-E5	–	67	SEE NOTES BELOW.
FCU-103	HP-106	REC. MANAGER 103	2x2 CEILING CASSETTE	315	–	8.0	6.2	80 / 67	61.4	8.9	70	96.4	410A	–	208/1/60	0.28	15	MITSUBISHI / PLFY-P08NFMU-ER1.TH	–	29	SEE NOTES BELOW.
FCU-104	HP-113	KITCHENETTE 104	CEILING CONCEALED	880	0.6	18.0	17.0	80 / 67	61.9	20.0	70	90.9	410A	–	208/1/60	2.88	15	MITSUBISHI / PEFY-P18NMAU-E5	–	47	SEE NOTES BELOW.
FCU-106	HP-106	COMPUTER ROOM 106	CEILING CONCEALED	880	0.6	18.0	17.0	80 / 67	61.9	20.0	70	90.9	410A	–	208/1/60	2.88	15	MITSUBISHI / PEFY-P18NMAU-E5	–	67	SEE NOTES BELOW.
FCU-108	HP-106	BOYS LOCKER/RESTROOM 108	CEILING CONCEALED	494	0.6	15.0	11.4	80 / 67	58.3	17.0	70	102	410A	–	208/1/60	2.88	15	MITSUBISHI / PEFY-P15NMAU-E4	–	67	SEE NOTES BELOW.
FCU-113	HP-113	LOUNGE 103	CEILING CONCEALED	494	0.6	15.0	11.4	80 / 67	58.3	17.0	70	102	410A	–	208/1/60	2.88	15	MITSUBISHI / PEFY-P15NMAU-E4	–	67	SEE NOTES BELOW.
FCU-115	HP-113	GIRLS LOCKER/RESTROOM 115	CEILING CONCEALED	880	0.6	18.0	17.0	80 / 67	61.9	20.0	70	90.9	410A	–	208/1/60	2.88	15	MITSUBISHI / PEFY-P18NMAU-E5	–	47	SEE NOTES BELOW.
FCU-118	HP-113	ZOOM ROOMS 118	MULTI-POSITION	585	0.8	18.0	13.7	80 / 67	57.9	20.0	70	102	410A	–	208/1/60	3.0	15	MITSUBISHI / PVFY-P18NAMU-E1	–	113	SEE NOTES BELOW.
FCU-124A	HP-124	MULTIPURPOSE ROOM 124	CEILING CONCEALED	2540	0.6	72.0	56.8	80 / 67	58.9	79.8	70	99.1	410A	–	208/1/60	7.7	15	MITSUBISHI / PEFY-P72NMHSU-E	–	214	SEE NOTES BELOW.
FCU-124B	HP-124	MULTIPURPOSE ROOM 124	CEILING CONCEALED	2540	0.6	72.0	56.8	80 / 67	58.9	79.8	70	99.1	410A	–	208/1/60	7.7	15	MITSUBISHI / PEFY-P72NMHSU-E	–	214	SEE NOTES BELOW.

NOTES:
1. PROVIDE A SPARE FILTER FOR EACH FAN COIL.
2. PROVIDE FILTER BOXES.
3. PROVIDE PAR-40MAAU OR PAC-YT53CRAU-J CONTROLLERS FOR FAN COILS. REFER TO PLANS AND SCHEMATICS FOR LOCATIONS.
4. PROVIDE "AUTOFAN" FUNCTION ON ALL UNITS.
5. CONTRACTOR TO PROVIDE CONTROLS INTERFACE INSTALLATION AND TRAINING FOR THE TOWN FACILITIES MANAGER ON THE DEPARTMENT COMPUTER.

VARIABLE REFRIGERANT VOLUME HEAT PUMP SCHEDULE (OUTDOOR UNIT)

TAG	SERVICE	LOCATION	O.A. TEMP COOLING (°F)	COOLING CAP. (MBH)	O.A. TEMP HEATING (°F)	HEATING CAP. (MBH)	ELECTRICAL *			MANUFACTURER / MODEL	WEIGHT (LBS)	IEER / EER	COP	REMARKS
							V/PH/HZ	MCA	MOCP					
HP-106	BOY'S LOCKER ROOM AREA	ROOF	89.0	73.7	5.0	79.8	208/3/60	55	90	MITSUBISHI / PUHY-HP72TNU-A1	609	24.7 / 12.5	4.39	SEE NOTES BELOW
HP-111	GYMNASIUM	ROOF	89.0	195.2	5.0	179.6	208/3/60	45 / 45*	70 / 70*	MITSUBISHI / PUHY-EP192TSNU-A1	609	24.7 / 12.5	4.39	SEE NOTES BELOW
HP-113	GIRL'S LOCKER ROOM AREA	ROOF	89.0	73.7	5.0	80.2	208/3/60	55	90	MITSUBISHI / PUHY-HP72TNU-A1	609	24.7 / 12.5	4.39	SEE NOTES BELOW
HP-124	MULTIPURPOSE ROOM	ROOF	89.0	146	5.0	160	208/3/60*	55 / 55*	90 / 90*	MITSUBISHI / PUHY-HP144TSNU-A1	1218	23.1 / 11.6	4.1	SEE NOTES BELOW

NOTES:
* TWO (2) ELECTRICAL POWER CIRCUITS REQUIRED
1. SYSTEM PERFORMANCE SHALL BE CONFIRMED BY COMPUTER SELECTION BY THE MANUFACTURER'S REPRESENTATIVE. REFRIGERANT PIPE SIZES SHALL BE PROVIDED BY THE MANUFACTURERS REPRESENTATIVE.
2. PROVIDE AE-200 TOUCH SCREEN CENTRAL CONTROL WITH BACNET/IP LICENSE AND A BCP-50 BUILDINGCONNECT+ PANEL.
3. MOUNT UNITS 18" (MINIMUM) ABOVE ROOF ON EQUIPMENT SUPPORT STANDS.
4. PROVIDE UNITS WITH PANEL HEATERS, SNOW/HAIL GUARDS AND HOODS.
5. PROVIDE SPRING VIBRATION ISOLATION RAILS, REFER TO SPECIFICATIONS FOR REQUIREMENTS.

ELECTRIC HEATING DEVICES SCHEDULE

TAG	SERVICE	TYPE	DIMENSIONS	BTU/HR OUTPUT	WATTS	POWER	MANUFACTURER / MODEL	REMARKS
EWH-117	RESTROOM 117	WALL HEATER	–	5118	1500	120/1/60	BERKO / FRC1512F	PROVIDE INTEGRAL TAMPER PROOF THERMOSTAT
EUH-B01	MECHANICAL ROOM B01	UNIT HEATER	–	17 MBH	5 KW	208/1/60	BERKO / HUH520SA	PROVIDE WALL MOUNTED THERMOSTAT
EWH-109	STORAGE 109	WALL HEATER	–	5118	1500	120/1/60	BERKO / FRC1512F	PROVIDE INTEGRAL TAMPER PROOF THERMOSTAT
EWH-110	CORRIDOR 110	WALL HEATER	–	5118	1500	120/1/60	BERKO / FRC1512F	PROVIDE INTEGRAL TAMPER PROOF THERMOSTAT
EWH-116	STORAGE 126	WALL HEATER	–	5118	1500	120/1/60	BERKO / FRC1512F	PROVIDE INTEGRAL TAMPER PROOF THERMOSTAT
EWH-120	HALL 120	WALL HEATER	–	5118	1500	120/1/60	BERKO / FRC1512F	PROVIDE INTEGRAL TAMPER PROOF THERMOSTAT
EWH-126	HALL 126	WALL HEATER	–	5118	1500	120/1/60	BERKO / FRC1512F	PROVIDE INTEGRAL TAMPER PROOF THERMOSTAT

AIR CURTAIN SCHEDULE

TAG	LOCATION	TYPE	DIMENSIONS (LxWxH)	BTU/HR OUTPUT	HP	POWER	FLA	MANUFACTURER / MODEL	REMARKS
AC-101	LOBBY 101	HORIZONTAL	73"x14.8"x8.5"	NO HEAT	(2) @ 0.2	208/1/60	4	POWERED AIRE / EVE-2-72	WALL MOUNTING, CONTROL PANEL, DOOR SWITCH, PROVIDE A SPARE WASHABLE FILTER, STAINLESS STEEL FINISH

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REVISIONS
1 Addendum 1 05/16/2025
DATE

DRAWING TITLE
HVAC Schedules

DRAWING INFORMATION
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N.T.S. SCALE
PL/CD DRAWN BY
64076 PROJECT #
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H200

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ENERGY RECOVERY VENTILATOR SCHEDULE

TAG	SERVICE	SUPPLY				EXHAUST				SUMMER CONDITIONS (DB/WB °F)			WINTER CONDITIONS (DB/WB °F)			FILTERS		DIMENSIONS L x W x H	WEIGHT (LBS)	ELECTRICAL			MANUFACTURER / MODEL	REMARKS
		CFM	ESP (IN WC)	RPM	HP	CFM	ESP (IN WC)	RPM	HP	E.A.T.	O.A.T.	S.A.T.	E.A.T.	O.A.T.	S.A.T.	SUPPLY	EXHAUST			VOLTS/PH/HZ	FLA	MOCP		
ERV-106	BOY'S LOCKER ROOM AREA	425	0.6	–	0.5	400	0.5	–	0.5	78 / 75	90.1/75.0	79.5/67.9	68 / 50	8.5/5.5	51.8/39.9	2" MERV 13	2" MERV 8	74" x 35" x 59"	700	208/1/60	3.5	15	RENEWAIRE / HE07-JRTV-D15AA--DGN4--WL	SEE NOTE 1
ERV-113	GIRL'S LOCKER ROOM AREA	425	0.6	–	0.5	400	0.5	–	0.5	78 / 75	90.1/75.0	79.5/67.9	68 / 50	8.5/5.5	51.8/39.9	2" MERV 13	2" MERV 8	74" x 35" x 59"	700	208/1/60	3.5	15	RENEWAIRE / HE07-JRTV-D15AA--DGN4--WL	SEE NOTE 1
ERV-124	MULTIPURPOSE ROOM	1300	0.5	–	1.5	1250	0.5	–	1.5	78 / 75	90.8/76.2	79.4/67.9	68 / 50	5 / 2.9	52.1/46.1	2" MERV 13	2" MERV 8	–	600	208/1/60	17.5	25	GREENHECK / HE-2XJINV-D15UU--DVNA--LL	SEE NOTE 2

NOTES:
1. PROVIDE UNITS WITH ROOF MOUNTING CURBS, DOUBLE WALL CONSTRUCTION, VARIABLE SPEED ECM MOTORS WITH TERMINAL STRIP, MOTORIZED EA & OA DAMPERS, 2" MERV 13 FILTERS, PREMIUM CONTROLS WITH BACNET FACTORY ACTIVATION, FILTER MONITORS
2. PROVIDE UNIT WITH DOUBLE WALL CONSTRUCTION, FACTORY WIRED DISCONNECT, FACTORY WIRED VFD's, PREMIUM CONTROLS, BACNET PROTOCOL, SUPPLY FAN CONTROL – DUCT SP, EXHAUST FAN CONTROL – SUPPLY FAN TRACKING, FILTER MONITORS, O.A. & R.A. LOW LEAKAGE DAMPERS, SET OF SPARE FILTERS

LOUVER SCHEDULE

TAG	SERVICE	CFM	FPM	SIZE (L x H x D)	DAMPER TYPE	FINISH	COLOR	MANUFACTURER / MODEL	REMARKS
IAL-B01	INTAKE	850	–	24"x 30" x 4"	MOTOR OPERATED	PAINTED	BY ARCHITECT	GREENHECK / ESD-403	SEE NOTES
IAL-124	INTAKE	1300	–	30"x 30" x 4"	NONE	PAINTED	BY ARCHITECT	GREENHECK / ESD-403	SEE NOTES
EAL-B01	EXHAUST	850	–	24" x 24" x 4"	MOTOR OPERATED	PAINTED	BY ARCHITECT	GREENHECK / ESD-403	SEE NOTES

NOTES:

1. MOTOR OPERATED DAMPER – GREENHECK MODEL VCD-34.
2. FINISH – 2 COATS 70% KYNAR/100% FLOUROPOLMER, COLOR TO BE SELECTED BY ARCHITECT
3. ALUMINUM BIRD SCREEN

FAN SCHEDULE

TAG	SERVICE	TYPE	CFM	HP	SP (IN)	RPM	VOLTAGE	MANUFACTURER / MODEL	WEIGHT (LBS)	REMARKS
EF-B01	MECHANICAL B01	INLINE	850	0.25	0.35	1363	120/1/60	GREENHECK / SQ-9-VG	65	SEE NOTE 1
DSF-101	LOBBY	DESTRATIFICATION	–	90 W	–	–	120/1/60	AIRIUSFANS / ONYX-EC-STD-100-130-X	13	SEE NOTE 2
DSF-111	GYMNASIUM	DESTRATIFICATION	–	90 W	–	–	120/1/60	AIRIUSFANS / ONYX-EC-STD-100-130-X	13	SEE NOTE 2
EF-124	DATA CLOSET	CEILING	80	18.4 W	0.125	–	120/1/60	PANASONIC / FV-05VK3	11	SEE NOTE 3
EF-B02	STORAGE B02	CEILING	150	48 W	0.5	–	120/1/60	GREENHECK / SP-A200	15	SEE NOTE 4
EF-122	RESTROOM 122	CEILING	50	15 W	0.25	–	120/1/60	PANASONIC / FV-05VK3	15	SEE NOTE 5

NOTES:
1. PROVIDE VARI-GREEN EC MOTOR, TEMPERATURE & HUMIDITY CONTROLLER, NEMA 1 TOGGLE SWITCH, SPRING HANGER VIBRATION ISOLATORS, INLET GUARD, DUCT MOUNTING COLLAR
2. PROVIDE AIRIUSBAC24 – BACNET INTERFACE CARD, COLOR SELECTION BY ARCHITECT.
3. ~~PROVIDE LINE VOLTAGE THERMOSTAT TO CYCLE FAN ON RISE IN SPACE~~ TEMPERATURE ABOVE 80 DEGREES (ADJUSTABLE).
4. PROVIDE SPEED CONTROL, HANGING KIT, INTEGRATED DEHUMIDISTAT.
5. WIRE TO LIGHT SWITCH WITH 10 MINUTE (ADJUSTABLE) OFF DELAY TIMER.

GRILLES, REGISTERS & DIFFUSER SCHEDULE

DIFFUSER TYPE (LETTERS) AND CFM RANGE (NUMBER). SEE COLUMN TAG BELOW.

SD1
100
CFM

ARROWS SHOWN ON FLOOR PLAN INDICATE DIFFUSER BLOW PATTERN (4-WAY IF NO ARROWS SHOWN)

TAG	DIFFUSER/GRILLE TYPE	CFM RANGE	NECK INLET SIZE	SIZE	MANUFACTURER / MODEL	DESCRIPTION
CD-1	CEILING DIFFUSER	15-150	6"x6"	10¾"x10¾"	NAILOR / 6500	FRAME TYPE S, OBD
CD-2	CEILING DIFFUSER	151-290	9"x9"	13¾"x13¾"	NAILOR / 6500	FRAME TYPE S, OBD
CD-3	CEILING DIFFUSER	291-490	12"x12"	16¾"x16¾"	NAILOR / 6500	FRAME TYPE S, OBD
EG-1	EXHAUST GRILLE	15-125	–	6"x6"	NAILOR / 6155H	OBD
EG-2	EXHAUST GRILLE	126-215	–	8"x8"	NAILOR / 6155H	OBD
EG-3	EXHAUST GRILLE	216-315	–	10"x10"	NAILOR / 6155H	OBD
SG-1	SIDEWALL SUPPLY	530-780	–	24"x8"	NAILOR / 71DH	OBD
RG-1	RETURN GRILLE	880	–	16"x16"	NAILOR / 6155H	
RG-2	RETURN GRILLE	490	–	14"x14"	NAILOR / 6155H	
TG-1	TRANSFER GRILLE	150	–	8"x8"	NAILOR / 6155H	OBD

NOTES:
1. ALL MODELS – COLOR SELECTION BY ARCHITECT.

CONSTANT VOLUME AIRFLOW REGULATOR SCHEDULE

TAG	SERVICE	TYPE	INLET SIZE (IN)	CFM	MIN CFM	MANUFACTURER/MODEL	REMARKS
CVR-124A	FRESH AIR SUPPLY	SUPPLY	10	650	–	TROX / VFC-10-E03	–
CVR-124B	FRESH AIR SUPPLY	SUPPLY	10	650	–	TROX / VFC-10-E03	–

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REVISIONS

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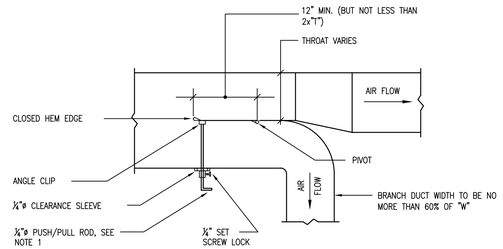
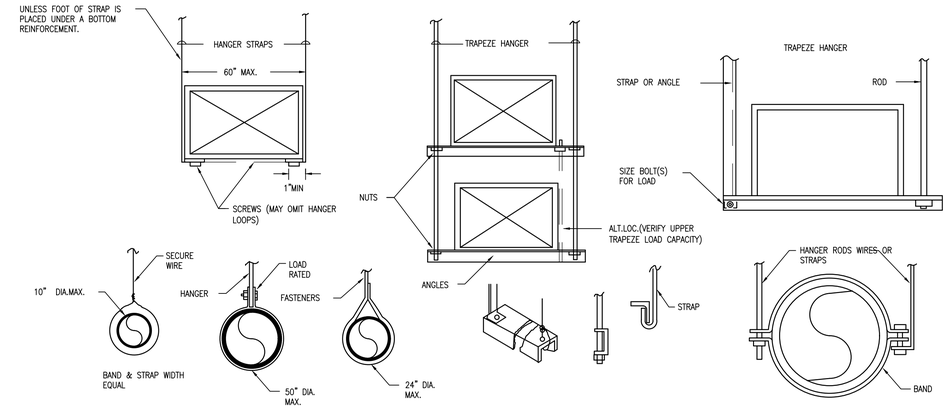


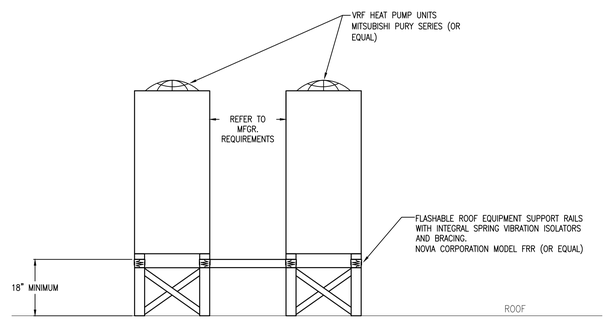
NOTES:

1. ONE ROD UP TO 24" DEPTH, TWO RODS 25" UP TO 30".
2. WHERE "W" IS OVER 36" USE DUCT BRANCH W/THROAT AND VOLUME DAMPER.

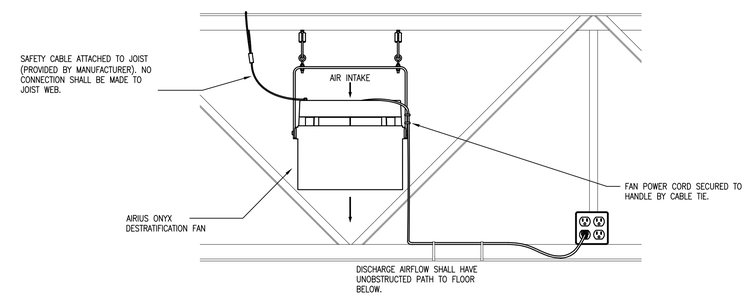
RECTANGULAR DUCT BRANCH W/THROAT & SPLITTER DAMPER | N.T.S.



DUCT HANGER DETAIL | N.T.S.



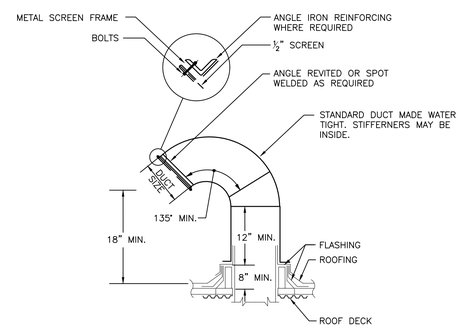
VRF HEAT PUMP UNITS ROOF SUPPORT DETAIL | N.T.S.



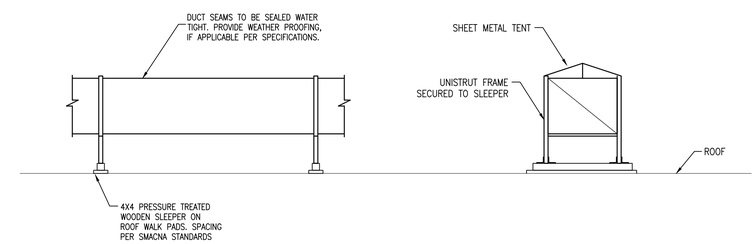
NOTES:

1. INSTALL FAN AS CLOSE AS POSSIBLE TO CEILING. (TYP 0'-6" TO 2'-0").
2. OPTIONAL HANGING METHODS INCLUDE: BEAM CLAMP/BRIDLE RING, CHAIN LINK/CARABINER, THREADED ROD/LOCK NUTS, ETC...
3. CONTRACTOR TO PROVIDE POWER FEED IN CONDUIT. THE ELECTRICAL CONNECTION CAN BE MADE IN A J-BOX (HARD WIRED) OR PLUG CONNECTION (J-BOX/RECEPTACLE).

DESTRATIFICATION FAN DETAIL | N.T.S.



RECTANGULAR GOOSENECK | N.T.S.



ROOF MOUNTED DUCTWORK DETAIL | N.T.S.

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REVISIONS

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HVAC Details

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05/16/2025
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64076	64076-H301.dwg
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H301

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DIAGRAM SYMBOL LEGEND	
DISPLAY	DESCRIPTION
-//-	POWER WIRE
- - -	CONTROL WIRE
———	REF. PIPE

CONT.No	PAGE

CITY MULTI

SYSTEM SCHEMATIC DWG.

This drawing is schematic in nature. Final routing of piping & wiring shall be determined by the installing contractor and/or designer of record

Additional refrigerant charge is needed depending on the size and length of extended piping. Please refer the amount of pre-charge and the formula of calculation which is mentioned on the data book.

$\frac{1}{2}$ 1.25mm(16 AWG) : $\frac{1}{2}$ 1.25mm(16 AWG) or more. 0.75mm(20 AWG) : between 0.5mm(24 AWG) and 0.75mm(20 AWG).

Coded Notes:
NOTE 1: Install twinning Y's within 15 degrees of level and with 20 inches of straight pipe on converging connection – reference installation manual for additional details including but not limited to special trapping requirements when twinning, and pipe slope requirements

PIPING AND CONTROLS		
SYMBOL	BRANCH PIPE	MODEL NAME
J1	CMY-Y100CBK3	
H1	CMY-Y68-G-E	
H2	CMY-Y108C-G	
SYMBOL	LIQUID PIPE	GAS PIPE SIZE
P1	1/4	1/2
P2	3/8	7/8
P3	3/8	3/4
P4	1/2	1-1/8
P5	3/8	
P6		7/8
SYMBOL	MODEL NUMBER	
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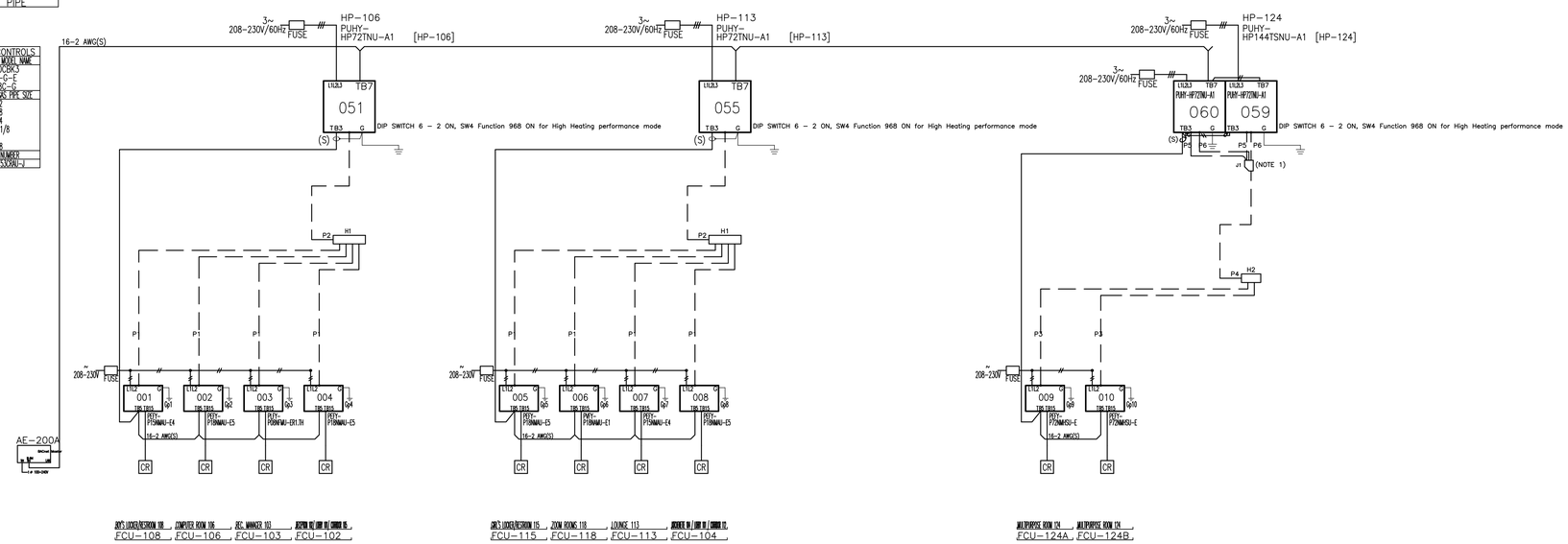

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REMARKS
Originator: PL
Comments:

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REVISIONS

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HVAC Schematics

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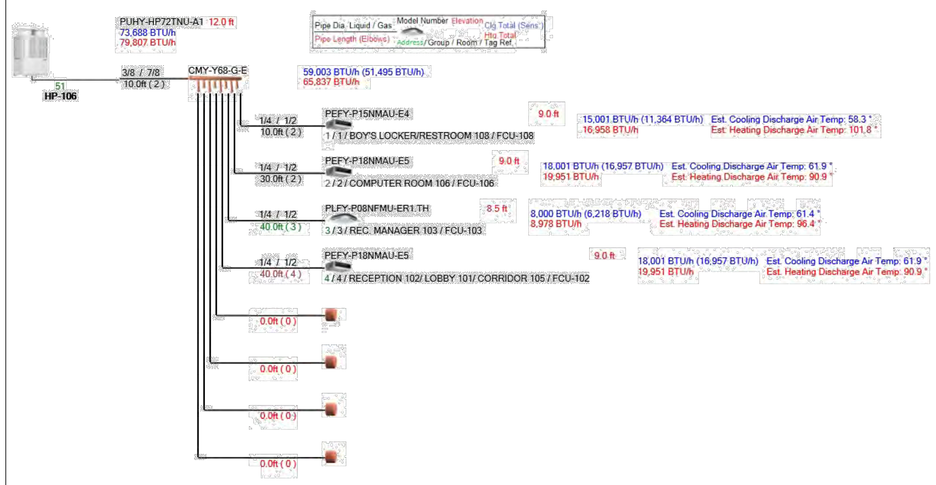
1

Design View Piping Diagrams



CENTRALIZED SYSTEM - HP-106

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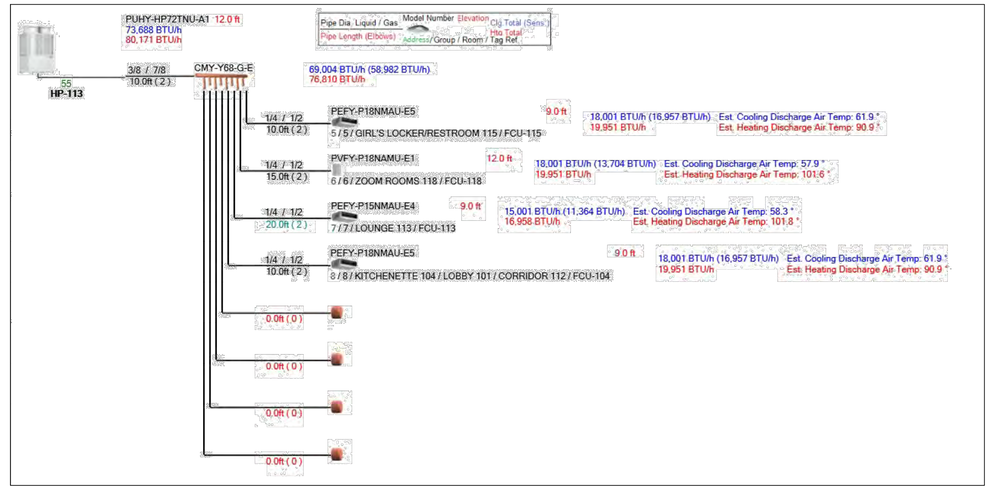

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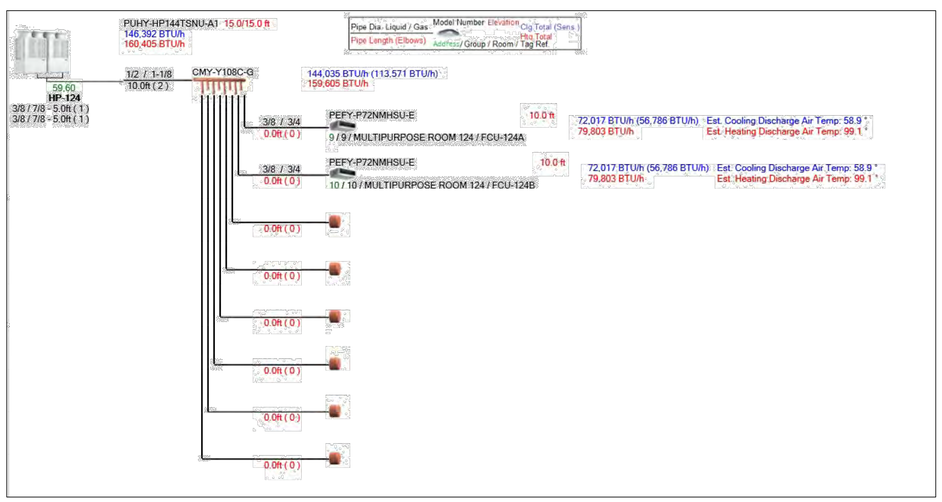

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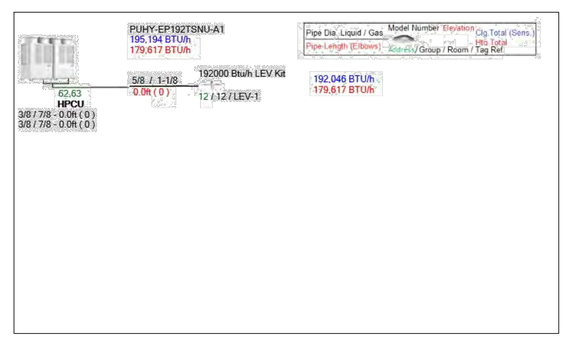

CENTRALIZED SYSTEM - GYM UNIT

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ARCHITECT

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HVAC Piping Diagrams

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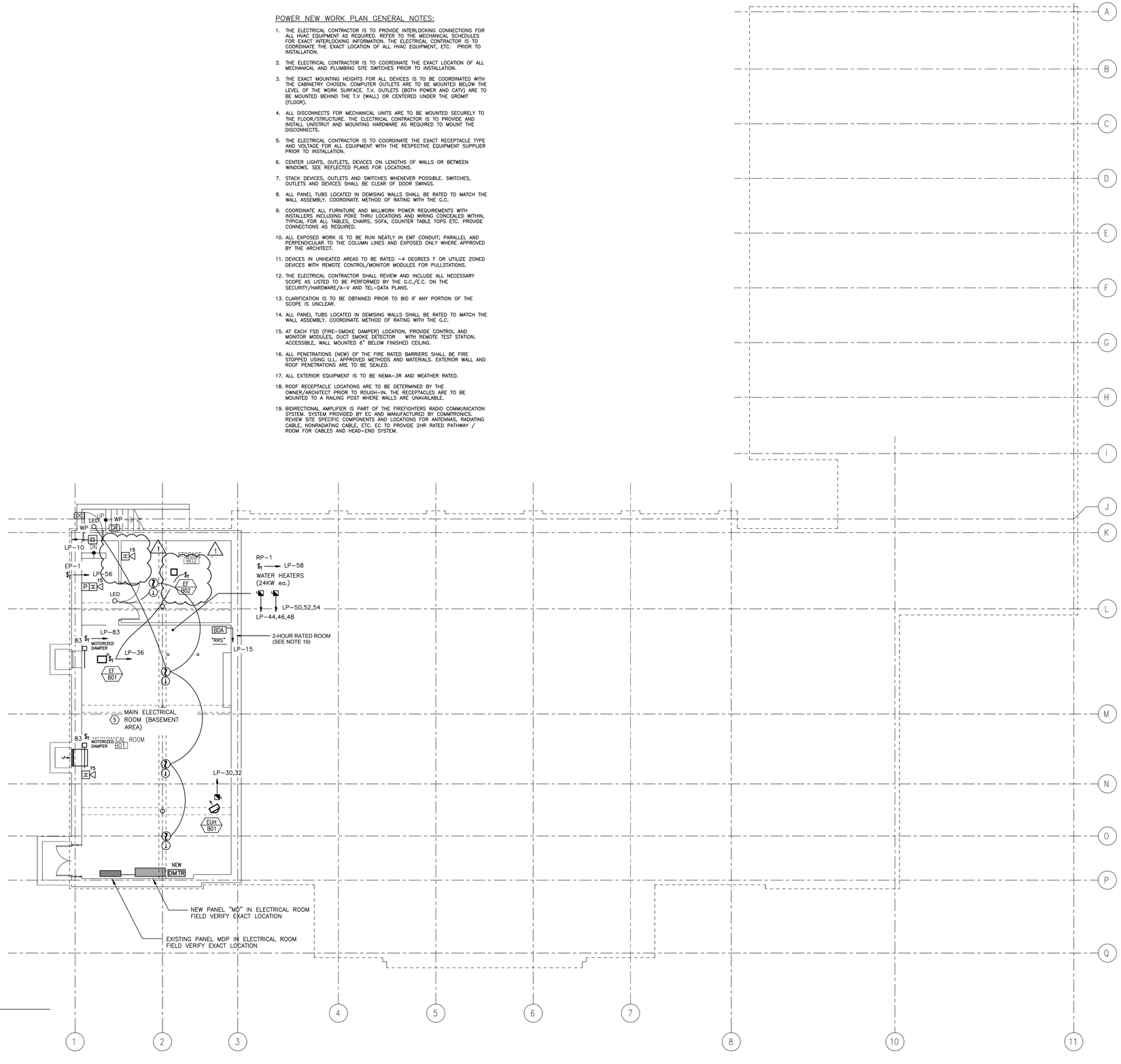
POWER NEW WORK PLAN GENERAL NOTES:

1. THE ELECTRICAL CONTRACTOR IS TO PROVIDE INTERLOCKING CONNECTIONS FOR ALL HVAC EQUIPMENT AS REQUIRED. REFER TO THE MECHANICAL SCHEDULES FOR EXACT INTERLOCKING INFORMATION. THE ELECTRICAL CONTRACTOR IS TO COORDINATE THE EXACT LOCATION OF ALL HVAC EQUIPMENT, ETC. PRIOR TO INSTALLATION.
2. THE ELECTRICAL CONTRACTOR IS TO COORDINATE THE EXACT LOCATION OF ALL MECHANICAL AND PLUMBING SITE SWITCHES PRIOR TO INSTALLATION.
3. THE EXACT MOUNTING HEIGHTS FOR ALL DEVICES IS TO BE COORDINATED WITH THE CABINETRY CHOSEN. COMPUTER OUTLETS ARE TO BE MOUNTED BELOW THE LEVEL OF THE WORK SURFACE. T.V. OUTLETS (BOTH POWER AND CATV) ARE TO BE MOUNTED BEHIND THE T.V (WALL) OR CENTERED UNDER THE GROMIT (FLOOR).
4. ALL DISCONNECTS FOR MECHANICAL UNITS ARE TO BE MOUNTED SECURELY TO THE FLOOR/STRUCTURE. THE ELECTRICAL CONTRACTOR IS TO PROVIDE AND INSTALL UNISTRUT AND MOUNTING HARDWARE AS REQUIRED TO MOUNT THE DISCONNECTS.
5. THE ELECTRICAL CONTRACTOR IS TO COORDINATE THE EXACT RECEPTACLE TYPE AND VOLTAGE FOR ALL EQUIPMENT WITH THE RESPECTIVE EQUIPMENT SUPPLIER PRIOR TO INSTALLATION.
6. CENTER LIGHTS, OUTLETS, DEVICES ON LENGTHS OF WALLS OR BETWEEN WINDOWS. SEE REFLECTED PLANS FOR LOCATIONS.
7. STACK DEVICES, OUTLETS AND SWITCHES WHENEVER POSSIBLE. SWITCHES, OUTLETS AND DEVICES SHALL BE CLEAR OF DOOR SWINGS.
8. ALL PANEL TUBS LOCATED IN DEMISING WALLS SHALL BE RATED TO MATCH THE WALL ASSEMBLY. COORDINATE METHOD OF RATING WITH THE G.C.
9. COORDINATE ALL FURNITURE AND MILLWORK POWER REQUIREMENTS WITH INSTALLERS INCLUDING POKE THRU LOCATIONS AND WIRING CONCEALED WITHIN, TYPICAL FOR ALL TABLES, CHAIRS, SOFA, COUNTER TABLE TOPS ETC. PROVIDE CONNECTIONS AS REQUIRED.
10. ALL EXPOSED WORK IS TO BE RUN NEATLY IN EMT CONDUIT; PARALLEL AND PERPENDICULAR TO THE COLUMN LINES AND EXPOSED ONLY WHERE APPROVED BY THE ARCHITECT.
11. DEVICES IN UNHEATED AREAS TO BE RATED -4 DEGREES F OR UTILIZE ZONED DEVICES WITH REMOTE CONTROL/MONITOR MODULES FOR PULLSTATIONS.
12. THE ELECTRICAL CONTRACTOR SHALL REVIEW AND INCLUDE ALL NECESSARY SCOPE AS LISTED TO BE PERFORMED BY THE G.C./E.C. ON THE SECURITY/HARDWARE/A-V AND TEL-DATA PLANS.
13. CLARIFICATION IS TO BE OBTAINED PRIOR TO BID IF ANY PORTION OF THE SCOPE IS UNCLEAR.
14. ALL PANEL TUBS LOCATED IN DEMISING WALLS SHALL BE RATED TO MATCH THE WALL ASSEMBLY. COORDINATE METHOD OF RATING WITH THE G.C.
15. AT EACH FSD (FIRE-SMOKE DAMPER) LOCATION, PROVIDE CONTROL AND MONITOR MODULES, DUCT SMOKE DETECTOR WITH REMOTE TEST STATION, ACCESSIBLE, WALL MOUNTED 6" BELOW FINISHED CEILING.
16. ALL PENETRATIONS (NEW) OF THE FIRE RATED BARRIERS SHALL BE FIRE STOPPED USING U.L. APPROVED METHODS AND MATERIALS. EXTERIOR WALL AND ROOF PENETRATIONS ARE TO BE SEALED.
17. ALL EXTERIOR EQUIPMENT IS TO BE NEMA-3R AND WEATHER RATED.
18. ROOF RECEPTACLE LOCATIONS ARE TO BE DETERMINED BY THE OWNER/ARCHITECT PRIOR TO ROUGH-IN. THE RECEPTACLES ARE TO BE MOUNTED TO A RAILING POST WHERE WALLS ARE UNAVAILABLE.
19. BIDIRECTIONAL AMPLIFIER IS PART OF THE FIREFIGHTERS RADIO COMMUNICATION SYSTEM. SYSTEM PROVIDED BY EC AND MANUFACTURED BY COMMTRONICS. REVIEW SITE SPECIFIC COMPONENTS AND LOCATIONS FOR ANTENNAS, RADIATING CABLE, NONRADIATING CABLE, ETC. EC TO PROVIDE 2HR RATED PATHWAY / ROOM FOR CABLES AND HEAD-END SYSTEM.



1 Basement Floor Plan
1/8" = 1'-0"

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KEYNOTES:

1. THE EXISTING ELECTRICAL PANEL "LPP" IN THIS AREA IS TO BE MAINTAINED THROUGHOUT CONSTRUCTION (TO KEEP THE CIRCUITS ACTIVE). THE EXISTING EQUIPMENT SHALL BE RELOCATED TO THE NEW LOCATION INDICATED ON THE PLAN. PROVIDE AND INSTALL NEW SPLICE BOX AND TERMINATIONS AND CONNECTORS (INSTALLED IN AN ACCESSIBLE LOCATION) TO SPLICE THE EXISTING CONDUCTORS (ALL BRANCH WIRES) AND INSTALL NEW EXTENSION WIRE AND CONDUIT (SIZED TO MATCH EXISTING) AS REQUIRED TO FACILITATE THE RELOCATION/REPLACEMENT INCLUDING THE FEEDERS. PHASING OF DEMOLITION AND RELOCATION WORK IS TO BE CLOSELY COORDINATED WITH THE G.C. AND OWNER. NEC–REQUIRED CLEARANCES ARE TO MAINTAINED FOR ALL NEW LOCATIONS.

2. FIRE ALARM DEVICES NOT SHOWN IN THIS AREA (SELECTED DEVICES SHOWN ONLY) – EXISTING TO REMAIN IN SIMILAR LOCATIONS, HOWEVER, REMOVE/RELOCATE PER GENERAL NOTE #11.

3. THE EXISTING ELECTRICAL PANEL "OMD" IN THIS AREA IS TO BE MAINTAINED THROUGHOUT CONSTRUCTION (TO KEEP THE CIRCUITS ACTIVE). THE EXISTING EQUIPMENT SHALL BE DEMO'ED AND EXISTING–TO–REMAIN CIRCUITS FED FROM THIS PANEL SHALL BE RE–FED FROM NEW PANEL "RP" (ADJUST BREAKERS TO MATCH). THE EXISTING FEEDERS SHALL BE DEMO'ED BACK TO THE SOURCE PANEL. PROVIDE AND INSTALL NEW SPLICE BOX AND TERMINATIONS AND CONNECTORS (INSTALLED IN AN ACCESSIBLE LOCATION) TO SPLICE THE EXISTING CONDUCTORS (ALL BRANCH WIRES) AND INSTALL NEW EXTENSION WIRE AND CONDUIT (SIZED TO MATCH EXISTING) AS REQUIRED TO FACILITATE THE DEMO/REPLACEMENT. PHASING OF DEMOLITION AND RELOCATION WORK IS TO BE CLOSELY COORDINATED WITH THE G.C. AND OWNER. NEC–REQUIRED CLEARANCES ARE TO MAINTAINED FOR ALL NEW LOCATIONS.

4. TEST AND MAIN POWER TO EXISTING PLATFORM ON THIS SIDE OF THE BUILDING. REPAIR CIRCUITS IF REQUIRED.

POWER NEW WORK PLAN GENERAL NOTES:

1. THE ELECTRICAL CONTRACTOR IS TO PROVIDE INTERLOCKING CONNECTIONS FOR ALL HVAC EQUIPMENT AS REQUIRED. REFER TO THE MECHANICAL SCHEDULES FOR EXACT INTERLOCKING INFORMATION. THE ELECTRICAL CONTRACTOR IS TO COORDINATE THE EXACT LOCATION OF ALL HVAC EQUIPMENT, ETC. PRIOR TO INSTALLATION.
2. CENTER LIGHTS, OUTLETS, DEVICES ON LENGTHS OF WALLS OR BETWEEN WINDOWS.
3. STACK DEVICES, OUTLETS AND SWITCHES WHENEVER POSSIBLE. SWITCHES, OUTLETS AND DEVICES SHALL BE CLEAR OF DOOR SWINGS.
4. AT EACH FSD (FIRE–SMOKE DAMPER) LOCATION, PROVIDE CONTROL AND MONITOR MODULES, DUCT SMOKE DETECTOR WITH REMOTE TEST STATION, ACCESSIBLE, WALL MOUNTED 6" BELOW FINISHED CEILING.
5. CLARIFICATION IS TO BE OBTAINED PRIOR TO BID IF ANY PORTION OF THE SCOPE IS UNCLEAR.
6. PROVIDE MASSACHUSETTS APPROVED BOILER SHUT–OFF SWITCH OUTSIDE BOILER ROOM TO SHUT–OFF ALL GAS / OIL BURNING EQUIPMENT AS APPLICABLE.
7. ALL EXPOSED WORK IS TO BE RUN NEATLY IN EMT CONDUIT; PARALLEL AND PERPENDICULAR TO THE COLUMN LINES.
8. ALL EXTERIOR EQUIPMENT IS TO BE NEMA–3R AND WEATHER RATED.
9. DUCT MOUNTED DETECTORS SHALL BE INSTALLED IN EACH BRANCH (PROVIDE QUANTITY AND LOCATION OF DETECTORS PER HVAC CONTRACTOR AS REQUIRED) AND SHALL HAVE A REMOTE TEST STATION AND LED MOUNTED ON THE INTERIOR OF THE BUILDING IN A READILY ACCESSIBLE LOCATION AS DIRECTED BY THE OWNER. INCLUDE WIRING AND CONDUIT (1" MINIMUM) FOR THE TEST STATIONS. ALL TEST STATIONS SHALL BE PERMANENTLY LABELED ON RED PLASTIC WITH ¼" TALL WHITE LETTERING.
10. PRIOR TO SUBMITTING A BID, THE EC IS TO PERFORM A FULL WALK THROUGH OF THE VACANT SPACE AND ADJACENT AREAS TO FAMILIARIZE THEMSELVES WITH THE EXISTING FIRE ALARM SYSTEM.
11. ALL DEVICES SHOWN BELONG TO THE NEW SYSTEM WITH THE EXCEPTION OF DEVICES LABELED "ETR" – THESE "ETR"–LABELED DEVICES ARE EXISTING AND SHALL BE RELOCATED TO ACCOMMODATE ANY CEILING / WALL WORK BUT GENERALLY REMAIN IN THE SAME AREA.

LEGEND:

ALL FIRE ALARM DEVICES ARE NEW UNLESS OTHERWISE INDICATED. CONNECT ALL DEVICES TO THE FLOOR TERMINAL CABINET, SEE FA RISER AND NOTES FOR ADDITIONAL INFORMATION.

FIRE ALARM PLAN GENERAL NOTES:

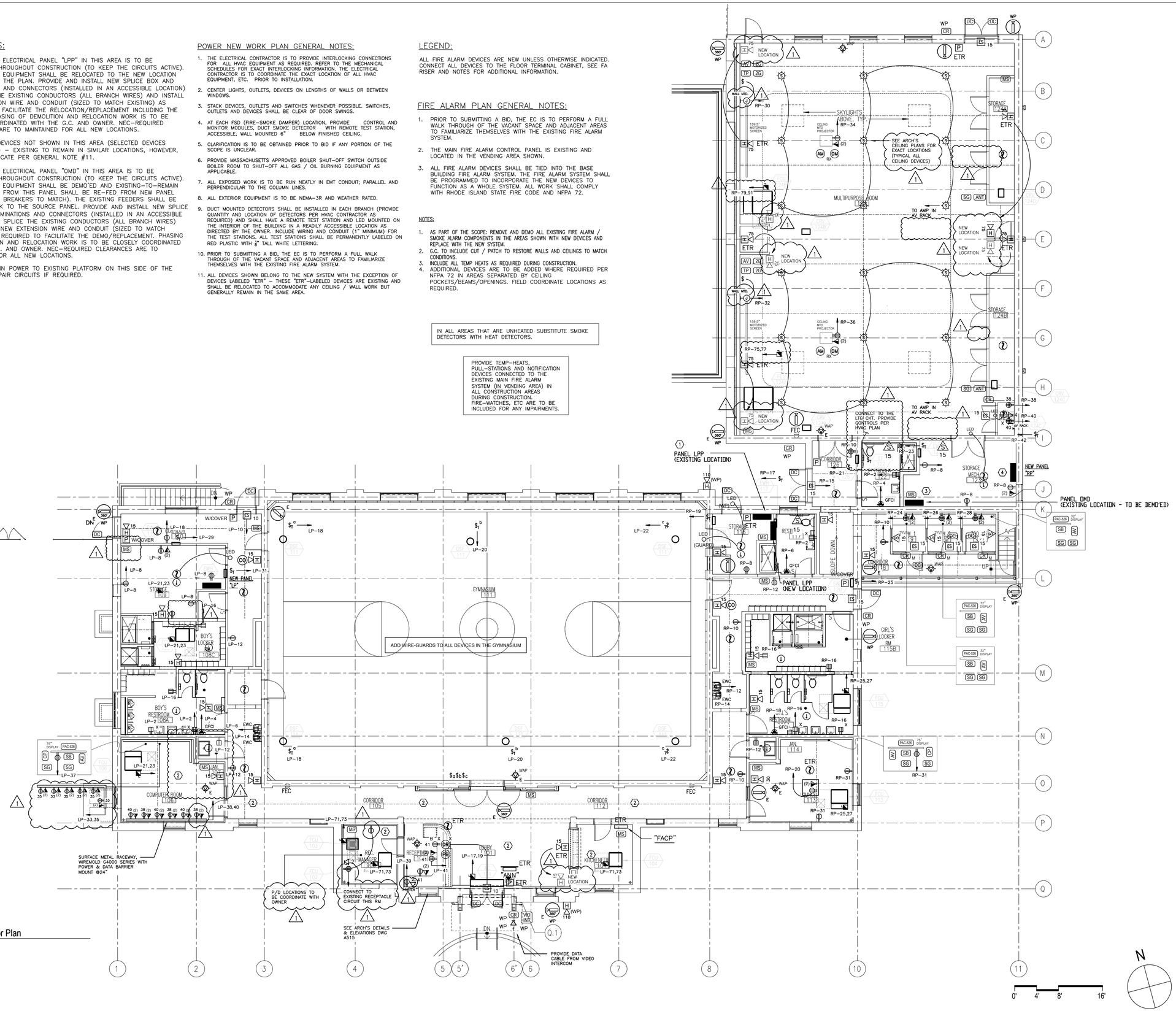
1. PRIOR TO SUBMITTING A BID, THE EC IS TO PERFORM A FULL WALK THROUGH OF THE VACANT SPACE AND ADJACENT AREAS TO FAMILIARIZE THEMSELVES WITH THE EXISTING FIRE ALARM SYSTEM.
2. THE MAIN FIRE ALARM CONTROL PANEL IS EXISTING AND LOCATED IN THE VENDING AREA SHOWN.
3. ALL FIRE ALARM DEVICES SHALL BE TIED INTO THE BASE BUILDING FIRE ALARM SYSTEM. THE FIRE ALARM SYSTEM SHALL BE PROGRAMMED TO INCORPORATE THE NEW DEVICES TO FUNCTION AS A WHOLE SYSTEM. ALL WORK SHALL COMPLY WITH RHODE ISLAND STATE FIRE CODE AND NFPA 72.

NOTES:

1. AS PART OF THE SCOPE: REMOVE AND DEMO ALL EXISTING FIRE ALARM / SMOKE ALARM COMPONENTS IN THE AREAS SHOWN WITH NEW DEVICES AND REPLACE WITH THE NEW SYSTEM.
2. G.C. TO INCLUDE CUT / PATCH TO RESTORE WALLS AND CEILINGS TO MATCH CONDITIONS.
3. INCLUDE ALL TEMP HEATS AS REQUIRED DURING CONSTRUCTION.
4. ADDITIONAL DEVICES ARE TO BE ADDED WHERE REQUIRED PER NFPA 72 IN AREAS SEPARATED BY CEILING POCKETS/BEAMS/OPENINGS. FIELD COORDINATE LOCATIONS AS REQUIRED.

IN ALL AREAS THAT ARE UNHEATED SUBSTITUTE SMOKE DETECTORS WITH HEAT DETECTORS.

PROVIDE TEMP–HEATS, PULL–STATIONS AND NOTIFICATION DEVICES CONNECTED TO THE EXISTING MAIN FIRE ALARM SYSTEM (IN VENDING AREA) IN ALL CONSTRUCTION AREAS DURING CONSTRUCTION. FIRE–WATCHES, ETC ARE TO BE INCLUDED FOR ANY IMPAIRMENTS.



1 First Floor Plan
1/8" = 1'-0"

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REVISIONS

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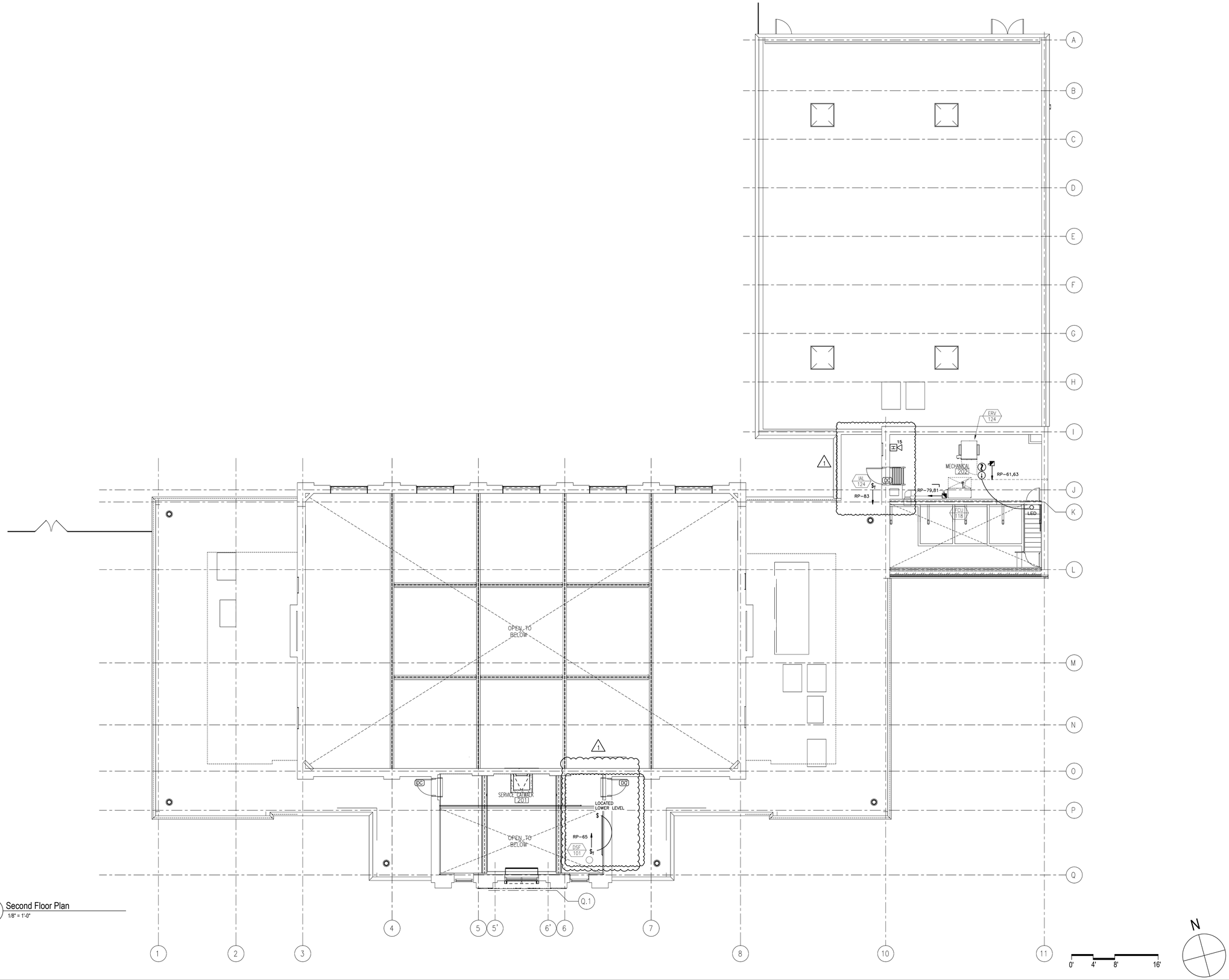

1 Second Floor Plan
1/8" = 1'-0"

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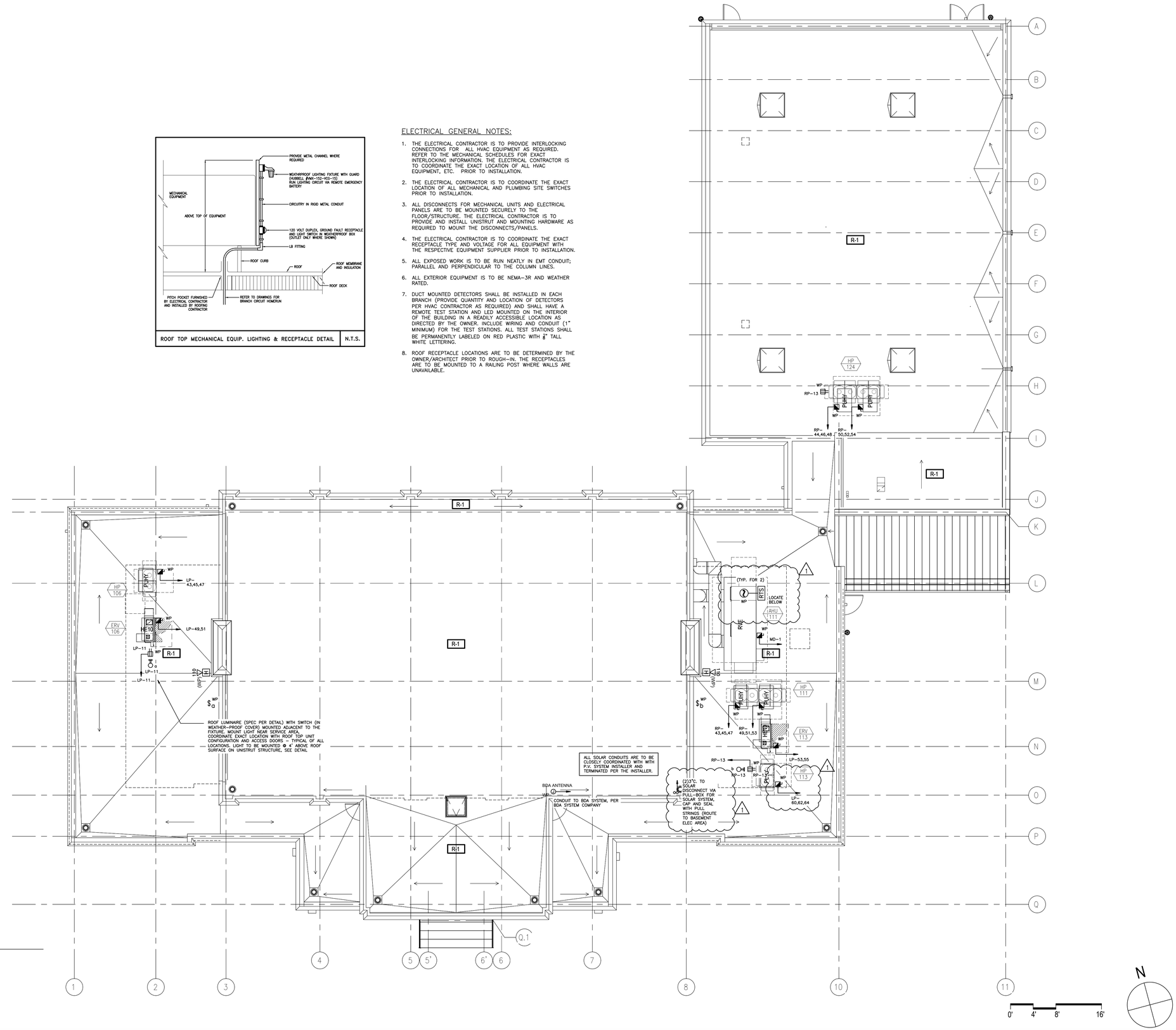
ROOF TOP MECHANICAL EQUIP. LIGHTING & RECEPTACLE DETAIL | N.T.S.

ELECTRICAL GENERAL NOTES:

1. THE ELECTRICAL CONTRACTOR IS TO PROVIDE INTERLOCKING CONNECTIONS FOR ALL HVAC EQUIPMENT AS REQUIRED. REFER TO THE MECHANICAL SCHEDULES FOR EXACT INTERLOCKING INFORMATION. THE ELECTRICAL CONTRACTOR IS TO COORDINATE THE EXACT LOCATION OF ALL HVAC EQUIPMENT, ETC. PRIOR TO INSTALLATION.
2. THE ELECTRICAL CONTRACTOR IS TO COORDINATE THE EXACT LOCATION OF ALL MECHANICAL AND PLUMBING SITE SWITCHES PRIOR TO INSTALLATION.
3. ALL DISCONNECTS FOR MECHANICAL UNITS AND ELECTRICAL PANELS ARE TO BE MOUNTED SECURELY TO THE FLOOR/STRUCTURE. THE ELECTRICAL CONTRACTOR IS TO PROVIDE AND INSTALL UNISTRUT AND MOUNTING HARDWARE AS REQUIRED TO MOUNT THE DISCONNECTS/PANELS.
4. THE ELECTRICAL CONTRACTOR IS TO COORDINATE THE EXACT RECEPTACLE TYPE AND VOLTAGE FOR ALL EQUIPMENT WITH THE RESPECTIVE EQUIPMENT SUPPLIER PRIOR TO INSTALLATION.
5. ALL EXPOSED WORK IS TO BE RUN NEATLY IN EMT CONDUIT; PARALLEL AND PERPENDICULAR TO THE COLUMN LINES.
6. ALL EXTERIOR EQUIPMENT IS TO BE NEMA-3R AND WEATHER RATED.
7. DUCT MOUNTED DETECTORS SHALL BE INSTALLED IN EACH BRANCH (PROVIDE QUANTITY AND LOCATION OF DETECTORS PER HVAC CONTRACTOR AS REQUIRED) AND SHALL HAVE A REMOTE TEST STATION AND LED MOUNTED ON THE INTERIOR OF THE BUILDING IN A READILY ACCESSIBLE LOCATION AS DIRECTED BY THE OWNER. INCLUDE WIRING AND CONDUIT (1" MINIMUM) FOR THE TEST STATIONS. ALL TEST STATIONS SHALL BE PERMANENTLY LABELED ON RED PLASTIC WITH $\frac{3}{4}$" TALL WHITE LETTERING.
8. ROOF RECEPTACLE LOCATIONS ARE TO BE DETERMINED BY THE OWNER/ARCHITECT PRIOR TO ROUGH-IN. THE RECEPTACLES ARE TO BE MOUNTED TO A RAILING POST WHERE WALLS ARE UNAVAILABLE.



1 Roof Plan
1/8" = 1'-0"

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REVISIONS

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1/8" = 1'-0" SCALE
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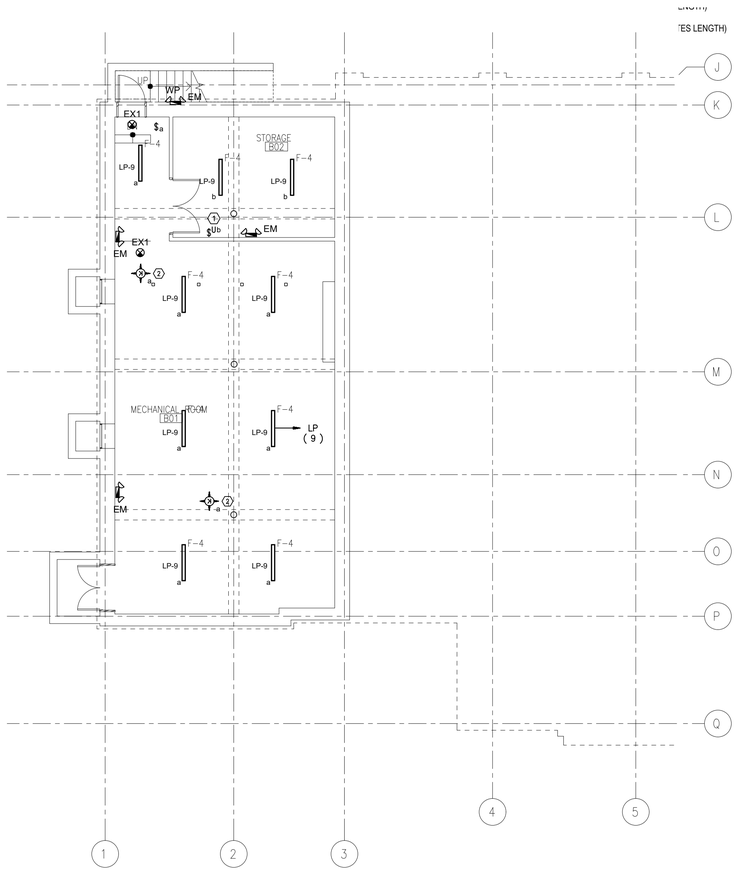
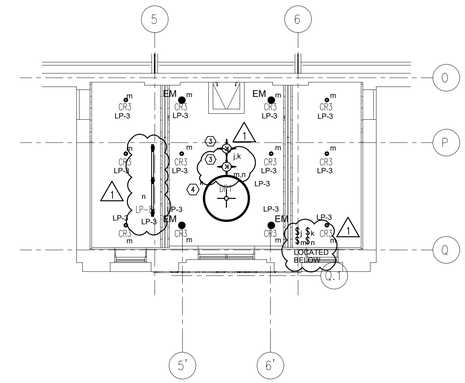


1 Basement Floor - Part Plan
1/8" = 1'-0"



2 Second Floor Lobby - Part Plan
1/8" = 1'-0"

INTERIOR LIGHT FIXTURES:

	CP1	CYLINDER PENDANT
	CR1	CYLINDER RECESSED
	CR2	CYLINDER RECESSED, LENSED, WET LABELED
	CR3	CYLINDER RECESSED
	CS1	CYLINDER SURFACE MOUNT
	DP1	DECORATIVE PENDANT
	GR-#	GRAZER RECESSED (# INDICATES LENGTH)
	LP-#	LINEAR PENDANT (# INDICATES LENGTH)
	LR-#	LINEAR RECESSED (# INDICATES LENGTH)
	LW-#	LINEAR WALL MOUNTED (# INDICATES LENGTH)

EXTERIOR LIGHT FIXTURES:

	ED1	EXTERIOR DOWNLIGHT
	EW1	EXTERIOR WALL SCONCE
	EW2	EXTERIOR WALL DOWNLIGHT
	EW3	EXTERIOR WALL PACK

LIGHTING SCHEDULE GENERAL NOTES:

ALL FIXTURES INSTALLED IN OR AROUND FIRE RATED OR IC RATED ASSEMBLIES ARE TO BE EQUIPPED WITH RATED BOXES BY TENMAT (SIZE TO SUIT FIXTURE).

THE ELECTRICAL CONTRACTOR IS TO VERIFY THE VOLTAGE OF THE FIXTURE WITH THE CIRCUIT AVAILABLE PRIOR TO ORDERING.

MOUNTING HEIGHTS, MOUNTING OPTIONS, FINISHES AND OPTIONS ARE TO BE APPROVED AND COORDINATED WITH THE ARCHITECT PRIOR TO ORDERING THE FIXTURES.

FIXTURES SHOWN ON ARCHITECTURAL PLANS OVER-RIDE THOSE SHOWN ON THE ELECTRICAL PLAN. REVIEW BOTH PLANS AND PROVIDE THE LARGER QUANTITY OF EACH TYPE.

EMERGENCY FIXTURE CHEVRONS / ARROWS TO BE SELECTED PER PLANS.

CLARIFICATION IS TO BE OBTAINED, PRIOR TO BID, REGARDING ANY QUESTIONS RELATED TO THE LIGHTING SYSTEM.

THE E.C. IS TO COMPLETE THE INSTALLATION OF ANY ADDITIONAL LIGHTING CONTROLS SUCH AS OCCUPANCY SENSORS, ETC. THAT ARE INCLUDED WITH THE FIXTURE PACKAGE.

TRACK LIGHTING LENGTHS ARE TO BE ADJUSTED TO THE LENGTH SHOWN ON THE PLANS. ALL ACCESSORIES ARE TO BE INCLUDED TO PROVIDE A COMPLETE SYSTEM.

ALL LAMPING (LED) AND FIXTURE WHIPS ARE TO BE INCLUDED.

REFER TO ARCHITECTURAL DOCUMENTS FOR EXACT FIXTURE LOCATIONS – ARCHITECTURAL LOCATIONS OVER-RIDE THE LOCATIONS SHOWN ON THE ELECTRICAL PLANS.

COORDINATE ALL MOUNTING HARDWARE WITH ARCHITECT'S RCP'S, DETAILS AND ELEVATIONS, PROVIDE MOUNTING FRAMES REQUIRED FOR CEILINGS INSTALLED, GWB, RCP, ETC.

ALL FIXTURES ARE TO BE RATED 120 VOLTS.

PROVIDE $600.00 DOLLAR ALLOWANCE PER LUMINAIRE WHERE NOT SPECIFIED, TBD.

LIGHTING FIXTURE & LAMP SCHEDULE

TYPE	MFGR	VOLT	CATALOG No.	WATTS	REMARKS
EX1	LITHONIA	120V	EDG*/W/1/R/EL USE RECESSED STYLE @CEILING	2.0	* LED EXIT LIGHT EDGE LIT STYLE WITH INTEGRAL BATTERY * SEE PLANS FOR MOUNTING, SINGLE FACE EXIT
EX2	LITHONIA	120V	EDG*/W/2/RMR/EL USE RECESSED STYLE @CEILING	2.0	* LED EXIT LIGHT EDGE LIT STYLE WITH INTEGRAL BATTERY * SEE PLANS FOR MOUNTING, DOUBLE FACE EXIT
EM1	LITHONIA	120V	ELM4L/ / /UVOLTLTP/SDRT	6.6	SELF CONTAINED BATTERY UNIT POLYCABRONATE HOUSING, BASEMENT AND 1ST FLOOR BATHROOMS, SMALL AREAS
WP	LITHONIA	120V	WLTUMR	6.0	SELF CONTAINED BATTERY UNIT POLYCABRONATE HOUSING, WET LOCATION, EXTERIORS

0' 4' 8' 16'

N

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PROJECT NAME

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REVISIONS

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ELECTRICAL Basement & Second Floor Part Plans

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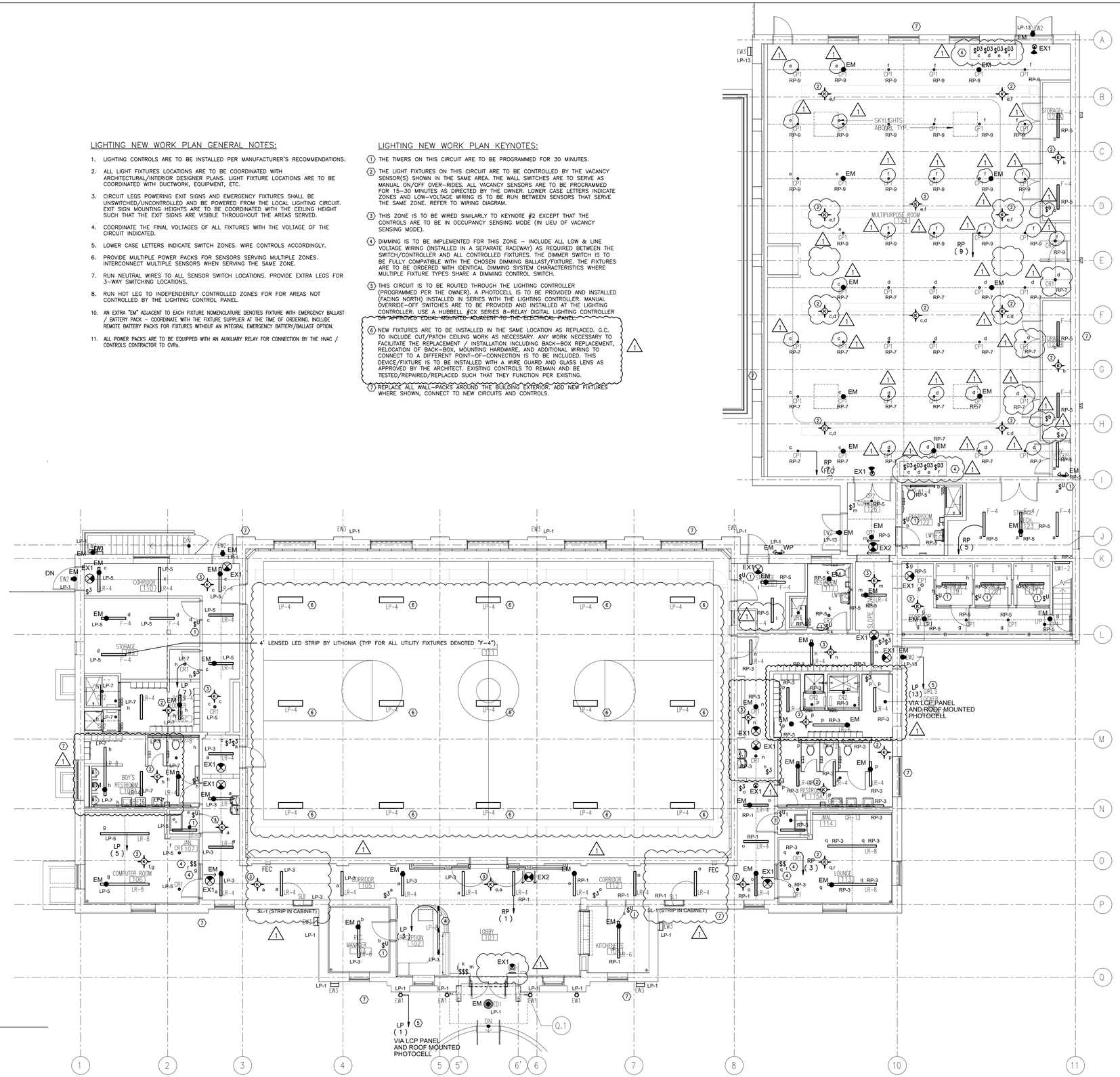
LIGHTING NEW WORK PLAN GENERAL NOTES:

1. LIGHTING CONTROLS ARE TO BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
2. ALL LIGHT FIXTURES LOCATIONS ARE TO BE COORDINATED WITH ARCHITECTURAL/INTERIOR DESIGNER PLANS. LIGHT FIXTURE LOCATIONS ARE TO BE COORDINATED WITH DUCTWORK, EQUIPMENT, ETC.
3. CIRCUIT LEGS POWERING EXIT SIGNS AND EMERGENCY FIXTURES SHALL BE UNSWITCHED/UNCONTROLLED AND BE POWERED FROM THE LOCAL LIGHTING CIRCUIT. EXIT SIGN MOUNTING HEIGHTS ARE TO BE COORDINATED WITH THE CEILING HEIGHT SUCH THAT THE EXIT SIGNS ARE VISIBLE THROUGHOUT THE AREAS SERVED.
4. COORDINATE THE FINAL VOLTAGES OF ALL FIXTURES WITH THE VOLTAGE OF THE CIRCUIT INDICATED.
5. LOWER CASE LETTERS INDICATE SWITCH ZONES. WIRE CONTROLS ACCORDINGLY.
6. PROVIDE MULTIPLE POWER PACKS FOR SENSORS SERVING MULTIPLE ZONES. INTERCONNECT MULTIPLE SENSORS WHEN SERVING THE SAME ZONE.
7. RUN NEUTRAL WIRES TO ALL SENSOR SWITCH LOCATIONS. PROVIDE EXTRA LEGS FOR 3-WAY SWITCHING LOCATIONS.
8. RUN HOT LEG TO INDEPENDENTLY CONTROLLED ZONES FOR FOR AREAS NOT CONTROLLED BY THE LIGHTING CONTROL PANEL.
10. AN EXTRA "EM" ADJACENT TO EACH FIXTURE NOMENCLATURE DENOTES FIXTURE WITH EMERGENCY BALLAST / BATTERY PACK – COORDINATE WITH THE FIXTURE SUPPLIER AT THE TIME OF ORDERING. INCLUDE REMOTE BATTERY PACKS FOR FIXTURES WITHOUT AN INTEGRAL EMERGENCY BATTERY/BALLAST OPTION.
11. ALL POWER PACKS ARE TO BE EQUIPPED WITH AN AUXILIARY RELAY FOR CONNECTION BY THE HVAC / CONTROLS CONTRACTOR TO CVRs.

LIGHTING NEW WORK PLAN KEYNOTES:

1. THE TIMERS ON THIS CIRCUIT ARE TO BE PROGRAMMED FOR 30 MINUTES.
2. THE LIGHT FIXTURES ON THIS CIRCUIT ARE TO BE CONTROLLED BY THE VACANCY SENSOR(S) SHOWN IN THE SAME AREA. THE WALL SWITCHES ARE TO SERVE AS MANUAL ON/OFF OVER-RIDES. ALL VACANCY SENSORS ARE TO BE PROGRAMMED FOR 15-30 MINUTES AS DIRECTED BY THE OWNER. LOWER CASE LETTERS INDICATE ZONES AND LOW-VOLTAGE WIRING IS TO BE RUN BETWEEN SENSORS THAT SERVE THE SAME ZONE. REFER TO WIRING DIAGRAM.
3. THIS ZONE IS TO BE WIRED SIMILARLY TO KEYNOTE #2 EXCEPT THAT THE CONTROLS ARE TO BE IN OCCUPANCY SENSING MODE (IN LIEU OF VACANCY SENSING MODE).
4. DIMMING IS TO BE IMPLEMENTED FOR THIS ZONE – INCLUDE ALL LOW & LINE VOLTAGE WIRING (INSTALLED IN A SEPARATE RACEWAY) AS REQUIRED BETWEEN THE SWITCH/CONTROLLER AND ALL CONTROLLED FIXTURES. THE DIMMER SWITCH IS TO BE FULLY COMPATIBLE WITH THE CHOSEN DIMMING BALLAST/FIXTURE. THE FIXTURES ARE TO BE ORDERED WITH IDENTICAL DIMMING SYSTEM CHARACTERISTICS WHERE MULTIPLE FIXTURE TYPES SHARE A DIMMING CONTROL SWITCH.
5. THIS CIRCUIT IS TO BE ROUTED THROUGH THE LIGHTING CONTROLLER (PROGRAMMED PER THE OWNER). A PHOTOCELL IS TO BE PROVIDED AND INSTALLED (FACING NORTH) INSTALLED IN SERIES WITH THE LIGHTING CONTROLLER. MANUAL OVERRIDE-OFF SWITCHES ARE TO BE PROVIDED AND INSTALLED AT THE LIGHTING CONTROLLER. USE A HUBBELL #CX SERIES 8-RELAY DIGITAL LIGHTING CONTROLLER ~~ON APPROVED LOCAL MOUNTED ADJACENT TO THE ELECTRICAL PANEL.~~
6. NEW FIXTURES ARE TO BE INSTALLED IN THE SAME LOCATION AS REPLACED. G.C. TO INCLUDE CUT/PATCH CEILING WORK AS NECESSARY. ANY WORK NECESSARY TO FACILITATE THE REPLACEMENT / INSTALLATION INCLUDING BACK-BOX REPLACEMENT, RELOCATION OF BACK-BOX, MOUNTING HARDWARE, AND ADDITIONAL WIRING TO CONNECT TO A DIFFERENT POINT-OF-CONNECTION IS TO BE INCLUDED. THIS DEVICE/FIXTURE IS TO BE INSTALLED WITH A WIRE GUARD AND GLASS LENS AS APPROVED BY THE ARCHITECT. EXISTING CONTROLS TO REMAIN AND BE TESTED/REPAIRED/REPLACED SUCH THAT THEY FUNCTION PER EXISTING.
7. REPLACE ALL WALL-PACKS AROUND THE BUILDING EXTERIOR. ADD NEW FIXTURES WHERE SHOWN, CONNECT TO NEW CIRCUITS AND CONTROLS.



1 First Floor Plan
1/8" = 1'-0"

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REVISIONS

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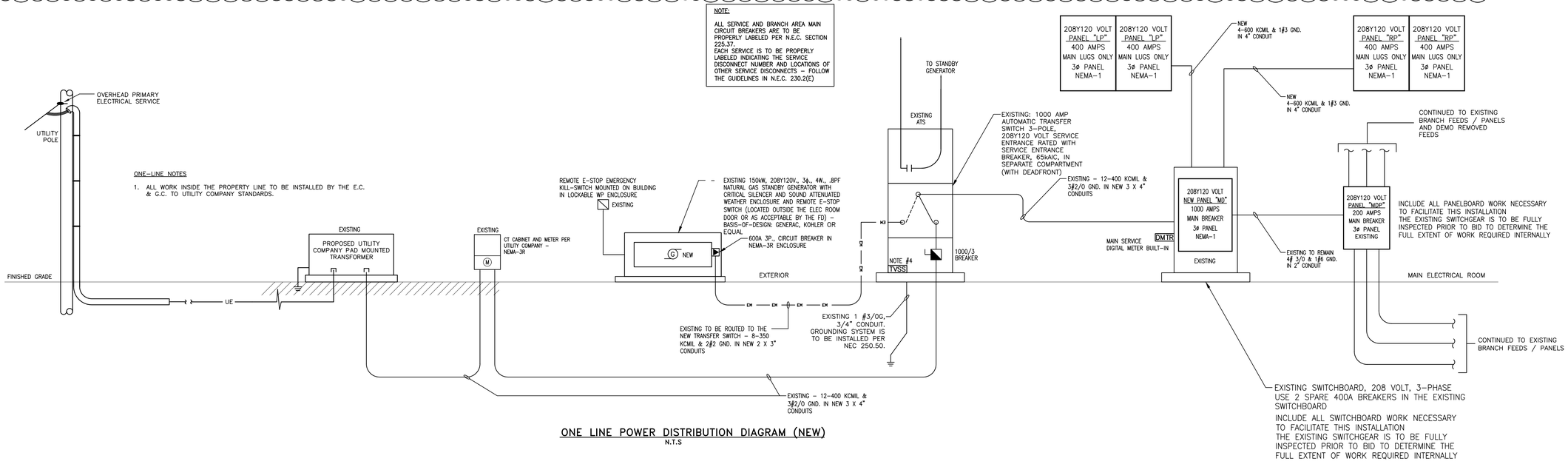
Label	Manufacturer	Catalog Number	Description	Spec Links
CP1	LUMENWERX	AERA4-FINISH-DIM-FINISH-FIXED-FINISH-CCT-CRI-XX-80-35-XX-UNV-20W-DIMMING-XX-CANOPY-FINISH-SUSP-XX	AERA 4 Pendant Cylinder	https://lumenwerx.com/wp-content/files/AERA4-CYLINDER-SURFACE-SPEC.pdf
CP2	LUMENWERX	AERA4-FINISH-DIM-FINISH-FIXED-FINISH-CCT-CRI-XX-80-35-XX-UNV-20W-DIMMING-XX-CANOPY-FINISH-SUSP-XX	AERA 4 Pendant Cylinder	https://lumenwerx.com/wp-content/files/AERA4-CYLINDER-SURFACE-SPEC.pdf
CR1	LUMENWERX	ECANA4-DOWNLIGHT-ROUND-RECESSED-FINISH-CCT-CRI-DIMMING-XX-EC4RRB-SW-90DEG-XX-80CRI-35K-XX-TRM-SQ-BAFFLE-TRM-XX-120V-14W	ECANA 4" Downlight	https://lumenwerx.com/wp-content/files/ECANA4-DOWNLIGHT-ROUND-RECESSED-SPEC.pdf
CR2	LUMENWERX	ECANA4-DOWNLIGHT-ROUND-RECESSED-FINISH-CCT-CRI-DIMMING-XX-EC4RRB-SW-90DEG-XX-80CRI-35K-XX-TRM-SQ-BAFFLE-TRM-WET-120V-20W	ECANA 4" Downlight - WET	https://lumenwerx.com/wp-content/files/ECANA4-DOWNLIGHT-ROUND-RECESSED-SPEC.pdf
CR3	LUMENWERX	ECANA4-DOWNLIGHT-ROUND-RECESSED-FINISH-CCT-CRI-DIMMING-XX-EC4RRB-SW-25DEG-XX-80CRI-35K-XX-TRM-SQ-BAFFLE-TRM-XX	ECANA 4" Downlight - High Ceiling	https://lumenwerx.com/wp-content/files/ECANA4-DOWNLIGHT-ROUND-RECESSED-SPEC.pdf
DP1	Mercury	GSDI S6800/36 935 FINISH DRIVER U	LED RING LIGHT	https://mercltg.com/wp-content/uploads/2023/04/SATURN-DIRECT-INDIRECT-9-5-23.pdf
ED1	Luminis	SN1100C-L1L25-35K-VOLTAGE-XX-XX-XX-FINISH	Scena - Ceiling Square	scena-sn1100-sn1100c.pdf?abl_version=05%2f06%2f2025+09%3a27%3a45&DOC_Type=
EW1	Brownlee	7115-26-FINISH-H32-35K-XX	CAPSULE SQUARE	https://s3.brownlee.com/spec_sheets/7115LED_ss.pdf
EW2	DesignPlan	SPT40210 2 4 N	FIXED M-01	https://designplan.com/cms/resources/media/2023/08/FIXED-M-01-DYKE_Datasheet-3.pdf
EW3	Lithonia Lighting	WDGE2 LED P1 30K 80CRI T3M	WDGE2 LED WITH P1 - PERFORMANCE PACKAGE, 3000K, 80CRI, TYPE 3 MEDIUM OPTIC	https://lmg.acuitybrands.com/public-assets/catalog/1000000/wdge2-led_precision_refractive_optic.pdf?abl_version=02%2f20%2f2025+09%3a50%3a01&DOC_Type=SPEC_SHEET
GR-12	ALWUSA	LPX4 D WM RN S12 05 35 80 SL DRIVER N N N N N N N N N N N N FINISH XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS	file/supportfiles/fbf75b3e932a27a40e29b7762751e98d/552/locale_file/lpx4rcspecsheet241220.pdf?mca=view-
GR-13	ALWUSA	LPX4 D WM RN S13 05 35 80 SL DRIVER N N N N N N N N N N N N FINISH XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS	file/supportfiles/fbf75b3e932a27a40e29b7762751e98d/552/locale_file/lpx4rcspecsheet241220.pdf?mca=view-
GR-16	ALWUSA	LPX4 D WM RN S16 05 35 80 SL DRIVER N N N N N N N N N N N N FINISH XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS	file/supportfiles/fbf75b3e932a27a40e29b7762751e98d/552/locale_file/lpx4rcspecsheet241220.pdf?mca=view-
GR-8	ALWUSA	LPX4 D WM RN S8 05 35 80 SL DRIVER N N N N N N N N N N N N FINISH XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS	file/supportfiles/fbf75b3e932a27a40e29b7762751e98d/552/locale_file/lpx4rcspecsheet241220.pdf
LP-4	Industrial Lighting Products Inc	HHB-18L-U-40-FRL-XX-XX	HIMALAYAN HIGH BAY	https://www.ilp-inc.com/wp-content/uploads/2020/04/HHB.pdf
LP-8	3G LIGHTING	3Gi -1PSL-DI-OC4-ZB-S(8'0")-ZB-35D-BLV-H90-35K-UNV-DIM-60"-1C	3Gi -1PSL-DI -1.5" Integrated Pendant Direct/Indirect	https://www.3glighting.com/File/Product/756/3Gi-1PSL-DI.pdf
LR-4	a.light	ACL5 4 LS 35 U HE MOUNTING FINISH DIMMING XX	ACL5 - 4FT	https://www.alights.com/assets/Uploads/ALIGHT-ACL5-SPECSHEET-IK-1-10.pdf?v=1736542579
LR-6	a.light	ACL5 6 LS 35 U HE MOUNTING FINISH DIMMING XX	ACL5 - 6FT	https://www.alights.com/assets/Uploads/ALIGHT-ACL5-SPECSHEET-IK-1-10.pdf?v=1736542578
LW1-2	Brownlee	5176-24-FINISH-H21-35K-XX	ZOOM-RD - 24"	https://s3.brownlee.com/spec_sheets/5176LED_ss.pdf
LW1-4	Brownlee	5176-48-FINISH-H32-35K-XX	ZOOM-RD - 48"	https://s3.brownlee.com/spec_sheets/5176LED_ss.pdf
SL1	LLIA	LLI-THN-SF-2.5W-30K-24V-LENGTH + POWER	Dry Location 2.5W 3000K LED tape w/ Thin Extrusion and Frosted Lens	https://llialighting.com/wp-content/uploads/LLI-THN-Thin-with-LED-REV_22.09-standard.pdf



ONE LINE POWER DISTRIBUTION DIAGRAM (NEW)
N.T.S

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REVISIONS

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NEW PANELS

PANEL "LP"

VOLTAGE: 208Y120 VOLT – 3 PH. – 4 WIRE — 400 AMP MAIN LUGS ONLY; SURFACE MOUNTED
REMARKS: PROVIDE WITH GROUND BAR, MINIMUM A.I.C. RATING = 42,000 AMPS SYM.

CKT NO.	LOAD DESCRIPTION	WIRE ø	BREAKER POLE	BREAKER AMP	CONN. LOAD (KVA) PH. "A"	PH. "B"	PH. "C"	BREAKER AMP	BREAKER POLE	WIRE ø	LOAD DESCRIPTION	CKT NO.
* 1	EXTERIOR LIGHTING, BLDG MOUNTED	10	1	20	·			20	1	12	RESTROOM OUTLETS	2
3	RECEPTION AREA LIGHTING	12	1	20		·		20	1	12	HAND DRYER	4
5	COMPUTER ROOM AREA LIGHTING	12	1	20			·	20	1	12	ELECTRIC WATER COOLERS	6
7	BOY'S LOCKER AREA LIGHTING	12	1	20	·			20	1	12	UTILITY OUTLETS	8
9	LIGHTING, BASEMENT	12	1	20		·		20	1	12	SECURITY DOORS, ELECTRIC STRIKES CR'S	10
11	ROOF, RECEPT, LIGHTS	12	1	20			·	20	1	12	CORRIDOR OUTLETS	12
* 13	EXTERIOR LIGHTING, BLDG MOUNTED	10	1	20	·			20	1	12	ELECTRIC WATER COOLERS	14
15	BDA PANEL, BSMT ELECT RM	12	1	20		·		20	1	12	LOCKER ROOM OUTLETS	16
17	AC-1 (2)1/4HP, LOBBY (1)	12	2	20			·	20	1	12	(2)DSF-111 (90WATTS ea.) GYM	18
19	–	–	–	–	·			20	1	12	(2)DSF-111 (90WATTS ea.) GYM	20
21	(2)FCU'S (3.0AMPS ea.) (1)	12	2	20		·		20	1	12	(2)DSF-111 (90WATTS ea.) GYM	22
23	–	–	–	–			·	20	1	–	SPARE	24
25	(2)FCU'S (3.0AMPS ea.) (1)	12	2	20	·			20	1	–	SPARE	26
27	–	–	–	–		·		20	1	–	SPARE	28
29	EWH-109 (1.5KW)	12	1	20			·	30	2	10	EUH-B01 (5.0KW) BSMT	30
31	EWH-110 (1.5KW) (1)	12	1	20				–	–	–	–	32
33	RECEPT, (3) COMP RM WIREMOLD	12	1	20		·		20	1	·	SPARE (1)	34
35	RECEPT, (3) COMP RM WIREMOLD	12	1	20			·	20	1	12	EF-7 (1/4HP) BSMT	36
37	RECEPT, 72" MONITOR COMP RM	12	1	20	·			20	1	12	RECEPT, (3) COMP RM WIREMOLD	38
39	PRINTER, RECEPTION DESK	12	1	20		·		20	1	12	RECEPT, (2) COMP RM WIREMOLD	40
41	RECEPT, (4) RECEPTION DESK	12	1	20			·	20	1	·	SPARE	42
	TOTALS PER PHASE				·	·	·	TUB 1				
	TOTAL LOAD				. kVA							

PANEL "LP"

VOLTAGE: 208Y120 VOLT – 3 PH. – 4 WIRE — 400 AMP MAIN LUGS ONLY; SURFACE MOUNTED
REMARKS: PROVIDE WITH GROUND BAR, MINIMUM A.I.C. RATING = 42,000 AMPS SYM.

CKT NO.	LOAD DESCRIPTION	WIRE ø	BREAKER POLE	BREAKER AMP	CONN. LOAD (KVA) PH. "A"	PH. "B"	PH. "C"	BREAKER AMP	BREAKER POLE	WIRE ø	LOAD DESCRIPTION	CKT NO.
43	HP-106 (55.0AMPS) ROOF	3	3	90	·			80	3	3	ELECT WATER HEATER WH-1 (24KW)	44
45	–	–	–	–		·		–	–	–	–	46
47	–	–	–	–			·	–	–	–	–	48
49	ERV-106 (3.5AMPS) ROOF	12	2	15	·			80	3	3	ELECT WATER HEATER WH-1 (24KW)	50
51	–	–	–	–		·		–	–	–	–	52
53	ERV-113 (3.5AMPS) ROOF	12	2	15 (1)			·	–	–	–	–	54
55	–	–	–	–	·			20	1	12	EP-1 (11.0AMPS) BSMT	56
57	SPARE	·	1	20		·		20	1	12	RP-1 (50WATTS) BSMT	58
59	SPARE	·	1	20			·	90	3	3	HP-113 (55.0AMPS) ROOF	60
61	SPARE	·	1	20	·		(1)	–	–	–	–	62
63	SPARE	·	1	20		·		–	–	–	–	64
65	SPARE	·	1	20			·	20	1	·	SPARE	66
67	SPARE	·	1	20	·			20	1	·	SPARE	68
69	SPARE	·	1	20		·		20	1	·	SPARE	70
71	(3)FCU'S (3.0AMPS ea.) (1)	12	2	20			·	20	1	·	SPARE	72
73	–	–	–	–	·			20	1	·	SPARE	74
75	FCU-124A (7.7AMPS)	12	2	20		·		20	1	·	SPARE	76
77	–	–	–	–			·	20	1	·	SPARE	78
79	FCU-124B (7.7AMPS)	12	2	20	·			20	1	·	SPARE	80
81	–	–	–	–		·		20	1	·	SPARE	82
83	(2)MOTORIZED DAMPERS, BSMT	12	1	20			·	20	1	·	SPARE	84
	TOTALS PER PHASE				·	·	·	TUB 2				
	TOTAL LOAD				. kVA							

EXISTING

PANEL "MD" SCHEDULE

VOLTAGE: 208Y120 VOLT – 3 PH. – 4 WIRE — 1000 AMP MAIN BREAKER; SURFACE MOUNTED
REMARKS: PROVIDE WITH GROUND BAR, MINIMUM A.I.C. RATING = 65,000 AMPS SYM.

CKT NO.	LOAD DESCRIPTION	WIRE ø	BREAKER POLE	BREAKER AMP	CONN. LOAD (KVA) PH. "A"	PH. "B"	PH. "C"	BREAKER AMP	BREAKER POLE	WIRE ø	LOAD DESCRIPTION	CKT NO.
1	AHU-111 (101.4AMPS) ROOF	1	3	110	·			200	3	3/0	EXISTING PANEL "MDP" (EXISTING)	2
–	" "	·	·	·		·		·	·	·	" "	–
–	" "	·	·	·			·	·	·	·	" "	–
3	NEW PANEL "RP"	600	3	400	·			400	3	600	NEW PANEL "LP"	4
–	" "	·	·	·		·		·	·	·	" "	–
–	" "	·	·	·			·	·	·	·	" "	–
5	TVSS	10	3	30	·			600	3	·	SPARE	6
–	" "	·	·	·		·		·	·	·	" "	–
–	" "	·	·	·			·	·	·	·	" "	–
	TOTALS PER PHASE				·	·	·	W/TVSS				
	TOTAL LOAD				. kVA							

PANEL "RP"

VOLTAGE: 208Y120 VOLT – 3 PH. – 4 WIRE — 400 AMP MAIN LUGS ONLY; SURFACE MOUNTED
REMARKS: PROVIDE WITH GROUND BAR, MINIMUM A.I.C. RATING = 22,000 AMPS SYM.

CKT NO.	LOAD DESCRIPTION	WIRE ø	BREAKER POLE	BREAKER AMP	CONN. LOAD (KVA) PH. "A"	PH. "B"	PH. "C"	BREAKER AMP	BREAKER POLE	WIRE ø	LOAD DESCRIPTION	CKT NO.
1	INTERIOR LIGHTING	12	1	20	·			20	1	12	RESTROOM OUTLETS	2
3	GIRLS LOCKER AREA LIGHTING	12	1	20		·		20	1	12	HAND DRYER	4
5	INTERIOR LIGHTING	12	1	20			·	20	1	12	HAND DRYER	6
7	MULTIPURPOSE LIGHTING	12	1	20	·			20	1	12	UTILITY OUTLETS	8
9	MULTIPURPOSE LIGHTING (1)	12	1	20		·		20	1	12	CORRIDOR OUTLETS	10
11	SPARE		1	20			·	20	1	12	ELECTRIC WATER COOLERS	12
13	ROOF, RECEPT, LIGHTS	12	1	20	·			20	1	12	ELECTRIC WATER COOLERS	14
15	SECURITY DOORS, ELECTRIC STRIKES CR'S	12	1	20		·		20	1	12	LOCKER ROOM OUTLETS	16
17	EWH-117 (0.5KW)	12	1	20			·	20	1	12	LOCKER ROOM HAND DRYER	18
19	EWH-116 (1.5KW)	12	1	20	·			20	1	12	LOUNGE / MEETING OUTLET	20
21	EWH-126 (1.5KW)	12	1	20		·		20	1	–	SPARE	22
23	EWH-123 (1.5KW)	12	1	20			·	20	1	12	RECEPT, (2) + 32" DISPLAY, ZOOM 1	24
25	EWH-120 (1.5KW)	12	1	20	·			20	1	12	RECEPT, (2) + 32" DISPLAY, ZOOM 2	26
27	(3)FCU'S (3.0AMPS ea.)	12	2	20		·		20	1	12	RECEPT, (2) + 32" DISPLAY, ZOOM 3	28
29	–	–	–	–			·	20	1	12	MOTORIZED PROJECTION SCREEN, GYM	30
31	OUTLETS LOUNGE 113	12	1	20				20	1	12	MOTORIZED PROJECTION SCREEN, GYM	32
33	SPARE	·	1	20		·		20	1	12	CEILING PROJECTOR, GYM	34
35	SPARE	·	1	20			·	20	1	12	CEILING PROJECTOR, GYM	36
37	SPARE	·	1	20	·			20	1	12	RECEPT, (2) AV RACK	38
39	SPARE	·	1	20		·		20	1	12	RECEPT, (2) AV RACK	40
41	SPARE	·	1	20			·	20	1	12	EF-124C (20WATTS)	42
	TOTALS PER PHASE				·	·	·	TUB 1				
	TOTAL LOAD				. kVA							

PANEL "RP"

VOLTAGE: 208Y120 VOLT – 3 PH. – 4 WIRE — 400 AMP MAIN LUGS ONLY; SURFACE MOUNTED
REMARKS: PROVIDE WITH GROUND BAR, MINIMUM A.I.C. RATING = 22,000 AMPS SYM.

CKT NO.	LOAD DESCRIPTION	WIRE ø	BREAKER POLE	BREAKER AMP	CONN. LOAD (KVA) PH. "A"	PH. "B"	PH. "C"	BREAKER AMP	BREAKER POLE	WIRE ø	LOAD DESCRIPTION	CKT NO.
43	HP-111 (45.0AMPS) ROOF	4	3	70	·			90	3	3	HP-124 (55.0AMPS) ROOF	44
45	–	–	–	–		·		–	–	–	–	46
47	–	–	–	–			·	–	–	–	–	48
49	HP-111 (45.0AMPS) ROOF	4	3	70	·			90	3	3	HP-124 (55.0AMPS) ROOF	50
51	–	–	–	–		·		–	–	–	–	52
53	–	–	–	–			·	–	–	–	–	54
55	SPARE	–	3	90	·			20	1	·	SPARE	56
57	SPARE	·	1	20		·		20	1	·	SPARE	58
59	SPARE	·	1	20			·	20	1	·	SPARE	60
61	ERV-124 (17.0AMPS) 2ND FLOOR	10	2	25	·			20	1	·	SPARE	62
63	SPARE	·	1	20		·		20	1	·	SPARE	64
65	DSF-111 (90WATTS) LOBBY	12	1	20			·	20	1	·	SPARE	66
67	SPARE	·	1	20	·			20	1	·	SPARE	68
69	SPARE	·	1	20		·		20	1	*	RESERVED FOR OLD "OMD" CKTS	70
71	SPARE	·	1	20			·	20	1	*	RESERVED FOR OLD "OMD" CKTS	72
73	SPARE	·	1	20	·			20	1	*	RESERVED FOR OLD "OMD" CKTS	74
75	SPARE	·	1	20		·		20	1	*	RESERVED FOR OLD "OMD" CKTS	76
77	SPARE	·	1	20			·	20	1	*	RESERVED FOR OLD "OMD" CKTS	78
79	FCU-118 (0.5AMPS) 2ND FLOOR	12	2	15	·			20	1	*	RESERVED FOR OLD "OMD" CKTS	80
81	–	–	–	–		·		20	1	*	RESERVED FOR OLD "OMD" CKTS	82
83	IAL-124 DAMPER (--HP) 2ND FL	12	1	20			·	20	1	*	RESERVED FOR OLD "OMD" CKTS	84
	TOTALS PER PHASE				·	·	·	TUB 2				
	TOTAL LOAD				. kVA							

* ADJUST BREAKERS / FEEDS TO MATCH OLD CKTS AS REQUIRED

Telecommunications Responsibility Matrix	Responsibility				
System	General Contractor	Electrical Contractor (EC) File Sub Bid	Telecommunications Contractor (TC) File Sub Sub Bid (If Required by Electrical Contractor)	Service Provider	Owner
Structured cabling System	X	X	X		
Telecommunications conduit/backbox	X	X	X		
Structured cabling terminations	X	X	X		
J Hook Pathways	X	X	X		
Structured Cabling SystemTesting	X	X	X		
Fiber Optic and Copper Backbone cabling	X	X	X		
Fiber Optic and copper backbone terminations	X	X	X		
Fiber optic and copper backbone testing	X	X	X		
Plywood backboards and supports for devices	X				
Racks and Cabinets	X	X	X		
Patch cords and adapters	X	X	X		
Incoming services cabling and Terminations				X	
Incoming Services Coonduit and Backbox	X	X			
Wireless Access Point procurement					X
Wireless Access point Installation	X	X	X		
Network Switches and Electronic equipment Procurement					X
Network Switches and Electronic equipment Installation					X
Paging System Conduit and Back box	X	X			
Paging system cabling	X	X	X		
Paging system speakers, amplifiers, zone modules, FX modules	X	X	X		
Paging System progamming and coordination	X	X	X		
Power in telecommunications rooms	X	X			
UPS	X	X	X		

Security Responsibility Matrix	Responsibility				
System	General Contractor	Electrical Contractor (EC) File Sub Bid	Telecommunications Contractor (TC) File Sub Sub Bid (If Required by Electrical Contractor)	Hardware Contractor	Owner
Conduit and Back box	X	X			
Security Access Control Cabling System	X	X			
Security Video Surveillance Camera Cabling	X	X	X		
Security J Hook Pathways	X	X			
Security Devices at Doors (card readers, door contacts, Request to exit devices)	X	X			
Security electronic Locks (Electric strike, Mortice Locks, Magnetic locks, exit devices)				X	
Security Back Boards	X				
Security access control panels	X	X			
Security power supplies	X	X			
Security video surveillance cameras	X	X			
Security coordination and programming	X	X			
Security Intrusion Detection System conduit and back box	X	X			
Security Intrusion Detection System Cabling	X	X			
Security Intrusion Dection System devices Motion sensors, door contacts,	X	X			
Security Intrusion Dection System panels	X	X			
Security Intrusion Detection system alarm circuits	X	X			

(1)

Audio Visual Responsibility Matrix	Responsibility		
System	General Contractor	Electrical Contractor (EC) File Sub Bid	Audio Visual Contractor (AVC) File Sub Sub Bid (If Required by Electrical Contractor)
Conduit and Back box	X	X	
Audio Visual Cabling System	X	X	
Audio Visual electronic equipment in AV rooms	X	X	X
Audio Visual displays and projectors (Including Mounting hardware)	X	X	X
Audio Visual devices in rooms	X	X	X
Audio Visual Assisted Listening Inductive Loop cabling	X	X	X
Audio Visual Assisted Listening inductive Loop Equipment	X	X	X
Audio Visual Assisted Listening inductive Loop Programming	X	X	X
Audio Visual FM+ Cabling	X	X	
Audio Visual FM+ Equipment	X	X	X
Audio Visual coordination and programming	X	X	X
Audio Visual Projection Screens	X	X	X
Audio Visual racks and cabinets	X	X	X
Audio Visual Power in AV rooms	X	X	
Audio Visual Plywood Back boards	X		

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1 Addendum 1 — 05/16/2025

DATE

DRAWING TITLE

ELECTRICAL Panel Schedules

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/8" = 1'-0" — SCALE
AP/RB — DRAWN BY
64076 — PROJECT #
64076-E300.dwg — FILE NAME

DRAWING NUMBER

E400

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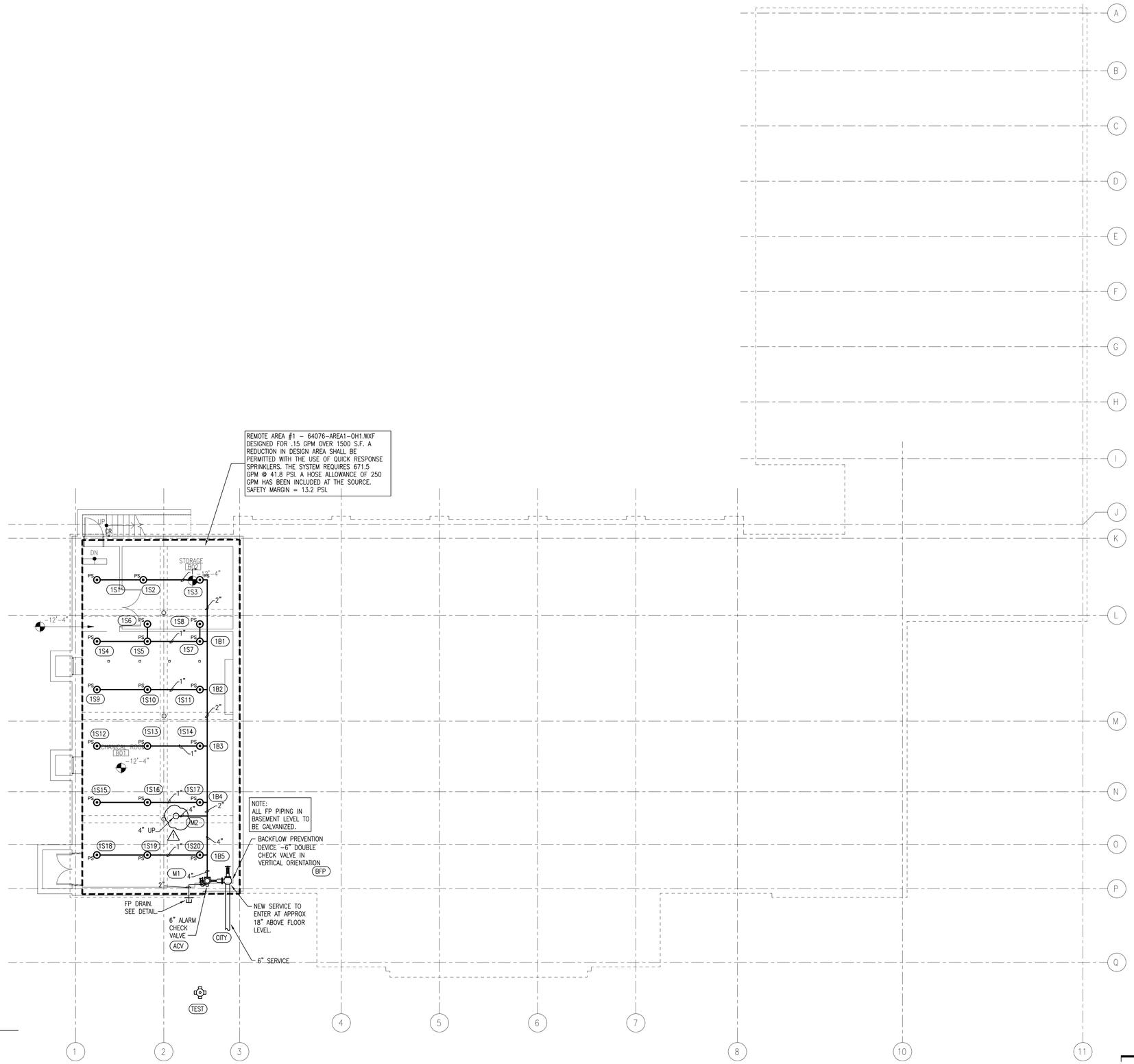

1 Basement Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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DRAWING TITLE

FIRE PROTECTION Basement Plan

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05/16/2025
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Construction Documents
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1/8" = 1'-0"
SCALE

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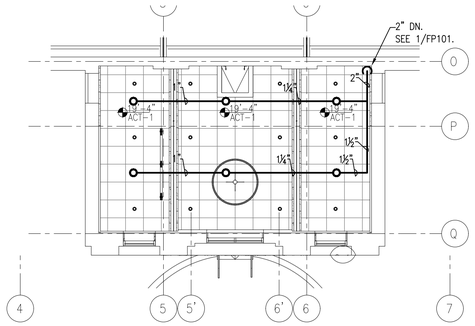
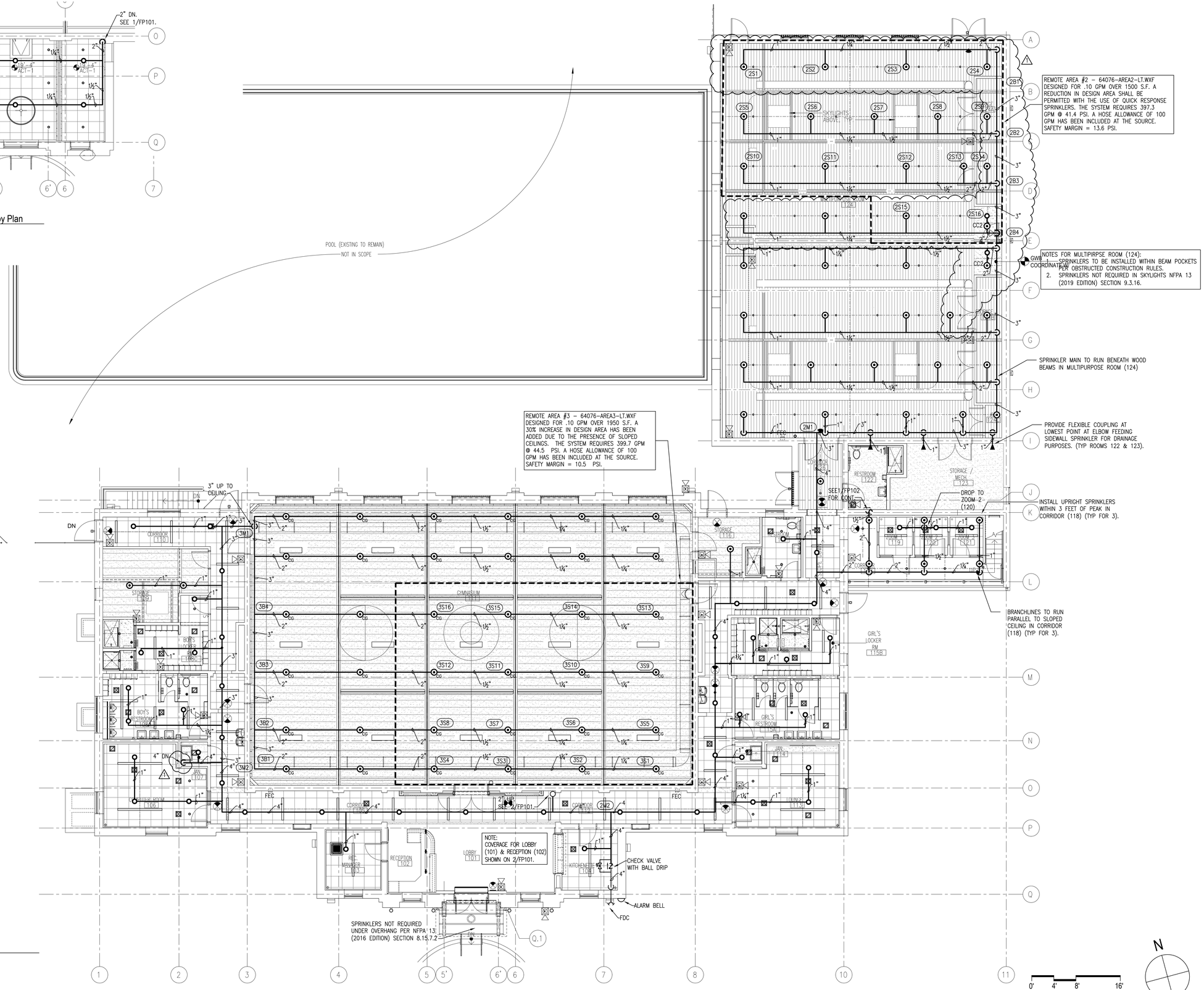


2 First Floor Partial Lobby Plan
1/8" = 1'-0"



1 First Floor Plan
1/8" = 1'-0"

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		DATE
1	Addendum 1	05/16/2025

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FIRE PROTECTION First Floor Plan

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64076-FP101.dwg — FILE NAME

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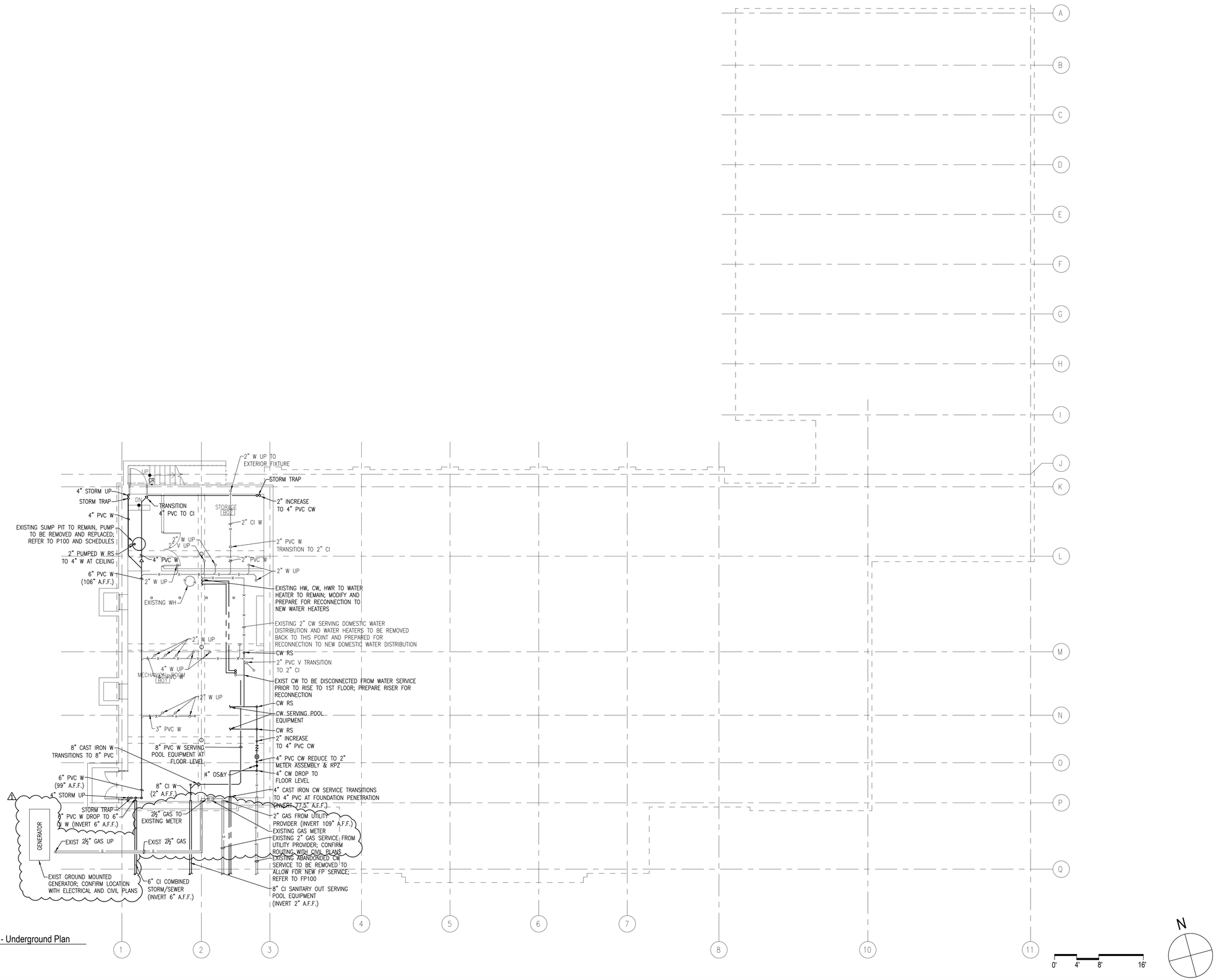

1 Basement - Underground Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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DRAWING TITLE

PLUMBING Basement Demo Plan

DRAWING INFORMATION

05/16/2025
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Construction Documents
DESCRIPTION

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PROJECT #	FILE NAME

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PD100

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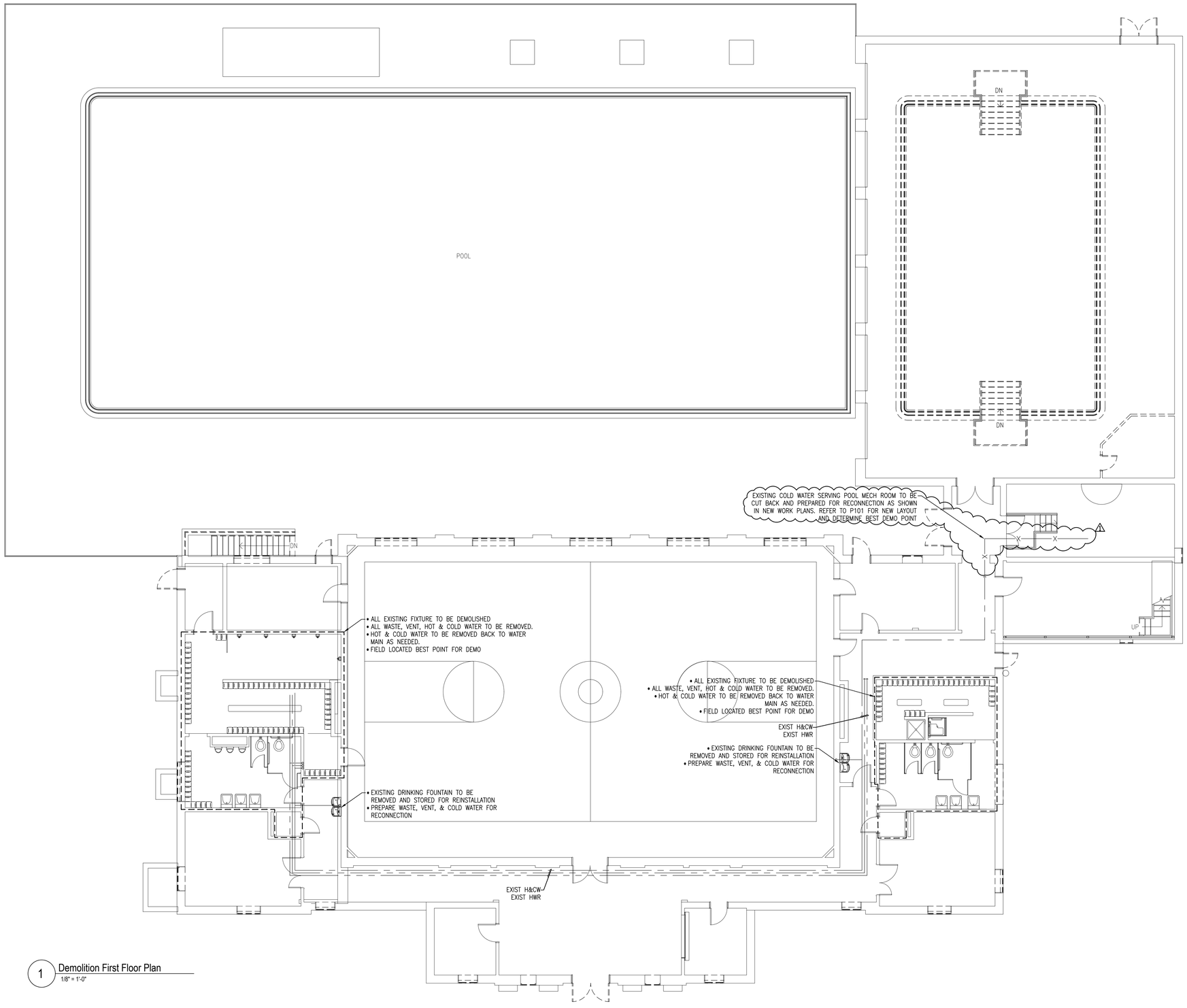

1 Demolition First Floor Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

DATE

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PLUMBING Demolition First Floor Plan

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05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

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SCALE

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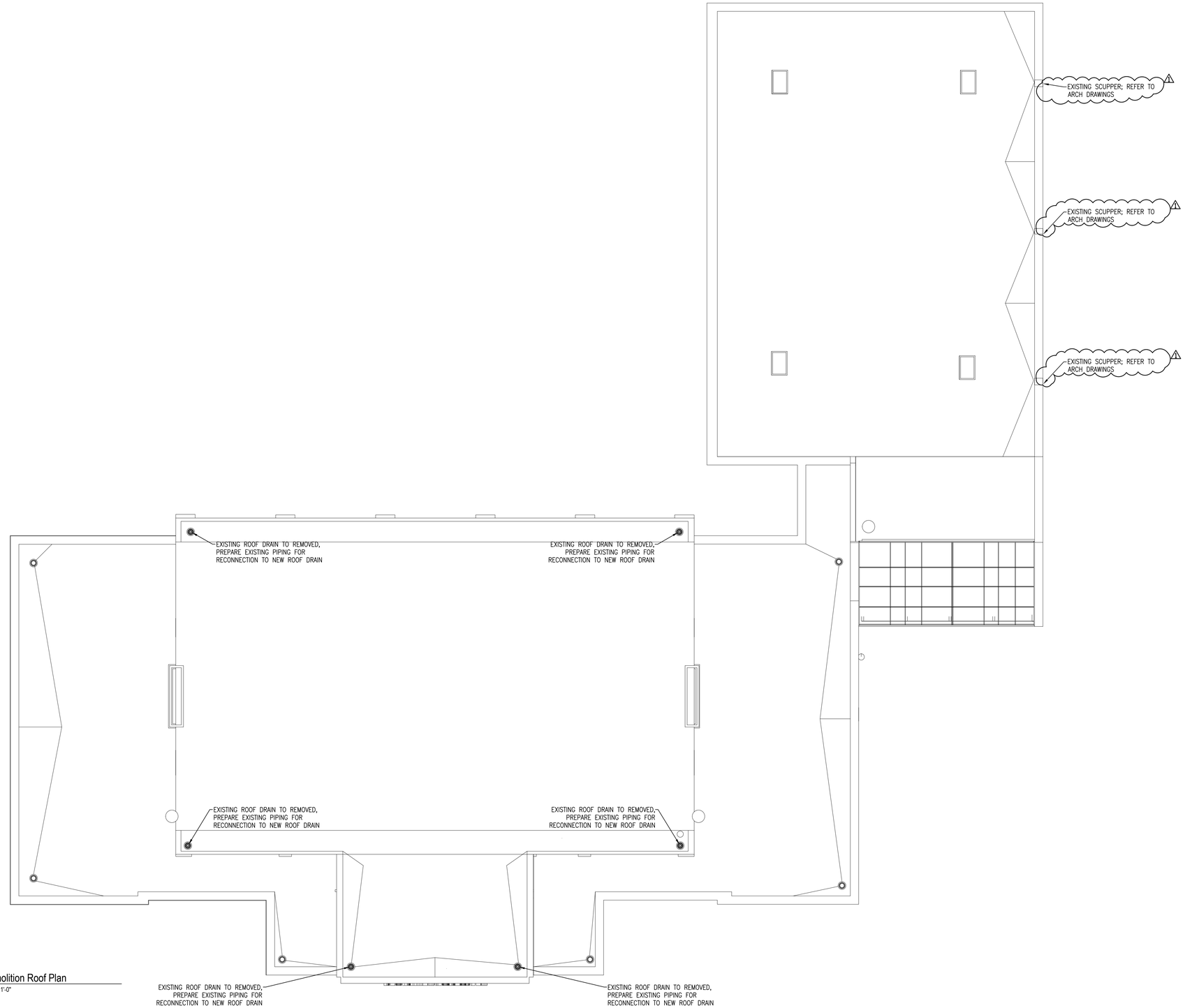

1 Demolition Roof Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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PLUMBING Demolition Roof Plan

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05/16/2025
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Construction Documents
DESCRIPTION

1/8" = 1'-0" SCALE
PP/KS DRAWN BY
64076 PROJECT #
64076-PD103.dwg FILE NAME

DRAWING NUMBER

PD103

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LEGEND

W =	WASTE
W&T =	WASTE AND TRAP
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HD =	HUB DRAIN
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DW =	DISH WASHER
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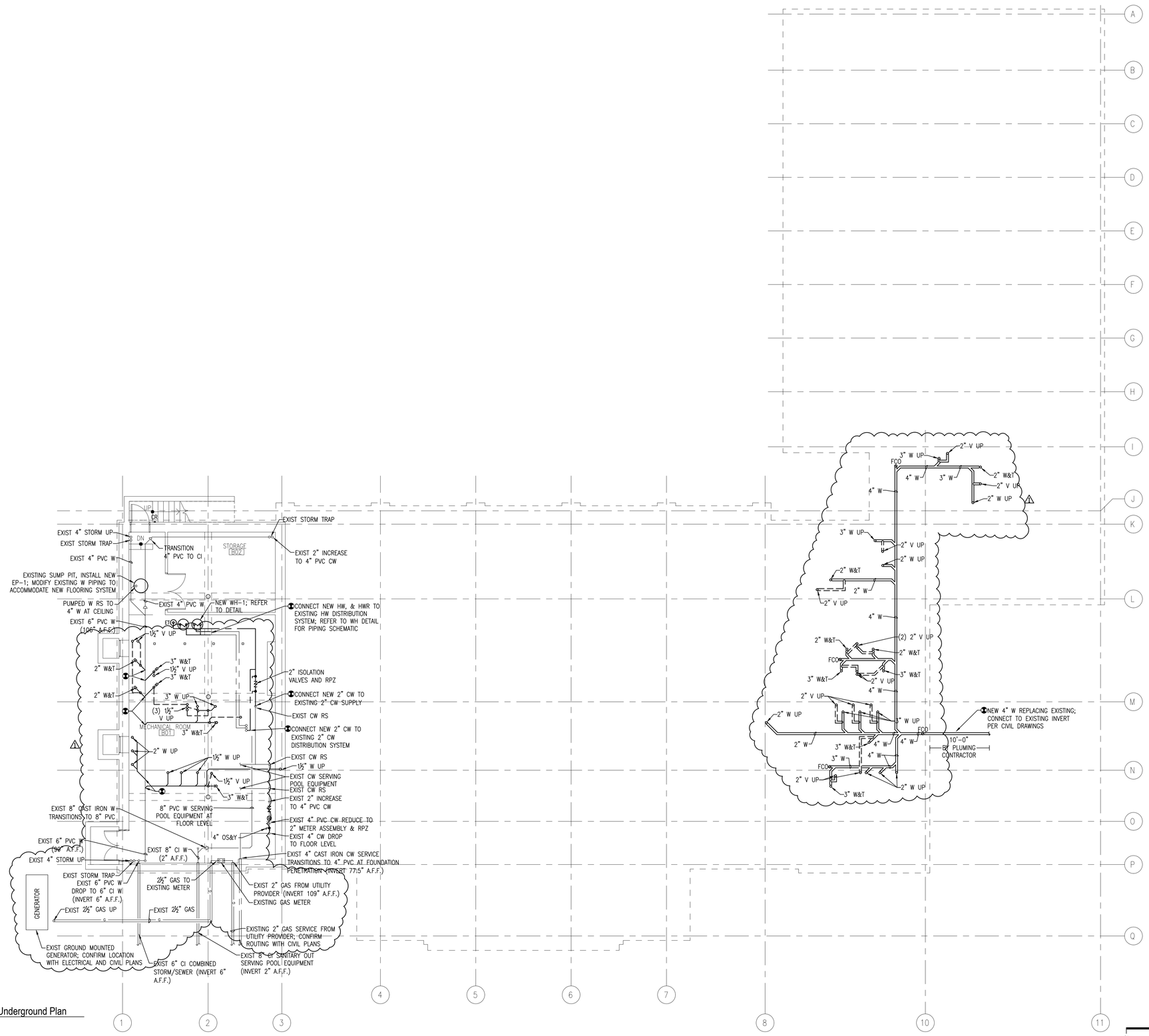

1 Basement - Underground Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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DRAWING TITLE

PLUMBING Underground Plan

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05/16/2025
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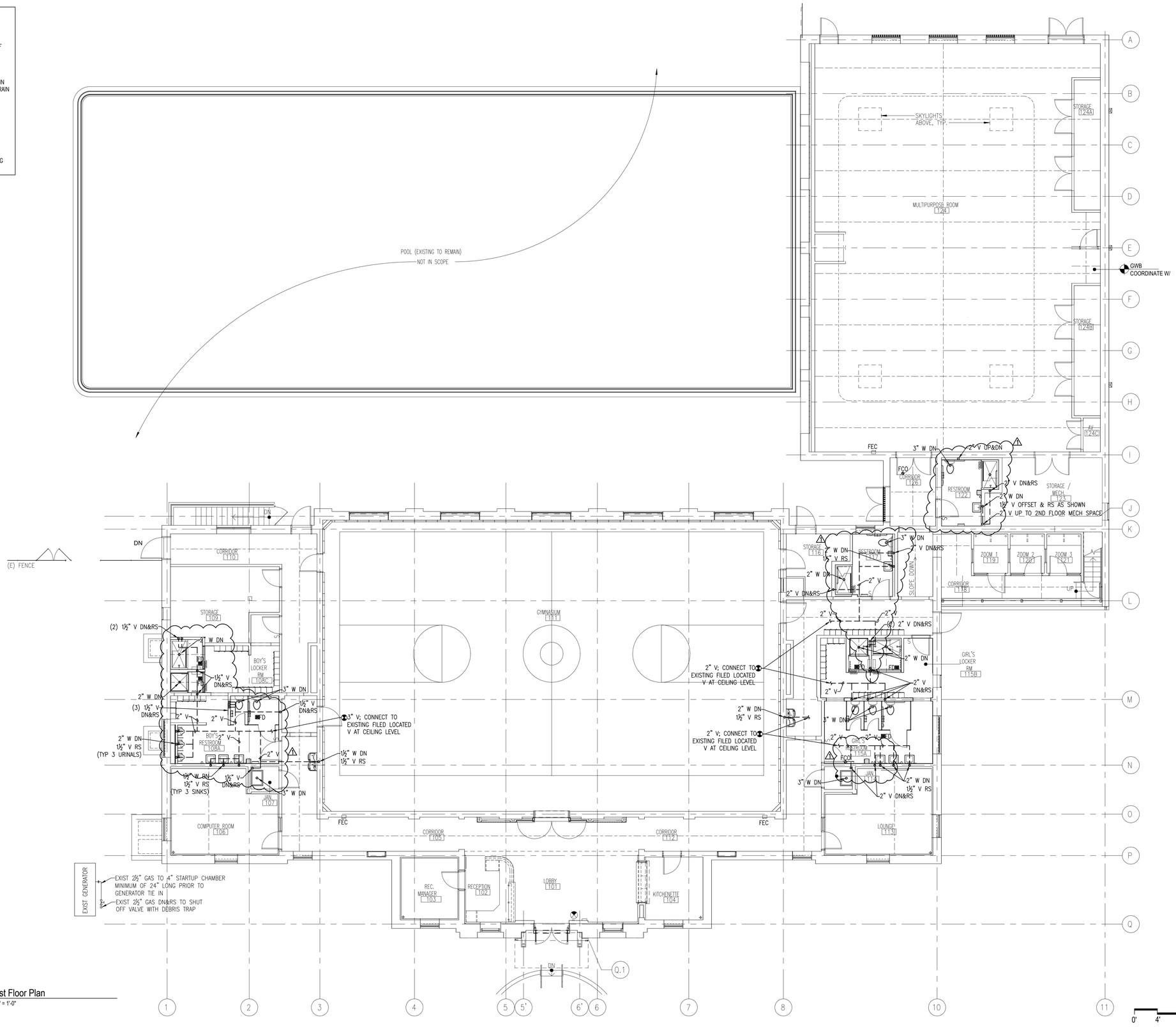

1 First Floor Plan
1/8" = 1'-0"

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1 Addendum 1	05/16/2025

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PLUMBING WASTE & VENT First Floor Plan

DRAWING INFORMATION

05/16/2025
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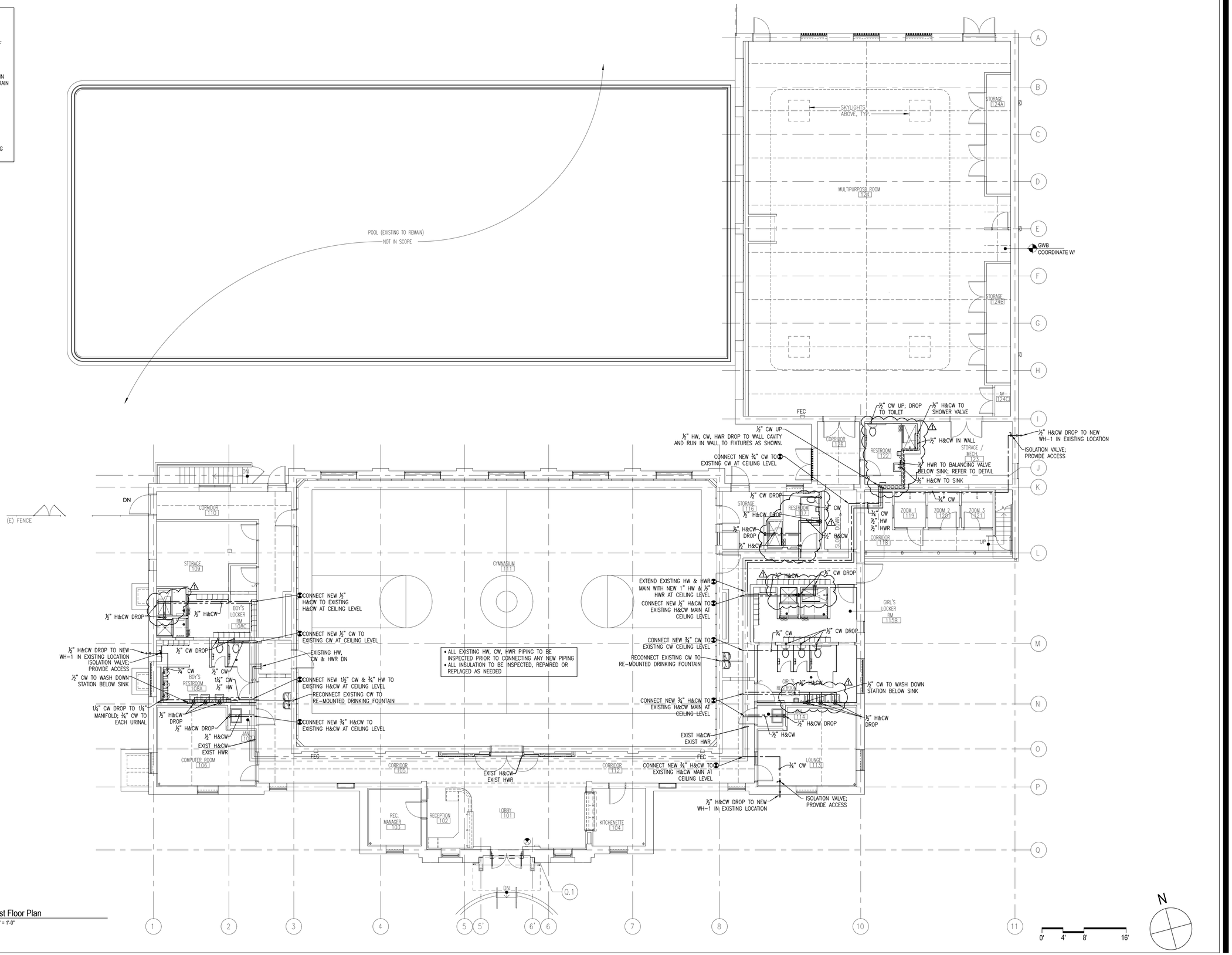

1 First Floor Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

DATE

DRAWING TITLE

PLUMBING DOMESTIC WATER First Floor Plan

DRAWING INFORMATION

05/16/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

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64076-P101.dwg — FILE NAME

DRAWING NUMBER

P101B

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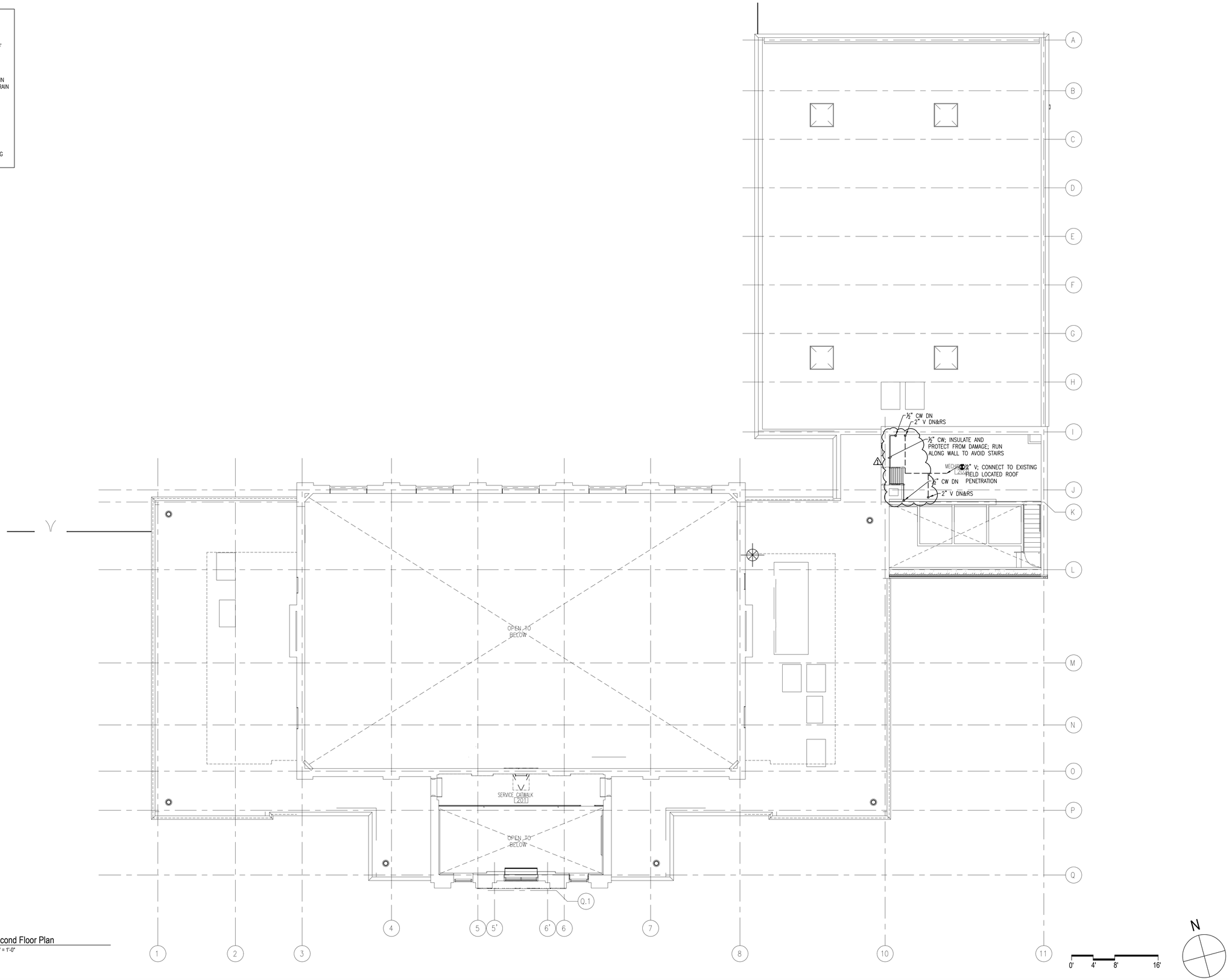

1 Second Floor Plan
1/8" = 1'-0"

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1	Addendum 1	05/16/2025

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PLUMBING Second Floor Plan

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05/16/2025
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DESCRIPTION

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SCALE

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PROJECT #

64076-P102.dwg
FILE NAME

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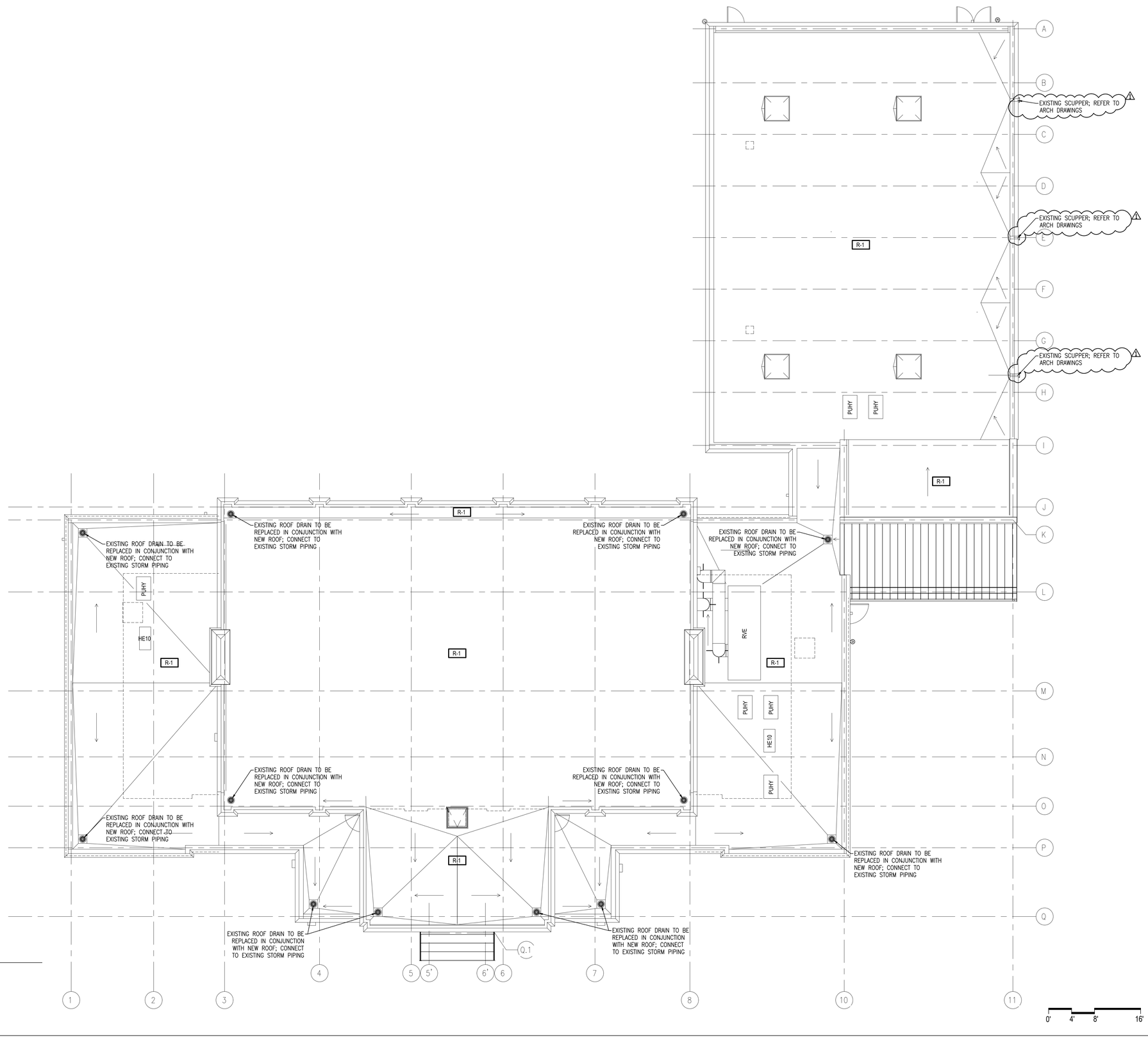

1 Roof Plan
1/8" = 1'-0"

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PLUMBING Roof Plan

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PLUMBING SYMBOLS AND PIPING LEGEND

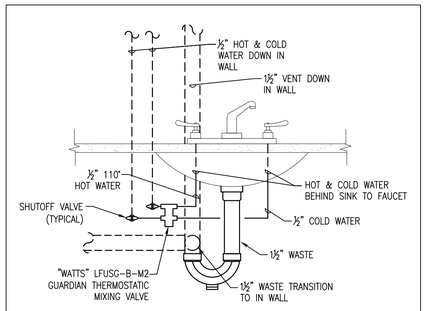
NOTE: THIS LEGEND IS ALL INCLUSIVE AND SOME OF THE PIPING SYSTEMS INDICATED MAY NOT BE PART OF THIS PROJECT OR TO SCALE.

ABBREV	DESCRIPTION
	BACKFLOW PREVENTER
	BACKFLOW PREVENTER & WATER METER
	WATER METER
	BALL VALVE – CLOSED
	BALL VALVE – OPEN
	GATE VALVE – CLOSED
	GATE VALVE – OPEN
	BUTTERFLY VALVE
	CAP
CO	CLEAN–OUT
	DIRECTION OF FLOW
	DRAIN VALVE
	ELBOW DOWN/DROP
	ELBOW UP/RISE
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
AD	AREA/GARAGE DRAIN
PD	PROMENADE DRAIN
GD	GREEN DRAIN
FS	FLOOR SINK
	GAS REGULATOR
	GATE VALVE
	HOSE BIBB
	LAUNDRY BOX
	CONNECT TO EXISTING
	RECIRCULATING PUMP
	REVISION DELTA
RD	ROOF DRAIN
	THERMOMETER
	UNION
	WASTE & TRAP

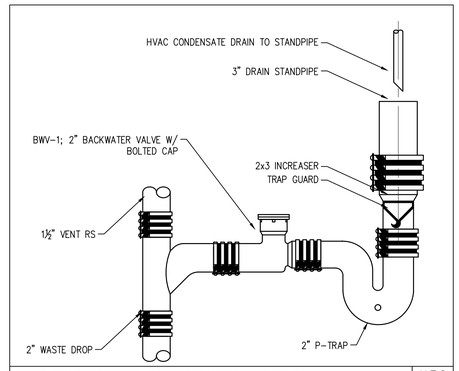
LINE TYPE	DESCRIPTION
	= CW (COLD WATER)
	= HW (HOT WATER)
	= HWR (HOT WATER RETURN)
G	= GAS (GAS LINE ABOVE GROUND)
115°	= 115° TEMPERATURE (HOT WATER)
125°	= 125° TEMPERATURE (HOT WATER)
140°	= 140° TEMPERATURE (HOT WATER)
	= TEMPERED WATER
GW	= GRAY WATER/GREASE WASTE
	= DEMO
	= S OR W (SANITARY WASTE)
STORM	= STORM (STORM PIPING)
	= VENT (VENT PIPING)
CA CA CA	= COMPRESSED AIR
VAC VAC	= VACUUM
	= CW (COLD WATER UNDERGROUND PIPING)
	= HW (HOT WATER UNDREGROUND PIPING)
	= HWR (HOT WATER RETURN U.G. PIPING)
G	= GAS (GAS LINE UNDERGROUND PIPING)
	= S OR W (SANITARY WASTE U.G.)
STORM	= STORM (STORM PIPING U.G.)
	= VENT (VENT PIPING U.G.)
X X X	= DEMO (DEMO PIPING U.G.)

PIPING ABBREVIATIONS

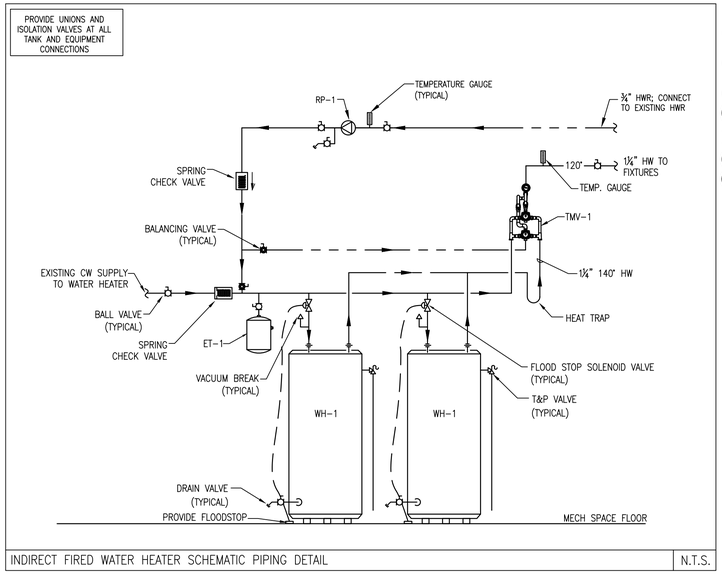
W	– WASTE
W&T	– WASTE AND TRAP
V	– VENT
FD	– FLOOR DRAIN
FCO	– FLOOR CLEAN OUT
CO	– CLEAN OUT
HW	– HOT WATER
CW	– COLD WATER
H&CW	– HOT AND COLD WATER
DN	– DOWN
RS	– RISE
PSD	– PRIMARY STORM DRAIN
OSD	– OVERFLOW STORM DRAIN
RD	– ROOF DRAIN



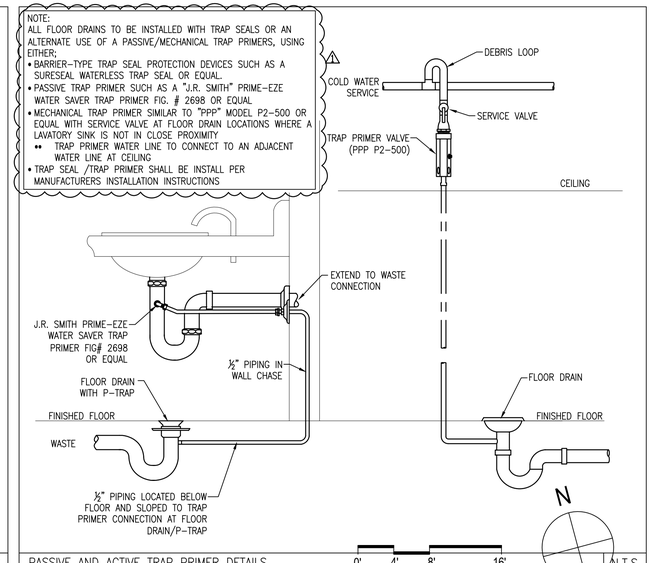
HAND SINK WITH POINT–OF–USE MIXING VALVE DETAIL — N.T.S.



HVAC CONDENSATE TO OPEN END STORM DRAIN DETAIL — N.T.S.



INDIRECT FIRED WATER HEATER SCHEMATIC PIPING DETAIL — N.T.S.



PASSIVE AND ACTIVE TRAP PRIMER DETAILS — N.T.S.

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