CSARCH

Bid Addendum No. 3

November 29, 2023

Pawling Central School District
2020 Capital Project – Phase 3

SED Project No. & Review No.
Pawling Elementary School: **SED No. 13-12-01-04-0-001-024**

CSArch Project No. 208-2101.03

Previously Issued Addenda Incorporated into Bid Documents

Bid Addendum No. 1	**11/17/2023**
Bid Addendum No. 2	**11/22/2023**

This Addendum No. 3 forms part of the Contract Documents and modifies the original construction documents Issued for Bid: November 1, 2023. Addendum No. 3 consists of THREE page(s) and the listed attachments.

Revisions to the Project Manual

1. Section 011200 – Multiple Contract Summary, Section 1.2 D **ADD** as follows;

   D. Each prime contractor MUST self-perform 25% of their scope of work. This requirement will be verified prior to contract award and monitored throughout the project.

2. Section 012300 - Alternates, Part 3.1, A. 3. Alternate #3: **ADD** "Contractor shall sum together the cost of Alternate Areas 3A, 3B, & 3C shown on the drawings for Alternate #3."
3. **Delete** Section 035416 – Hydraulic Cement Underlayment, **Add** revised Section 035416.
4. **Delete** Section 220523.12 – Ball Valves for Plumbing Piping, **Add** revised Section 220523.12.
5. **Delete** Section 224213.13 – Commercial Water Closets, **Add** revised Section 224213.13.
6. **Delete** Section 230713 – Duct Insulation, **Add** revised Section 230713.
7. **Delete** Section 233113 – Metal Ducts, **Add** revised Section 233113.
8. **Delete** Section 233300 – Air Duct Accessories, **Add** revised Section 233300.
9. **Delete** Section 237220 – Energy Recovery Ventilators, **Add** revised Section 237220.
10. **Delete** Section 237416.11 – Packaged Rooftop Air-Conditioning Units, **Add** revised Section 237416.11.

11. **Delete** Section 238129 – Variable-Refrigerent-Flow Systems, **Add** revised Section 238129.
12. **Delete** Section 238216.11 – Hydronic Air Coils, **Add** revised Section 238216.11.
13. **Delete** Section 238236 – Finned-Tube Radiation Heaters, **Add** revised Section 238236.

Revisions to the Contract Drawings

14. **Delete** drawing sheet A112, **Add** revised drawing sheet A112.
15. **Delete** drawing sheet A202, **Add** revised drawing sheet A202.
16. **Delete** drawing sheet A302, **Add** revised drawing sheet A302.
17. **Delete** drawing sheet A304, **Add** revised drawing sheet A304.
18. **Delete** drawing sheet P101, **Add** revised drawing sheet P101.
19. **Delete** drawing sheet P112, **Add** revised drawing sheet P112.
20. **Delete** drawing sheet P113, **Add** revised drawing sheet P113.
21. **Delete** drawing sheet P114, **Add** revised drawing sheet P114.
22. **Delete** drawing sheet P601, **Add** revised drawing sheet P601.
23. **Delete** drawing sheet P901, **Add** revised drawing sheet P901.
24. **Delete** drawing sheet MD112, **Add** revised drawing sheet MD112.
25. **Delete** drawing sheet MD113, **Add** revised drawing sheet MD113.
26. **Delete** drawing sheet MD114, **Add** revised drawing sheet MD114.
27. **Delete** drawing sheet M101, **Add** revised drawing sheet M101.
28. **Delete** drawing sheet M111, **Add** revised drawing sheet M111.
29. **Delete** drawing sheet M112, **Add** revised drawing sheet M112.
30. **Delete** drawing sheet M113, **Add** revised drawing sheet M113.
31. **Delete** drawing sheet M114, **Add** revised drawing sheet M114.
32. **Delete** drawing sheet M121, **Add** revised drawing sheet M121.
33. **Delete** drawing sheet M131, **Add** revised drawing sheet M131.
34. **Delete** drawing sheet M141, **Add** revised drawing sheet M141.
35. **Delete** drawing sheet M142, **Add** revised drawing sheet M142.
36. **Delete** drawing sheet M601, **Add** revised drawing sheet M601.
37. **Delete** drawing sheet M901, **Add** revised drawing sheet M901.
38. **Delete** drawing sheet E101, **Add** revised drawing sheet E101.
39. **Delete** drawing sheet E141, **Add** revised drawing sheet E141.

40. **Delete** drawing sheet E142, **Add** revised drawing sheet E142.
41. **Delete** drawing sheet E211, **Add** revised drawing sheet E211.
42. **Delete** drawing sheet E501, **Add** revised drawing sheet E501.
43. **Delete** drawing sheet E902, **Add** revised drawing sheet E902.
44. **Delete** drawing sheet ED101, **Add** revised drawing sheet ED101.
45. **Delete** drawing sheet ED501, **Add** revised drawing sheet ED501.

END OF BID ADDENDUM NO. 3

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Hydraulic cement underlayment.
2. Reinforcement.
3. Primer.
4. Surface sealer.

B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Test Reports:

1. For fire-resistant ratings, from a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 HYDRAULIC CEMENT UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ARDEX Americas.
b. Laticrete International, Inc.
c. MAPEI Corporation.
d. Maxxon Corporation.

2. Cement Binder: ASTM C150/C150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

5. Schedule of underlayment thickness based on building area to be field verified upon completion of demolition activities prior to placement of underlayment.

a. Area 1 Resilient/ Carpet/ Ceramic floor replacements, assumed thickness 1".
b. Area 1 Resilient/ Carpet floor at removed wood floor, assumed thickness 3".
c. Areas 2, 3, 4 Resilient/ Carpet floor replacements, assumed thickness 1/2".
d. Areas 2, 3, 4 Ceramic floor replacements, assumed thickness 2".

B. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

C. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

E. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) Insert area, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.

C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Install underlayment reinforcement recommended in writing by manufacturer.

D. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

E. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

F. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 INSTALLATION

A. Mix and install underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Install underlayment to produce uniform, level surface.

1. Install a final layer without aggregate to product surface.
2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61and NSF 372.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.18 for solder-joint connections.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Stainless-Steel Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Center Line; a Crane Co. brand.
c. Hammond Valve.

d. Milwaukee Valve Company.
e. NIBCO INC.
f. Viega LLC.

2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Press.
f. Press Ends Connections Rating: Minimum 200 psig.
g. Seats: PTFE or RTPFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel.
j. Port: Full.
k. O-Ring Seal: EPDM or Buna-N.

B. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Center Line; a Crane Co. brand.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Viega LLC.

2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 3: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze ball valves, two-piece with full port and stainless steel trim. Provide with threaded solder or press connection-joint ends.

~~*B. Pipe NPS 2-1/2 and Larger:*~~

1. ~~*Bronze ball valves, two-piece with full port and stainless steel trim. Provide with threaded solder or press connection-joint ends.*~~ *REVISED BY ADDENDUM No. 3*

END OF SECTION 220523.12

SECTION 224213.13 - COMMERCIAL WATER CLOSETS *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. *Floor-mounted, bottom-outlet water closets. REVISED BY ADDENDUM No. 3*
2. Wall-mounted water closets.
3. Flushometer valves.
4. Toilet seats.
5. Supports.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
5. Comply with ASME A112.6.1M for water-closet supports.
6. Comply with ICC A117.1 for ADA-compliant water closets.
7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS *REVISED BY ADDENDUM No. 3*

A. Water Closets – Floor Mounted, Bottom Outlet, Top Spud: WC-2

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Mansfield Plumbing Products LLC.
d. Sloan Valve Company.
e. TOTO USA, INC.
f. Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.

3. Bowl:

a. Material: Vitreous china.
b. Type: Siphon jet.
c. Style: Flushometer valve.
d. Rim Height: 16-3/4"
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Spud Size and Location: NPS 1-1/2; top.

h. Color: White.

B. Water Closets – Floor Mounted, Bottom Outlet, Top Spud: WC-3

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard.
   b. Kohler Co.
   c. Mansfield Plumbing Products LLC.
   d. Sloan Valve Company.
   e. TOTO USA, INC.
   f. Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.
3. Bowl:

   a. Material: Vitreous china.
   b. Type: Siphon jet.
   c. Style: Flushometer valve.
   d. Rim Height: 14"
   e. Rim Contour: Elongated.
   f. Water Consumption: 1.28 gal. per flush.
   g. Spud Size and Location: NPS 1-1/2; top.
   h. Color: White.

C. Water Closets – Floor Mounted, Bottom Outlet, Top Spud: WC-4

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard.
   b. Kohler Co.
   c. Mansfield Plumbing Products LLC.
   d. Sloan Valve Company.
   e. TOTO USA, INC.
   f. Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.
3. Bowl:

   a. Material: Vitreous china.
   b. Type: Siphon jet.
   c. Style: Flushometer valve.

d. Rim Height: 10"
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Spud Size and Location: NPS 1-1/2; top.
h. Color: White.

REVISED BY ADDENDUM No. 3

2.3 WALL-MOUNTED WATER CLOSETS

A. Water Closets - Wall Mounted, Top Spud: *WC-1 REVISED BY ADDENDUM No. 3*

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Mansfield Plumbing Products LLC.
d. Sloan Valve Company.
e. TOTO USA, INC.
f. Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.
3. Bowl:

a. Material: Vitreous china.
b. Type: Siphon jet.
c. Style: Flushometer valve.
d. Rim Contour: Elongated.
e. Water Consumption: 1.28 gal. per flush.
f. Spud Size and Location: NPS 1-1/2; top.
g. Color: White.

4. Support: Water-closet carrier.

2.4 FLUSHOMETER VALVES

A. Flushometer Valves - Diaphragm, Solenoid Actuated: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Delany Products.

b. Sloan Valve Company.
c. Zurn Industries, LLC.

2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Style: Exposed.
7. Exposed Flushometer-Valve Finish: Chrome-plated.
8. Panel Finish: Chrome-plated or stainless steel.
9. Actuator: Side or top mounted; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

2.5 TOILET SEATS

A. Toilet Seats: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Church Seats; Bemis Manufacturing Company.
c. Kohler Co.
d. TOTO USA, INC.
e. Zurn Industries, LLC.

2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.
10. Surface Treatment: Antimicrobial.

2.6 SUPPORTS

A. Water-Closet Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. MIFAB, Inc.
c. Zurn Industries, LLC.

2. Source Limitations: Obtain water-closet carrier from single source from single manufacturer.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.

2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations easily reachable for people with disabilities.
5. Install new batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.

3.3 PIPING CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 230713 - DUCT INSULATION *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.2 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

B. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Ductwork Mockups:

a. One 10-foot section each of rectangular and round straight duct.
b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
d. One rectangular and round transition fitting.
e. Four support hangers for round and rectangular ductwork.
f. Each type of damper and specialty.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
   1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Johns Manville; a Berkshire Hathaway company.
      b. Knauf Insulation.
      c. Manson Insulation Inc.
      d. Owens Corning.

G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Knauf Insulation.
    c. Manson Insulation Inc.
    d. Owens Corning.

H. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Knauf Insulation.
    c. Manson Insulation Inc.
    d. Owens Corning.

2. Semirigid board material with factory-applied FSK jacket.

3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armacell LLC.
    b. Nomaco.
    c. Sekisui Voltek, LLC.
    d. Thermaduct.

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Johns Manville; a Berkshire Hathaway company.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. 3M.
    b. Thermal Ceramics.
    c. Unifrax Corporation.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Mon-Eco Industries, Inc.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Mon-Eco Industries, Inc.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Proto Corporation.
    c. Sekisui Voltek, LLC.
    d. Speedline Corporation.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Vimasco Corporation.

2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
5. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Exterior Use: Suitable for outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Knauf Insulation.
e. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Color: White.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.7 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.

2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.

2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.

7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. P.I.C. Plastics, Inc.
    c. Proto Corporation.
    d. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Factory cut and rolled to size.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier: 3-mil- thick polysurlyn.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Vimasco Corporation.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Alpha Associates, Inc.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.

c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches.

3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches75 mm.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

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

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.

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.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. 3M Industrial Adhesives and Tapes Division.
   b. Avery Dennison Corporation, Specialty Tapes Division.
   c. Ideal Tape Co., Inc., an American Biltrite Company.
   d. Knauf Insulation.

2. Width: 2 inches50 mm.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Johns Manville; a Berkshire Hathaway company.
   b. RPR Products, Inc.

2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- or larger diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) AGM Industries, Inc.
      2) CL WARD & Family Inc.
      3) Gemco.

4) Midwest Fasteners, Inc.
5) Nelson Stud Welding.

2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Gemco.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Johns Manville; a Berkshire Hathaway company.

c. RPR Products, Inc.

2.14 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum in accordance with ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC AND POLYOLEFIN INSULATION

A. Comply with manufacturer's written installation instructions and ASTM C1710.

B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Square and Rectangular Ducts and Plenums:

1. Provide 1/4 inch more per side for a tight, compression fit.
2. Cut sheet insulation with the following dimensions:

a. Width of duct plus 1/4 inch, one piece.
b. Height of duct plus 1/4 inch, plus thickness of insulation, two pieces.
c. Width of duct plus 1/4 inch, plus two times the thickness of insulation, one piece.

3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.
4. Insulation without self-adhering backing:

a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last 1/4 inch where sheets will butt together.
b. Roll sheet down into position.
c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.

5. Insulation with self-adhering backing:

a. Peel back release paper in 6- to 8-inch increments and line up sheet.
b. Press firmly to activate adhesive.
c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
d. Allow 1/4-inch overlap for compression at butt joints.

e. Apply adhesive at the butt joint to seal the two sheets together.

6. Insulate duct brackets following manufacturer's written installation instructions.

D. Circular Ducts:

1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be used.
2. Cut the sheet to the required size.
3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

   1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Comply with manufacturer's written installation instructions.

B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

C. Insulate duct access panels and doors to achieve same fire rating as duct.

D. Install firestopping at penetrations through fire-rated assemblies.

3.9 DUCT AND PLENUM INSULATION SCHEDULE

A. Interior supply air ductwork.

1. Concealed Locations: Mineral-Fiber Blanket; R-6.
2. Exposed Locations: Mineral-Fiber Board; R-6.
3. Exception: Supply air ductwork exposed to view in conditioned spaces served by ductwork shall not be insulated.

B. Interior outdoor air ductwork and plenums.

1. Concealed Locations: Mineral-Fiber Blanket; R-12
2. Exposed Locations: Mineral-Fiber Board; R-12

C. Interior exhaust air ductwork and plenums (3 feet from penetration of building exterior or isolation damper, whichever is longer).

1. Concealed Locations: Mineral-Fiber Blanket; R-12
2. Exposed Locations: Mineral-Fiber Board; R-12

D. Attic supply air, return air, outdoor air, and exhaust air ductwork.

1. Mineral-Fiber Board; R-12

E. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

~~*F. Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.*~~ *REVISED BY ADDENDUM No. 3*

~~*3.10 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE*~~ *REVISED BY ADDENDUM No. 3*

~~*A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.*~~

~~*B. If more than one material is listed, selection from materials listed is Contractor's option.*~~

~~*C. Ducts and Plenums, Exposed,:*~~

~~*1. Painted Aluminum, Stucco Embossed: 0.024 inch thick.*~~

END OF SECTION 230713

SECTION 233113 - METAL DUCTS *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: *REVISED BY ADDENDUM No. 3*

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round ducts and fittings.
4. Double-wall round ducts and fittings.
5. Sheet metal materials.
~~6. *Duct liner.*~~
7. Sealants and gaskets.
8. Hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products: *REVISED BY ADDENDUM No. 3*

1. ~~*Liners and a A*~~dhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Wind Performance: Ducts are to withstand the effects of wind determined in accordance with to ASCE/SEI 7.

D. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

F. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

G. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS *REVISED BY ADDENDUM No. 3*

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. ~~*For ducts exposed to weather, construct of stainless steel indicated by manufacturer to be suitable for outdoor installation.*~~

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS *REVISED BY ADDENDUM No. 3*

A. Source Limitations: Obtain double-wall rectangular ducts and fittings from single manufacturer.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
   1. For ducts exposed to weather, construct outer duct of aluminum indicated by manufacturer to be suitable for outdoor installation.

D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
   2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
   3. Provide weather tight clips at all joints.

E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Provide weather tight clips at all joints.

F. Inner Duct: Solid galvanized sheet steel. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

G. Interstitial Insulation, 2" Foam ~~*complying with NFPA 90A, or NFPA 90B.*~~

   1. R-12 insulation.
   ~~*2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.*~~
   ~~*3. Coat insulation with antimicrobial coating.*~~
   ~~*4. Cover insulation with polyester film complying with UL 181, Class 1.*~~

H. Double-wall assembly shall be tested and complies with UL-723 and ASTM E84.

2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS *REVISED BY ADDENDUM No. 3*

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
~~2. For ducts exposed to weather, construct of stainless steel indicated by manufacturer to be suitable for outdoor installation.~~

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Linx Industries; a DMI company (formerly Lindab).
b. MKT Metal Manufacturing.
c. SEMCO, LLC; part of FlaktGroup.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Source Limitations: Obtain single-wall round ducts and fittings from single manufacturer.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

F. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.5 DOUBLE-WALL ROUND DUCTS AND FITTINGS *REVISED BY ADDENDUM No. 3*

A. Source Limitations: Obtain double-wall round ducts and fittings from single manufacturer.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
   1. For ducts exposed to weather, construct outer duct of aluminum indicated by manufacturer to be suitable for outdoor installation.
   2. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

      a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
      b. Provide weather tight clips at all joints.

   3. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

      a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
      b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
      c. Provide weather tight clips at all joints.

   4. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree

Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Solid galvanized sheet steel. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

A. Interstitial Insulation, 2" Foam ~~*complying with NFPA 90A, or NFPA 90B.*~~

1. R-12 insulation.
~~*2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.*~~
~~*3. Coat insulation with antimicrobial coating.*~~
~~*4. Cover insulation with polyester film complying with UL 181, Class 1*~~

B. Double-wall assembly shall be tested and complies with UL-723 and ASTM E84.

2.6 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.7 ~~*DUCT LINER*~~ *REVISED BY ADDENDUM No. 3*

~~*A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."*~~

~~*1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:*~~

~~*a. Johns Manville; a Berkshire Hathaway company.*~~

~~b. Knauf Insulation.~~
~~c. Owens Corning.~~

~~2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.~~
~~3. Maximum Thermal Conductivity:~~

~~a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.~~
~~b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.~~

~~4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.~~
~~5. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.~~

~~B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.~~

~~1. Source Limitations: Obtain flexible elastomeric duct liner from single manufacturer.~~
~~2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.~~
~~3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.~~

~~C. Insulation Pins and Washers:~~

~~1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.~~
~~2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.~~

~~D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."~~

~~1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.~~

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

~~*3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT*~~ *REVISED BY ADDENDUM No. 3*

~~*A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.*~~

~~*B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.*~~

~~*C. All ducts exposed to view are to be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view are to be [stainless] [**carbon**] steel as per "Duct Schedule" Article.*~~

~~*D. All joints are to be welded and are to be telescoping, bell, or flange joint as per NFPA 96.*~~

~~*E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of [**20**] [12] <**Insert dimension**> feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.*~~

~~*F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.*~~

~~*3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS*~~ *REVISED BY ADDENDUM No. 3*

~~*A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.*~~

~~*B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.*~~

~~*C. Minimize number of transverse seams.*~~

~~*D. Do not locate longitudinal seams on bottom of duct.*~~

~~*3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS*~~ *REVISED BY ADDENDUM No. 3*

~~*A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."*~~

~~*B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.*~~

C. ~~*Connect duct to fan, fume hood, and other equipment indicated on Drawings*~~.

3.6 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Double Wall:

1. Ductwork complies with requirements in "Double-Wall Rectangular Ducts and Fittings" or "Double-Wall Round Ducts and Fittings" Article.
2. Ductwork outer wall is to be aluminum indicated by manufacturer to be suitable for outdoor installation.
3. Provide interstitial insulation.

3.7 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.9 DUCTWORK CONNECTIONS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.10 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use duct cleaning methodology as indicated in NADCA ACR.

C. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

D. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

E. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

F. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.13 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 3-inch wg.
b. Minimum SMACNA Seal Class: A.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.

3. Ducts Connected to Equipment Not Listed above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

3. Ducts Connected to Equipment Not Listed above:

a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: B if negative pressure; A if positive pressure.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.

F. Exterior Supply and Return/Exhaust Ducts: *REVISED BY ADDENDUM No. 3*
1. Ducts Connected to all equipment:
a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. Double-wall construction *complying with requirements in "Double-Wall Rectangular Ducts and Fittings" or "Double-Wall Round Ducts and Fittings" Article.*
d. Ductwork outer wall is to be aluminum indicated by manufacturer to be suitable for outdoor installation.

G. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

H. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.

2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Smoke dampers.
5. Combination fire and smoke dampers.
6. Flange connectors.
7. Duct silencers.
8. Turning vanes.
9. Remote damper operators.
10. Duct-mounted access doors.
11. Flexible connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a division of MESTEK, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.
7. Safe Air - Dowco Products.
8. United Enertech.
9. Vent Products Co., Inc.

B. Description: Gravity balanced.

C. Performance:

1. Maximum Air Velocity: 1250 fpm.
2. Maximum System Pressure: 2 inches wg.
3. AMCA Certification: Test and rate in accordance with AMCA 511.
4. Leakage:
   a. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

D. Construction:

1. Frame:

   a. Hat shaped.
   b. 16-gauge- thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.

2. Blades:

   a. Multiple single-piece blades.
   b. Off-center pivoted, maximum 6-inch width, 16-gauge- thick, with sealed edges.

3. Blade Action: Parallel.

E. Blade Seals: Neoprene, mechanically locked.

F. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 0.20 inch.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

I. Bearings: Steel ball Brass sleeve or synthetic pivot bushings.

J. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Chain pulls.
4. Screen Mounting:

a. Front mounted in sleeve.

1) Sleeve Thickness: 20 gauge minimum.
2) Sleeve Length: 6 inches minimum.

5. Screen Material: Aluminum.
6. Screen Type: Bird.
7. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance; a division of MESTEK, Inc.
b. Aire Technologies, Inc.; a DMI company.
c. Greenheck Fan Corporation.
d. Lloyd Industries, Inc.
e. McGill AirFlow LLC.
f. Nailor Industries Inc.
g. Ruskin Company.

2. Performance:

a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:

    a. Linkage out of airstream.
    b. Suitable for horizontal or vertical airflow applications.

4. Frames:

    a. Hat-shaped, 16-gauge- thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized steel; 16 gauge thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Oil-impregnated stainless steel sleeve.
    b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

8. Tie Bars and Brackets: Galvanized steel.
9. Locking device with offset handle to hold damper blades in a fixed position without vibration.

~~*B. Standard, Aluminum, Manual Volume Dampers:*~~ *REVISED BY ADDENDUM No. 3*

~~*1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:*~~

~~*a. American Warming and Ventilating; a Mestek Architectural Group company.*~~
~~*b. Arrow United Industries.*~~
~~*c. Cesco Products; a division of MESTEK, Inc.*~~
~~*d. McGill AirFlow LLC.*~~
~~*e. Nailor Industries Inc.*~~
~~*f. Pottorff.*~~
~~*g. Ruskin Company.*~~
~~*h. Safe Air - Dowco Products.*~~
~~*i. United Enertech.*~~
~~*j. Vent Products Co., Inc.*~~

2. Performance:

a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:

a. Linkage out of airstream.
b. Suitable for horizontal or vertical airflow applications.

4. Frames:

a. Hat-shaped, 0.10-inch- thick, aluminum sheet channels.
b. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Oil-impregnated bronze Molded synthetic Stainless steel sleeve.
b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

8. Tie Bars and Brackets: Aluminum.
9. Locking device with offset handle to hold damper blades in a fixed position without vibration.

C. Low-Leakage, Steel, Manual Volume Dampers: REVISED BY ADDENDUM No. 3

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance; a division of MESTEK, Inc.
b. American Warming and Ventilating; a Mestek Architectural Group company.
c. Arrow United Industries.
d. Cesco Products; a division of MESTEK, Inc.
e. Greenheck Fan Corporation.
f. McGill AirFlow LLC.

g. Nailor Industries Inc.
h. Pottorff.
i. Ruskin Company.
j. Safe Air – Dowco Products.
k. United Enertech.
l. Vent Products Co., Inc.

2. Performance:

a. AMCA Certification: Test and rate in accordance with AMCA 511.
b. Leakage:
1) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:

a. Linkage: Out of airstream.
b. Suitable for horizontal or vertical airflow applications.

4. Frames:

a. Hat, U, or angle shaped.
b. Thickness: 16-gauge galvanized sheet steel.
c. Mitered and welded corners.
d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel; 16 gauge thick.

6. Blade Edging Seals:

a. Closed-cell neoprene.
b. Inflatable seal blade edging or replaceable rubber seals.

7. Blade Jamb Seals: Neoprene.
8. Blade Axles: Galvanized steel.
9. Bearings:

a. Oil-impregnated stainless steel sleeve.
b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

10. Tie Bars and Brackets: Galvanized steel.
11. Locking device with offset handle to hold damper blades in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers: REVISED BY ADDENDUM No. 3

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Air Balance; a division of MESTEK, Inc.
    b. American Warming and Ventilating; a Mestek Architectural Group company.
    c. Arrow United Industries.
    d. Cesco Products; a division of MESTEK, Inc.
    e. McGill AirFlow LLC.
    f. Nailor Industries Inc.
    g. Pottorff.
    h. Ruskin Company.
    i. Safe Air - Dowco Products.
    j. United Enertech.
    k. Vent Products Co., Inc.

2. Performance:
    a. Leakage:
        1) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:

    a. Linkage out of airstream.
    b. Suitable for horizontal or vertical airflow applications.

4. Frames:

    a. Hat, U, or angle shaped.
    b. Thickness: 0.08-inch aluminum sheet channels.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Roll-Formed Aluminum Blades:0.072-inch thick aluminum sheet.
    d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Edging Seals:

~~a. Closed-cell neoprene.~~
~~b. Inflatable seal blade edging or replaceable rubber seals.~~

~~7. Blade Jamb Seals: Neoprene.~~
~~8. Blade Axles: Nonferrous metal.~~
~~9. Bearings:~~

~~a. Molded synthetic Stainless steel sleeve.~~
~~b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.~~

~~10. Tie Bars and Brackets: Aluminum.~~
~~11. Locking device with offset handle to hold damper blades in a fixed position without vibration.~~

E. Jackshaft:
1. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
2. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK, Inc.
2. Arrow United Industries.
3. Cesco Products; a division of MESTEK, Inc.
4. Greenheck Fan Corporation.
5. NCA Manufacturing, Inc.
6. Pottorff.
7. Ruskin Company.
8. Safe Air - Dowco Products.
9. United Enertech.
10. Vent Products Co., Inc.

B. Type: dynamic; rated and labeled in accordance with UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed galvanized sheet steel, interlocking. Material gauge is to be in accordance with UL listing.

I. Horizontal Dampers: Include blade lock and stainless steel closure spring.

J. Heat-Responsive Device:

1. Replaceable, 165 deg F rated, fusible links.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK, Inc.
2. Arrow United Industries.
3. Cesco Products; a division of MESTEK, Inc.
4. Greenheck Fan Corporation.
5. Pottorff.
6. Ruskin Company.
7. Safe Air - Dowco Products.
8. United Enertech.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
3. Unless otherwise indicated, use parallel-blade configuration.

4. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.
5. Factory install damper actuator by damper manufacturer as integral part of damper assembly. Coordinate actuator location, mounting, and electrical requirements with damper manufacturer.

C. Performance:
1. Leakage:
   a. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

2. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
3. Velocity: Up to 3000 fpm.
4. Temperature: Minus 25 to plus 180 deg F.
5. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Suitable for horizontal or vertical airflow applications.
2. Linkage out of airstream.
3. Frame:

   a. Hat shaped.
   b. Galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
   c. Gauge in accordance with UL listing.

4. Blades:

   a. Roll-formed, horizontal, airfoil, galvanized sheet steel.
   b. Maximum width and gauge in accordance with UL listing.

5. Blade Edging Seals:

   a. Silicone rubber.

6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage is to be mounted out of airstream.
8. Bearings:

a. Oil-impregnated stainless steel sleeve.

E. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application; gauge in accordance with UL listing.

F. Damper Actuator - Electric:

1. Electric - 120 V ac.
2. UL 873, plenum rated.
3. Designed to operate in smoke-control systems complying with UL 555S requirements.
4. Two position with fail-safe spring return.

a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
b. Maximum 15-second full-stroke closure.
c. Minimum 90-degree drive rotation.

5. Clockwise or counterclockwise drive rotation as required for application.
6. Environmental Operating Range:

a. Temperature: Minus 40 to plus 130 deg F.
b. Humidity: 5 to 95 percent relative humidity noncondensing.

7. Environmental Enclosure: NEMA 2.
8. Actuator to be factory mounted and provided with single-point wiring connection.

G. Controllers, Electrical Devices, and Wiring:
1. Electrical Connection: 115 V, single phase, 60 Hz.

H. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches, damper mounted.
3. Smoke Detector: Integral, factory wired for single-point connection.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK, Inc.
2. Arrow United Industries.

3. Cesco Products; a division of MESTEK, Inc.
4. Greenheck Fan Corporation.
5. Pottorff.
6. Ruskin Company.
7. Safe Air - Dowco Products.
8. United Enertech.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
3. Unless otherwise indicated, use parallel-blade configuration.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.

D. Fire Rating: [**1-1/2**] [**and**] [**3**] hours.

E. Performance:
1. Leakage:

a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

2. Pressure Drop: 0.05 in. wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
3. Velocity: Up to 3000 fpm.
4. Temperature: Minus 25 to plus 180 deg F.
5. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

F. Construction:

1. Suitable or horizontal or vertical airflow applications.
2. Linkage out of airstream.
3. Frame:

a. Hat shaped.
b. Galvanized sheet steel, with welded or mechanically attached corners and mounting flange.

c. Gauge is to be in accordance with UL listing.

4. Blades:

a. Roll-formed, horizontal, airfoil, galvanized sheet steel.
b. Maximum width and gauge in accordance with UL listing.

5. Blade Edging Seals:

a. Silicone rubber.

6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of airstream.
8. Bearings:

a. Oil-impregnated stainless steel sleeve.

G. Mounting Sleeve:

1. Factory installed, galvanized sheet steel.
2. Length to suit wall or floor application.
3. Gauge in accordance with UL listing.

H. Heat-Responsive Device:

1. Replaceable, 165 deg F rated, fusible links.

I. Master control panel for use in dynamic smoke-management systems.

J. Damper Actuator - Electric:

1. Electric - 120 V ac.
2. UL 873, plenum rated.
3. Designed to operate in smoke-control systems complying with UL 555S requirements.
4. Two position with fail-safe spring return.

a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
b. Maximum 15-second full-stroke closure.
c. Minimum 90-degree drive rotation.

5. Clockwise or counterclockwise drive rotation as required for application.

6. Environmental Operating Range:

    a. Temperature: Minus 40 to plus 130 deg F.
    b. Humidity: 5 to 95 percent relative humidity noncondensing.

7. Environmental Enclosure: NEMA 2.
8. Actuator to be factory mounted and provided with single-point wiring connection.

K. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
2. Electrical Connection: 115 V, single phase, 60 Hz.

L. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches, damper mounted.
3. Smoke Detector: Integral, factory wired for single-point connection.

2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. DynAir; a Carlisle Company.
3. Elgen Manufacturing.

B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.8 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FläktGroup.

2. Flexmaster U.S.A., Inc.
3. McGill AirFlow LLC.
4. Pottorff.
5. Ruskin Company.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
4. Bearing AMCA's Certified Ratings Seal for prefabricated silencer sound and air performance.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A653/A653M, G90, galvanized sheet steel, 0.034 inch thick.

E. Round Silencer Outer Casing: ASTM A653/A653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 22 gauge thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 20 gauge thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 18 gauge thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 16 gauge thick.

F. Inner Casing and Baffles: ASTM A653/A653M, G90 galvanized sheet metal, 22 gauge thick, and with 1/8-inch- diameter perforations.

G. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss.

H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Dissipative type with fill material.

a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression.
b. Erosion Barrier: Polymer bag enclosing fill, heat-sealed before assembly.

3. Lining: Fiberglas cloth.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Joints: Lock formed and sealed or flanged connections.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

K. Source Quality Control:

1. Test in accordance with ASTM E477.
2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000 fpm face velocity.
3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.9 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.
2. Duro Dyne Inc.
3. DynAir; a Carlisle Company.
4. Elgen Manufacturing.

B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

E. Vane Construction:
1. Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.10 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. DynAir; a Carlisle Company.
2. METALAIRE, Inc.
3. United Enertech.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Aluminum.

D. Cable: Steel.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover-Plate Material: Stainless steel.

2.11 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aire Technologies.
2. Arrow United Industries.
3. Cesco Products; a division of MESTEK, Inc.
4. Duro Dyne Inc.
5. McGill AirFlow LLC.

6. Ruskin Company.
7. United Enertech.

B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. 24-gauge- thick galvanized steel door panel.
   d. Vision panel.
   e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   f. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

   a. 24-gauge- thick galvanized steel or 0.032-inch- thick aluminum Insert value frame.

3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.12 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Flame Gard, Inc.

B. Access panels used in cooking applications:

1. Labeled compliant to NFPA 96 for grease duct access doors.
2. Labeled in accordance with UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 16-gauge carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10 inches wg positive or negative.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. DynAir; a Carlisle Company.
4. Elgen Manufacturing.

B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Materials: Flame-retardant or noncombustible fabrics.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

G. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.14 DUCT ACCESSORY HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen Manufacturing.
5. United Enertech.

B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.15 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

F. Set dampers to fully open position before testing, adjusting, and balancing.

G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

H. Install fire and smoke dampers in accordance with UL listing.

I. Connect ducts to duct silencers with flexible duct connectors.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.

5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-ft. spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. For grease ducts, install at locations and spacing as required by NFPA 96.
11. Control devices requiring inspection.
12. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Install duct test holes where required for testing and balancing purposes.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 237220 - ENERGY RECOVERY VENTILATORS *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include packaged, outdoor, fixed-plate, energy-recovery-unit rated capacities, operating characteristics, furnished specialties, and accessories.
2. Fans:

    a. Certified fan-performance curves with system operating conditions indicated.
    b. Certified fan-sound power ratings.
    c. Fan construction and accessories.
    d. Motor ratings, electrical characteristics, and motor accessories.

B. Shop Drawings: For packaged, outdoor, fixed-plate, energy-recovery ventilators.

1. Include plans, elevations, sections, details, and mounting attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, lifting requirements, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.2 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, roof plans, elevations, and other details, drawn to scale. and coordinated with each other, using input from installers of items involved.

B. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged, outdoor, fixed-plate, energy-recovery equipment to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed. Package with protective covering for storage and identify with labels describing contents.

1. Filters: One set(s) of each type of filter specified.
2. Fan Belts: One set(s) of belts for each belt-driven fan in energy recovery ventilators.

1.5 COORDINATION

A. Coordinate sizes and locations of building openings and duct connections with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, outdoor, fixed-plate, energy-recovery ventilators that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Energy-Recovery ventilators: One year(s) from date of Substantial Completion.
2. Warranty Period for Fixed-Plate Heat Exchangers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

B. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1.
2. Capacity ratings for fixed-plate energy-recovery ventilators shall comply with ASHRAE 84.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. UL Compliance:

1. Packaged heat-recovery ventilators shall comply with requirements in UL 1815 or UL 1812.
2. Electric coils shall comply with requirements in UL 1995.

E. Comply with ASTM E84 or UL 723.

2.2 ENERGY-RECOVERY VENTILATORS – Standard construction

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Venmar CES Inc.
3. RenewAire.

B. Source Limitations: Energy-recovery ventilators from single manufacturer.

C. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1.

D. Housing: Manufacturer's double wall construction with corrosion-protection coating and exterior finish, gasketed, hinged access doors or removable panels with neoprene gaskets for inspection and access to internal parts, minimum 2-inch thick, thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.

E. Fixed-Plate, Heat Exchanger:

1. Casing: Aluminum.

a. Comply with requirements in ASHRAE 62.1.

2. Plates: Evenly spaced, sealed, and arranged for counter-flow.

1. Plate Material: Chemically treated paper, or polymer on aluminum, with selective hydroscopicity, moisture permeability, and gas barrier properties.

F. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators or restrained spring isolators of 1-inch static deflection.

1. Motors and Drives: Direct driven.
   a. Motor Sizes: Minimum size as indicated. If size is not indicated, provide motor large enough so driven load will not require motor to operate in service factor range above 1.0.

G. Filters: *ADDED BY ADDENDUM No. 3*

1. Description: Cleanable wire mesh at outside air intake and pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. UL Compliance: Comply with UL 900.
3. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
4. Filter Media Frame: Beverage board with perforated metal retainer or metal grid on outlet side.
5. Filter-Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
6. *Outdoor air filters*
   a. *Outdoor air filter rack shall accommodate factory-provided 2" MERV 8 filters.*
7. *Return air filters*
   a. *Return air filter rack shall accommodate factory-provided 2" MERV 8 filters.*

H. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls so only external connections are required during installation.

1. Outdoor Enclosure: NEMA 250, Type 3R enclosure contains relays, starters, and terminal strip.
2. Include nonfused disconnect switches.

2.3 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by NRTL, and marked for intended location and application.

B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060IP.

C. Fan Performance Rating: Comply with AMCA 211, and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210 and ASHRAE 51.

D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260IP.

E. UL Compliance:

1. Packaged, Fixed-Plate, Energy-Recovery Units: Comply with requirements in UL 1812.
2. Electric Coils: Comply with UL 1995.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before packaged, outdoor, fixed-plate, energy-recovery unit installation. Replace insulation materials and filter media that are wet, moisture damaged, or mold damaged.

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

3.2 INSTALLATION OF ENERGY-RECOVERY VENTILATORS

A. Install energy-recovery ventilators, so supply and exhaust airstreams flow in opposite directions.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.

B. Install roof-mounted energy-recovery ventilators on dunnage.

C. Install indoor, floor-mounted energy-recovery ventilators on concrete pads where shown or equipment stand.

D. Install indoor, ceiling suspended energy recovery ventilators using threaded steel rods and spring hangers.

E. Install units with clearances for service and maintenance.

F. Do not operate equipment fans until temporary or permanent filters are in place. Replace temporary filters used during construction and testing with new, clean filters prior to final inspection.

3.3 DUCTWORK CONNECTIONS

A. Connect duct to units with flexible connections.

3.4 ELECTRICAL CONNECTIONS

A. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs.
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

3.6 STARTUP SERVICE

A. Engage factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity setpoints.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with assistance of factory-authorized service representative.

E. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Energy-recovery ventilators will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain energy-recovery ventilators.

END OF SECTION 237220

SECTION 237416.11 - PACKAGED, ROOFTOP AIR-CONDITIONING UNITS *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components:

1. Casings.
2. Fans, drives, and motors.
3. Coils.
4. Refrigerant circuit components.
5. Air filtration.
6. Dampers.
7. Electrical power connections.
8. Accessories.

1.2 DEFINITIONS

A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, small-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

1.3 ACTION SUBMITTALS

A. Product Data: For each RTU.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Include certified fan-performance curves with system operating conditions indicated.
    b. Include certified fan-sound power ratings.

c. Include fan construction and accessories.
d. Include motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include gas furnaces with performance characteristics.
9. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each packaged, small-capacity, rooftop air-conditioning unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Sample Warranty: For manufacturer's warranty.

C. System startup reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.
2. Gaskets: One set for each access door.
3. Fan Belts: One set for each belt-driven fan.

1.7 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 3 years from date of Substantial Completion.
2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion
3. Warranty Period for Compressors: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE 15 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. UL Compliance: Comply with UL 1995.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON.
2. Daikin Applied.
3. Trane.

2.3 UNIT CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Double-Wall Construction:

1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
2. Inside Casing Wall: G90-coated galvanized steel, 0.034 inch thick.
3. Floor Plate: G90 galvanized steel, minimum 18 gauge thick.
4. Casing Insulation:

a. Materials: Injected polyurethane foam insulation.
b. Casing Panel R-Value: Minimum 7
c. Insulation Thickness: 1 inch.
d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. Static-Pressure Classifications:

1. For Unit Sections Upstream of Fans: Minus 3-inch wg.
2. For Unit Sections Downstream and Including Fans: 4-inch wg.

E. Panels and Doors:

1. Panels:

a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
c. Gasket: Neoprene, applied around entire perimeters of panel frames.
d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

2. Access Doors:

a. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
b. Gasket: Neoprene, applied around entire perimeters of panel frames.
c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

3. Locations and Applications:

a. Fan Section: Doors and inspection and access panels.
b. Access Section: Doors.
c. Coil Section: Inspection and access panels.
d. Damper Section: Doors.
e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
f. Mixing Section: Doors.

F. Condensate Drain Pans:

1. Location: Each type of cooling coil rotary heat exchanger.
2. Construction:

a. Single-wall, stainless steel sheet.

3. Drain Connection:

a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
b. Minimum Connection Size: NPS 1.

4. Slope: Minimum 0.125-in./ft. slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
6. Width: Entire width of water producing device.
7. Depth: A minimum of 2 inches deep.
8. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
9. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
5. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
6. Shaft Lubrication Lines: Extended to a location outside the casing.
7. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch- thick, galvanized-steel sheet.

a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

C. Drives, Direct: Factory-mounted, direct drive.

D. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated multispeed ECM motors.

E. Relief-Air Fan: , shaft mounted on permanently lubricated motor.

2.5 COILS

A. General Requirements for Coils:

1. Comply with AHRI 410.
2. Fabricate coils section to allow for removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Supply-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins: Aluminum Plate

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Coatings: None.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

    a. Working Pressure: Minimum 300 psig.

C. Outdoor-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins: Aluminum Platre

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Coatings: None.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

    a. Working Pressure: Minimum 300 psig.

D. Hot-Gas Reheat Refrigerant Coil:

1. Tubes: Copper.
2. Fins: Aluminum Plate

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Coatings: None.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

a. Working Pressure: Minimum 300 psig.

8. Suction-discharge bypass valve.

2.6 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor: Hermetic, variable-speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

B. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve modulating with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

C. Refrigeration only controller.
1. DDC controller capable of running all components associated with the refrigerant circuit.

2.7 AIR FILTRATION

A. Panel Filters: *ADDED BY ADDENDUM No. 3*

1. Description: Flat, non-pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. *Efficiency: minimum MERV 8 or based on manufacturers recommendation*
4. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
5. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

2.8 ELECTRICAL POWER CONNECTIONS

A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.9 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Return-air bypass damper.

C. Factory- or field-installed, demand-controlled ventilation.

D. Safeties:
1. Condensate overflow switch.
2. Phase-loss reversal protection.
3. High and low pressure control.

E. Coil guards of painted, galvanized-steel wire.

F. Hail guards of galvanized steel, painted to match casing.

G. Door switches to disable heating or reset set point when open.

H. Outdoor-air intake weather hood.

I. Oil separator.

J. Service Lights and Switch: Factory installed in fan and coil sections with weatherproof cover. Factory wire lights to a single-point field connection.

2.10 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

E. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.

F. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.

1. Standards:

a. ASTM B117 for salt spray.
b. ASTM D2794 for minimum impact resistance of 100 in-lb.
c. ASTM B3359 for cross-hatch adhesion of 5B.

2. Application: Spray.
3. Thickness: 1 mil.
4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.11 SOURCE QUALITY CONTROL

A. AHRI Compliance:

1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested according to AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Unit Support: Install unit level on structural dunnage. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to RTU, allow space for service and maintenance.

C. Connect piping to unit mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

3.4 DUCT CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. RTU will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect for visible damage to unit casing.
3. Inspect for visible damage to furnace combustion chamber.
4. Inspect for visible damage to compressor, coils, and fans.
5. Inspect internal insulation.
6. Verify that labels are clearly visible.
7. Verify that clearances have been provided for servicing.
8. Verify that controls are connected and operable.
9. Verify that filters are installed.
10. Clean condenser coil and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.

14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.

20. Calibrate thermostats.
21. Adjust and inspect high-temperature limits.
22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
23. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

26. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

27. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

a. High-temperature limit on gas-fired heat exchanger.
b. Low-temperature safety operation.
c. Filter high-pressure differential alarm.
d. Economizer to minimum outdoor-air changeover.
e. Relief-air fan operation.
f. Smoke and firestat alarms.

28. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.7 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing RTUs and air-distribution systems, clean RTUs internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. RTU will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237416.11

SECTION 238130 - VARIABLE-REFRIGERANT-FLOW SYSTEMS *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY *REVISED BY ADDENDUM No. 3*

A. Section includes complete VRF HVAC system(s) including, but not limited to the following components to make a complete operating system(s) according to requirements indicated:
   1. Indoor, exposed, wall-mounted units.
   2. Indoor, recessed, ceiling-mounted units.
   3. *Indoor, vertical/horizontal ducted (multi-position air handler) units.*
   4. Outdoor, air-source heat ~~*recovery*~~ *pump* units.
   ~~*5. Heat recovery control units.*~~
   6. System controls.
   7. System refrigerant and oil.
   8. System condensate drain piping.

1.3 DEFINITIONS *REVISED BY ADDENDUM No. 3*

A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.

B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

D. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

~~*E. Three-Pipe System Design: One high pressure refrigerant vapor line, one low pressure refrigerant vapor line, and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One liquid line and refrigerant vapor line connect HRCUs to associated indoor units.*~~

~~*F.*~~ Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated ~~*system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated*~~ indoor units. ~~*HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.*~~

G. VRF: Variable refrigerant flow.

~~*1.4 PREINSTALLATION MEETINGS*~~ *REVISED BY ADDENDUM No. 3*

~~*A. Preinstallation Conference: Conduct conference at NPES Hyde Park NY.*~~

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. *REVISED BY ADDENDUM No. 3*

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units ~~*and for HRCUs*~~
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit ~~*and HRCU*~~ control.
6. Include description of control software features.
7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
8. Include refrigerant type and data sheets showing compliance with requirements indicated.
9. For system design software.
10. Indicate location and type of service access.

B. Shop Drawings: For VRF HVAC systems.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For fully and partially exposed indoor units with factory finishes viewable by occupants.

1. Include a Sample for each unique finish with unit identification, detailed description of application, and cross-referenced floor plans showing locations.

D. Delegated-Design Submittals:
1. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing for each system installed.
2. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
3. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, sections, and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural floors, roofs and associated members to which equipment, piping,cables, and conduit will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Wall-mounted controllers located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
5. Size and location of access doors and panels installed behind walls and inaccessible ceilings for products installed behind walls and requiring access.
6. Items penetrating finished ceiling including the following:

a. Luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Service access panels.

B. Qualification Data:

1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.

a. Retain copies of Installer certificates on-site and make available on request.

2. For VRF HVAC system manufacturer.
3. For VRF HVAC system provider.

C. Product Certificates: For each type of product.

The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended and successfully completed a minimum 3- day VRF Service & Installation course at an approved training facility. A copy of this certificate shall be presented to the VRF manufacturer prior to the commencement of installation activity.

D. Product Test Reports: Where tests are required, for each product, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's warranties.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS *REVISED BY ADDENDUM No. 3*

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters:

a. One 1 set(s) for each unit with replaceable filters.

~~*2. Indoor Units: One 1 for each unique size and type installed.*~~
~~*3. Controllers for Indoor Units: One 1 for each unique controller type installed.*~~

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Nationally recognized manufacturer of VRF HVAC systems and products.
2. Shipped VRF HVAC systems with similar requirements to those indicated for a continuous period of five 5 years within time of bid.
3. VRF HVAC systems and products that have been successfully tested and in use on at least three 3 completed projects.
4. Having complete published catalog literature, installation, and operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:

a. Product research and development.
b. Product and application engineering.
c. Product manufacturing, testing, and quality control.
d. Technical support for system installation training, startup, commissioning, and troubleshooting of installations.
e. Owner training.

B. Factory-Authorized Service Representative Qualifications:

1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
2. In-place facility located within 60miles of Project.
3. Demonstrated past experience with products being installed for period within three 3 consecutive years before time of bid.

4. Demonstrated past experience on five 5 projects of similar complexity, scope, and value.

    a. Each person assigned to Project shall have demonstrated past experience.

5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
6. Service and maintenance staff assigned to support Project during warranty period.
7. Product parts inventory to support ongoing system operation for a period of not less than five 5 years after Substantial Completion.
8. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
2. Installer certification shall be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and make available on request.
4. Each person assigned to Project shall have demonstrated past experience.

    a. Demonstrated past experience with products being installed for period within five 5 consecutive years before time of bid.
    b. Demonstrated past experience on five 5 projects of similar complexity, scope, and value.

D. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in a clean and dry place.

B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.

1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

E. Replace installed products damaged during construction.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period:

a. For Compressor: Seven 7 year(s) from date of Substantial Completion.
b. For Parts, Including Controls: Five 5 year(s) from date of Substantial Completion.
c. For Labor: No labor coverage provided by VRF manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Daikin AC (Americas), Inc.
2. LG Electronics.
3. Samsung HVAC.
4. Trane Company

B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:

1. Indoor and outdoor units, including accessories.
2. Controls and software.
3. Refrigerant isolation valves.
4. Specialty refrigerant pipe fittings.

2.2 SYSTEM DESCRIPTION *REVISED BY ADDENDUM No. 3*

A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units~~, HRCUs~~, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.

1. Two-pipe system design.
2. System(s) operation, air-conditioning heat ~~recovery~~ *pump* as indicated on Drawings.
3. Each system with one refrigerant circuit shared by all indoor units connected to system.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. AHRI Compliance: System and equipment performance certified according to AHRI 1230.

D. ASHRAE Compliance:

1. ASHRAE 15: For safety code for mechanical refrigeration.
2. ASHRAE 62.1: For indoor air quality.
3. ASHRAE 135: For control network protocol with remote communication.
4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.

E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, to design complete and operational VRF HVAC system(s) complying with requirements indicated.

1. Provide system refrigerant calculations.

a. Refrigerant concentration limits shall be within allowable limits of ASHRAE 15 and governing codes.
b. Indicate compliance with manufacturer's maximum vertical and horizontal travel distances. Prepare a comparison table for each system showing calculated distances compared to manufacturer's maximum allowed distances.

2. Include a mechanical ventilation system and gas detection system as required to comply with ASHRAE 15 and governing codes.
3. System Refrigerant Piping and Tubing:

a. Arrangement: Arrange piping to interconnect indoor units, HRCUs, and outdoor unit(s) in compliance with manufacturer requirements and requirements indicated.
b. Routing: Conceal piping above ceilings and behind walls to maximum extent possible.
c. Sizing: Size piping system, using a software program acceptable to manufacturer, to provide performance requirements indicated. Consider requirements to accommodate future change requirements.

4. System Controls:

a. Network arrangement.
b. Network interface with other building systems.
c. Product selection.
d. Sizing.

B. Service Access:

1. Provide and document service access requirements.
2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
4. If less than full and unrestricted access is provided, locate components within an 18-inch (450-mm) reach of the finished assembly.
5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
6. Comply with OSHA regulations.

C. System Design and Installation Requirements:

1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.

D. System Adaptability to Future Changes: Arrange and size system refrigerant piping to accommodate future changes to system without having to resize and replace existing refrigerant piping.

1. Future changes to system(s) indicated on Drawings.
2. Each branch circuit shall accommodate addition of three 3indoor unit(s) with unit capacity equal to 54,000 BTUH indoor unit connected to the branch circuit.

E. Isolation of Equipment: Provide isolation valves to isolate each, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.

F. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:

1. Not less than 60 percent.
2. Not more than 130 percent.
3. Range acceptable to manufacturer.

G. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.

H. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.

I. Outdoor Conditions: *REVISED BY ADDENDUM No. 3*

1. Suitable for outdoor ambient conditions encountered.

    a. Design equipment and supports to withstand wind loads of governing code.
    b. Design equipment and supports to withstand snow and ice loads of governing code.
    c. Provide corrosion-resistant coating for components and supports where located in coastal or industrial climates that are known to be harmful to materials and finishes.

2. Maximum System Operating Outdoor Temperature: 126 ~~0~~ deg. F.
3. Minimum System Operating Outdoor Temperature: ~~-4~~ -25 deg. F.

J. Sound Performance: Sound levels generated by operating HVAC equipment shall be within requirements indicated.

1. Indoor: Within design guidelines of "2015 ASHRAE HANDBOOK- HVAC Applications."
2. Outdoor: Within ordinance of governing authorities.

K. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.

L. Capacities and Characteristics: As indicated on Drawings.

2.4 INDOOR, EXPOSED, WALL-MOUNTED UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

B. Cabinet:

1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Gravity.

    a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.

3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan(s):

    a. Direct-drive arrangement.
    b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Front, to accommodate filter replacement without the need for tools.
2. Efficiency: minimum MERV 3 or based on manufacturers recommendation
3. Washable Media: Manufacturer's standard filter with antimicrobial treatment.

G. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.

H. Unit Accessories:

1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.

I. Unit Controls: *REVISED BY ADDENDUM No. 3*

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors: Unit inlet air temperature Coil entering refrigerant temperature Coil leaving refrigerant temperature.
4. Field-Customizable I/O Capability:

~~*a. Analog Inputs: Two 2 for use in customizable control strategies.*~~
b. Digital Inputs: ~~*Two 2*~~ *four 4* for use in customizable control strategies.
c. Digital Outputs: ~~*Two 2*~~ *Three 3* for use in customizable control strategies.

5. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch.
6. Communication: Network communication with other indoor units and outdoor unit(s).
7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

J. Unit Electrical: *REVISED BY ADDENDUM No. 3*

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
~~*3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.*~~
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

2.5 INDOOR, RECESSED, CEILING-MOUNTED UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan(s):

a. Direct-drive arrangement.

b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Efficiency: ASHRAE 52.2, MERV 11.
3. Media:

a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
b. Washable: Manufacturer's standard filter with antimicrobial treatment.

G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.

1. Discharge Pattern: One-, two-, three-, or four-way throw as indicated on Drawings.

a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.
b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.

2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.
3. Additional Branch Supply Duct Connection: Sheet metal knockout for optional connection to one additional supply branch duct.

H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.

I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.

J. Unit Accessories:

1. Outdoor Air Ventilation Kit: Connection, motorized damper, and control to satisfy unit control sequence of operation indicated on Drawings.
2. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

K. Unit Controls: *REVISED BY ADDENDUM No. 3*

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors: Unit inlet air temperature Coil entering refrigerant temperature Coil leaving refrigerant temperature.
4. Field-Customizable I/O Capability:

~~*a. Analog Inputs: Two 2 for use in customizable control strategies.*~~

b. Digital Inputs: ~~*Two 2*~~ *four 4* for use in customizable control strategies.
c. Digital Outputs: ~~*Two 2*~~ *Three 3* for use in customizable control strategies.

5. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch.
6. Communication: Network communication with other indoor units and outdoor unit(s).
7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

L. Unit Electrical: *REVISED BY ADDENDUM No. 3*

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.

~~*3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.*~~

4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.

5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring inraceways to comply with NFPA 70.

2.6 INDOOR, VERTICAL/HORIZONTAL DUCTED (MULTI-POSITION AIR HANDLER) UNITS REVISED BY ADDENDUM No. 3

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

B. Cabinet:

1. The cabinet shall include a fixed bottom return, a fixed vertical discharge supply and be pre-painted, pre-insulated, 22 gauge galvanized steel.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Gravity.

3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan(s):

a. Direct-drive arrangement.
b. Single or multiple fans connected to a common motor shaft and driven by a single motor.

c. *Fabricated from non-ferrous components or ferrous components with corrosion protection finish.*
d. *Wheels statically and dynamically balanced.*

2. *Motor: Brushless dc or electronically commutated with permanently lubricated bearings.*
3. *Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.*
4. *Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.*
5. *Vibration Control: Integral isolation to dampen vibration transmission.*

F. *Filter Assembly:*

1. *Access: Front, to accommodate filter replacement without the need for tools.*
2. *Efficiency: minimum MERV 8 or based on manufacturers recommendation*
3. *Washable Media: Manufacturer's standard filter with antimicrobial treatment.*

G. *Unit Accessories:*

1. *Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.*

H. *Unit Controls:*

1. *Enclosure: Manufacturer's standard, and suitable for indoor locations.*
2. *Factory-Installed Controller: Configurable digital control.*
3. *Factory-Installed Sensors: Unit inlet air temperature Coil entering refrigerant temperature Coil leaving refrigerant temperature.*
4. *Field-Customizable I/O Capability:*
   a. *Digital Inputs: Four 4 for use in customizable control strategies.*
   b. *Digital Outputs: Three 3 for use in customizable control strategies.*

5. *Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch.*
6. *Communication: Network communication with other indoor units and outdoor unit(s).*
7. *Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.*
8. *Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.*

I. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
4. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
5. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

2.7 OUTDOOR, AIR-SOURCE HEAT ~~*RECOVERY*~~ *PUMP* UNITS *REVISED BY ADDENDUM No. 3*

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with ~~*simultaneous*~~ heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.

a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.

2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
2. Protection: Integral protection against the following:

a. High refrigerant pressure.
b. Low oil level.
c. High oil temperature.
d. Thermal and overload.
e. Voltage fluctuations.

f. Phase failure and phase reversal.
g. Short cycling.

3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4. Vibration Control: Integral isolation to dampen vibration transmission.
5. Oil management system to ensure safe and proper lubrication over entire operating range.
6. Crankcase heaters with integral control to maintain safe operating temperature.
7. Fusible plug.

D. Condenser Coil Assembly:

1. Plate Fin Coils:

a. Casing: Aluminum, galvanized, or stainless steel.
b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
c. Tubes: Copper, of diameter and thickness required by performance.

2. Aluminum Microchannel Coils:

a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
b. Single- or multiple-pass arrangement.
c. Construct fins, tubes, and header manifolds of aluminum alloy.

3. Coating: Corrosion resistant.
4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

E. Condenser Fan and Motor Assembly:

1. Fan(s): Propeller type.

a. Direct-drive arrangement.
b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
c. Statically and dynamically balanced.

2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
6. Vibration Control: Integral isolation to dampen vibration transmission.

F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

G. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:

    a. Refrigerant suction temperature.
    b. Refrigerant discharge temperature.
    c. Outdoor air temperature.
    d. Refrigerant high pressure.
    e. Refrigerant low pressure.
    f. Oil level.

4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch equalize run time between multiple same components.
5. Communication: Network communication with indoor units and other outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

H. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.

2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring inraceways to comply with NFPA 70.

I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevention corrosion when exposed to salt spray test for 1000 hours according ASTM B117.

J. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.8 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units, and outdoor units shall include integral controls and connect through a TIA-485A or manufacturer-selected BACnet control network.
2. Network Communication Protocol: open control communication between interconnected units.
3. Integration with Building Automation System: ASHRAE 135, BACnet MS/TP and certified by BACnet Testing Lab (BTL), including the following:

    a. Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.
    b. Integration devices shall be connected to local uninterruptible power supply unit(s) to provide at least 5 minutes of battery backup operation after a power loss.
    c. Integration shall include control monitoring scheduling change of value notifications.

4. Operator Interface:

a. Operators shall interface with system and unit controls through the following:

1) Operator interfaces integral to controllers.
2) Owner-furnished PC connected to central controller(s).
3) Web interface through web browser software.
4) Integration with Building Automation System.

b. Users shall be capable of interface with controllers for indoor units control to extent privileges are enabled. Control features available to users shall include the following:

1) On/off control.
2) Temperature set-point adjustment.

B. VRF HVAC System Operator Software for PC:

1. Software offered by VRF HVAC system manufacturer shall provide system operators with ability to monitor and control VRF HVAC system(s) from a single dedicated Owner-furnished PC.
2. Software shall provide operator with a graphic user interface to allow monitoring and control of multiple central controllers from a single device location through point-and-click mouse exchange.
3. Plan views shall show building plans with location of indoor units and identification superimposed on plans.
4. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
5. Schedules operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Schedules daily, weekly, and annual events.
6. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
7. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
8. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
9. Supports Multiple Languages: English or Spanish.
10. Supports Imperial and Metric Temperature Units: Fahrenheit and Celsius.
11. Displays service notifications and error codes.
12. Monitors and displays up to 3000 item error history and 10000 item operation history for regular reporting and further archiving.

13. Monitors and displays cumulative operating time of indoor units.
14. Able to disable and enable operation of individual controllers for indoor units.
15. Information displayed on individual controllers shall also be available for display.
16. Information displayed for outdoor units, including refrigerant high and low pressures.

C. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.

    a. Include multiple interconnected controllers as required.

2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.

    a. Sets schedule for daily, weekly, and annual events.
    b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.

4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.
9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel and web accessible through standard web browser software.

D. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.

2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. Multiple Language: English or Spanish.
4. Temperature Units: Fahrenheit and Celsius.
5. On/Off: Turns indoor unit on or off.
6. Hold: Hold operation settings until hold is released.
7. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
8. Temperature Display: 1-degree increments.
9. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between 65-78 deg.F..
10. Relative Humidity Display: 1 percent increments.
11. Relative Humidity Set-Point: Adjustable in 1 percent increments between 40-60%RH.
12. Fan Speed Setting: Select between available options furnished with the unit.
13. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
14. Seven-day programmable operating schedule with up to eight 8 events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
15. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
16. Occupancy detection.
17. Service Notification Display: "Filter" dirty.
18. Service Run Tests: Limit use by service personnel to troubleshoot operation.
19. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
20. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
21. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
22. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

2.9 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, refrigerant classification.
3. R-410a.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.10 SYSTEM CONDENSATE DRAIN PIPING

A. If more than one material is listed, material selection is Contractor's option.

B. Copper Tubing:

1. Drawn-Temper Tubing: According to ASTM B88, Type L (ASTM B88M, Type B) or Type DWV according to ASTM B306.
2. Wrought-Copper Fittings: ASME B16.22.
3. Wrought-Copper Unions: ASME B16.22.
4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.

C. CPVC plastic pipe according to ASTM F441/F441M, Schedule 40, with socket-type pipe fittings according to ASTM F438 and solvent cement according to ASTM F493.

D. PVC plastic pipe according to ASTM D1785, Schedule 40, with socket-type pipe fittings according to ASTM D2466 and solvent cement according to ASTM D2564, primer according to ASTM F656.

2.11 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect factory-assembled equipment.

B. Equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports for historical record. Submit reports only if requested.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.

D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.

E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.

F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.

G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 EQUIPMENT INSTALLATION, GENERAL

A. Clearance:

1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Maintain clearances required by governing code.

B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.

1. Loose components shall be installed by manufacturer's service representative or system Installer under supervision of manufacturer's service representative.

C. Equipment Restraint Installation: Install equipment with seismic-restraint device. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 INSTALLATION OF INDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch (10 mm).

C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.

D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.

E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch (13 mm).

H. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.

I. Attachment: Install hardware for proper attachment to supported equipment.

J. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.4 INSTALLATION OF OUTDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Install outdoor units on support structures indicated on Drawings.

C. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases.

1. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
2. Grouting: Place grout under equipment supports and make bearing surface smooth.

D. Roof-Mounted Installations: Anchor units to supports with removable, stainless-steel fasteners.

3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping and tubing to permit valve servicing.

F. Install piping and tubing at indicated slopes.

G. Install piping and tubing free of sags.

H. Install fittings for changes in direction and branch connections.

I. Install piping and tubing to allow application of insulation.

J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.

K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors.

L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors.

3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

A. General Requirements for Drain Piping and Tubing:

1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:

    a. Details indicated on Drawings.
    b. Manufacturer's requirements.
    c. Governing codes.
    d. In the absence of requirements, comply with requirements of ASHRAE handbooks.

4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:

1. Slope piping from unit connection toward drain termination at a constant slope of minimum of ¼-inch per foot.

C. Pumped Drains:

1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.7 SOFTWARE

A. Cybersecurity:

1. Software:

a. Coordinate security requirements with IT department.
b. Ensure that latest stable software release is installed and properly operating.
c. Disable or change default passwords to password using a combination of uppercase and lower letters, numbers, and symbols at least eight characters in length. Record passwords and turn over to party responsible for system operation and administration.

2. Hardware:

a. Coordinate location and access requirements with IT department.
b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
c. Disable dual network connections.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect

components, assemblies, and equipment installations, including controls and connections.

1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.

    a. Additional factory-authorized representatives may assist with completion of certain activities only if supervised by manufacturer's employee. A factory-authorized representative shall not provide assistance without manufacturer's employee supervision.

2. Manufacturer shall provide on-site visits during the course of construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.

    a. First Visit: Kick-off meeting.
    b. Second Visit: At approximately 25 percent completion of system(s).
    c. Third Visit: At approximately 50 percent completion of system(s).
    d. Fourth Visit: At approximately 75 percent completion of system(s).
    e. Fifth Visit: Final inspection before system startup.

3. Kick-off Meeting:

    a. Meeting shall include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
    b. Meeting shall be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.
    c. Meeting shall cover the following as a minimum requirement:

        1) Review of latest issue of Contract Documents, Drawings, and Specifications, relevant to VRF HVAC systems.
        2) Manufacturer's installation requirements specific to systems being installed.
        3) Review of all relevant VRF HVAC system submittals, including delegated-design submittals.
        4) Required field activities related installation of VRF HVAC system.
        5) Project team communication protocol, contact information, and exchange of responsibilities for each party involved, including manufacturer, supplier, system Installer, and other related trades.

4. Site Visits: Activities for each site visit shall include the following:

a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
b. Offer technical support to Installer and related trades as related to VRF system(s) being installed.
c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements.
d. Advise and if necessary assist Installer with updating related refrigerant calculations and system documentation.
e. Issue a report for each visit, documenting the visit.

1) Report to include name and contact information of individual making the visit.
2) Date(s) and time frames while on-site.
3) Names and contact information of people meeting with while on-site.
4) Clearly identify and list each separate issue that requires resolution. For each issue, provide a unique identification number, relevant importance, specific location or equipment identification, description of issue, recommended corrective action, and follow-up requirements needed. Include a digital photo for clarification if deemed to be beneficial.

5. Final Inspection before Startup:

a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according manufacturer's requirements and ready for final inspection.
b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
c. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
d. Inspection reports for indoor units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.

8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity settings and readings within an acceptable range.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Unit airflow direction within an acceptable range.
19) If applicable, fan external static pressure setting.
20) Filter type and condition acceptable.
21) Noise level within an acceptable range.
22) Refrigerant piping properly connected and insulated.
23) Condensate drain piping properly connected and insulated.
24) If applicable, ductwork properly connected.
25) If applicable, external interlocks properly connected.
26) Remarks.

e. Inspection reports for outdoor units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Condensate removal acceptable.
13) Noise level within an acceptable range.
14) Refrigerant piping properly connected and insulated.
15) Condensate drain piping properly connected and insulated.
16) Remarks.

f. Inspection reports for indoor, dedicated outdoor air ventilation units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity settings and readings within an acceptable range.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Fan external static pressure setting.
19) Filter type and condition acceptable.
20) Noise level within an acceptable range.
21) Refrigerant piping properly connected and insulated.
22) Condensate drain piping properly connected and insulated.
23) Automatic dampers properly installed and operating.
24) Ductwork properly connected.
25) If applicable, external interlocks properly connected.
26) Remarks.

g. Inspection reports for energy recovery ventilators shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.

14) Temperature settings and readings within an acceptable range.
15) Humidity readings.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Fan external static pressure setting.
19) Filter type and condition acceptable.
20) Noise level within an acceptable range.
21) Automatic dampers properly installed and operating.
22) Ductwork properly connected.
23) If applicable, external interlocks properly connected.
24) Remarks.

h. Inspection reports for hydronic units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Condensate removal acceptable.
16) Noise level within an acceptable range.
17) Refrigerant piping properly connected and insulated.
18) Hydronic piping properly connected and insulated.
19) Proof of water flow checked for proper operation.
20) Condensate drain piping properly connected and insulated.
21) If applicable, external interlocks properly connected.
22) Remarks.

i. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
j. Installer shall correct observed deficiencies found by the inspection.

k. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
l. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.
m. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.

B. Perform the following tests and inspections with the assistance of manufacturer's service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Refrigerant Tubing Positive Pressure Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.5 times VRF HVAC system operating pressure, but not less than 600 psig (4137 kPa), using dry nitrogen.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record the following information for each test:

a. Name of person starting test, company name, phone number, and e-mail address.
b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
c. Detailed description of extent of tubing tested.
d. Date and time at start of test.
e. Test pressure at start of test.
f. Outdoor temperature at start of test.
g. Name of person ending test, company name, phone number, and e-mail address.

h. Date and time at end of test.
i. Test pressure at end of test.
j. Outdoor temperature at end of test.
k. Remarks:

5. Submit test reports for Project record.

D. Refrigerant Tubing Evacuation Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
4. Prepare test report to record the following information for each test:

a. Name of person starting test, company name, phone number, and e-mail address.
b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
c. Detailed description of extent of tubing tested.
d. Date and time at start of test.
e. Test pressure at start of test.
f. Outdoor temperature at start of test.
g. Name of person ending test, company name, phone number, and e-mail address.
h. Date and time at end of test.
i. Test pressure at end of test.
j. Outdoor temperature at end of test.
k. Remarks:

5. Submit test reports for Project record.
6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

E. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.

3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

F. Products will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.9 STARTUP SERVICE

A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

1. Service representative shall be an employee or a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

B. Startup checks shall include, but not be limited to, the following:

1. Check control communications of equipment and each operating component in system(s).
2. Check each indoor unit's response to demand for cooling and heating.
3. Check each indoor unit's response to changes in airflow settings.
4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
5. Check sound levels of each indoor and outdoor unit.

C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.

1. Installer shall correct deficiencies found during startup service for reverification.

D. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
3. Manufacturer shall electronically record not less than two 2 hours of continuous operation of each system and submit with report for historical reference.

a. All available system operating parameters shall be included in the information submitted.

E. Witness:

1. Invite Owner and Commissioning Agent to witness startup service procedures.
2. Provide written notice not less than 20 business days before start of startup service.

3.10 ADJUSTING

A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.

C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.

D. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two 2 visits to Project during other-than-normal occupancy hours for this purpose.

3.11 PROTECTION

A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.

B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.

C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.

D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

3.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of system Installer who are manufacturer's authorized service representative. Include two 2 service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.13 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two 2 years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.14 DEMONSTRATION

A. Engage a VRF HVAC system manufacturer's employed training instructor or factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

B. Instructor:

1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.
2. Instructor's credentials shall be submitted for review by Architect Commissioning Agent Owner before scheduling training.
3. Instructor(s) primary job responsibility shall be Owner training.
4. Instructor(s) shall have not less than three 3 years of training experience with VRF HVAC system manufacturer and past training experience on at least three 3 projects of comparable size and complexity.

C. Schedule and Duration:

1. Schedule training with Owner at least 20 business days before first training session.
2. Training shall occur before Owner occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.
4. Each training day shall not exceed eight 8 hours of training. Daily training schedule shall allow time for one 1-hour lunch period and 15 -minute break after every two 2 hours of training.
5. Perform not less than eight 8 total hours of training.

D. Location: Owner shall provide a suitable on-site location to host classroom training.

E. Training Attendees: Assume three 3 people.

F. Training Attendance: For record purposes, document training attendees at the start of each new training session. Record attendee's name, signature, phone number, and e-mail address.

G. Training Format: Individual training modules shall include classroom training followed by hands-on field demonstration and training.

H. Training Materials: Provide training materials in electronic format to each attendee.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

I. Acceptance: Obtain Architect or Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 238130

SECTION 238216.11 - HYDRONIC AIR COILS *REVISED BY ADDENDUM No. 3*

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydronic air coils.
2. Integral face-and-bypass hot-water coils.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, sections, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE 62.1 Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5, "Systems and Equipment," and Section 7, "Construction and Startup."

B. Performance Ratings: Tested and rated in accordance with AHRI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig/300 deg F.

D. Select cooling coils for no moisture carryover at design conditions. Provide moisture eliminators on discharge face of cooling coil if necessary to eliminate moisture carryover.

2.2 HYDRONIC AIR COILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerofin.
2. Modine Commercial and Industrial Solutions.
3. Trane.
4. USA Coil & Air.

B. Source Limitations: Obtain hydronic coils from single source from single manufacturer.

C. Description: Coils constructed of staggered tubes mechanically expanded into continuous collars that are die-formed into the coil fins; self-venting; counterflow design of air to fluid.

D. Tubes:

1. Material: Copper.
2. Nominal Diameter: Minimum 1/2 inch or 5/8 inch (16 mm) before expanding, selected to provide performance indicated.
3. Nominal Wall Thickness: As required by performance, minimum 0.035 inch thick.
4. Return Bends: 180-degree bends; material and nominal diameter to match tubes.
5. Fluid Velocity at Design Flow Rate:

a. Maximum: 6 fps.
b. Minimum: 3 fps.

6. Features: Cleanable ~~*Individually drainable.*~~ *REVISED BY ADDENDUM No. 3*

E. Fins:

1. Type: Plate.
2. Materials:

   a. Aluminum: 0.0060 inch (0.15 mm) thick.
   b. Copper: 0.0060 inch (0.15 mm) thick.

3. Spacing: Maximum 12 fins per inch.
4. Collars: Full collars for accurate fin spacing and maximum tube contact while leaving no surface of tube exposed.
5. Configuration: Fin type as required by performance requirements.

F. Headers:

1. Material: Carbon steel Copper, removable for cleaning and inspection of tubes.
2. Tube-to-Header Connections: Tube-to-header holes to intrude inward, so landed surface area is 3 times the core tube thickness, to provide enhanced-header-to-tube joint integrity. Evenly extend tubes within the ID of the header no more than 0.12 inch (3 mm).
3. Header Top and Bottom Caps: End caps to be die-formed and installed on the ID of header, such that the landed surface area is 3 times the header wall thickness.
4. Drains: Include low point of header with a NPS 1/2 (DN 13) drain connection.
5. Vents: Include high point of header with a NPS 1/2 (DN 13) vent connection.
6. Supply and Return Connections: Copper Carbon steel pipe; threaded or flanged, same end of coil.
7. Protect opening of supply, return, vent, and drain connections with a threaded cap to prevent entry of dirt into coil.
8. Fluid Velocity at Design Flow Rate: Maximum of 6 fps (1.8 m/s).

G. Holes: Include number, size, and location of holes in casing and end tube sheets required for coil installation.

H. Hardware: Use hex-head bolts, nuts, and washers constructed of Type 304 or Type 316 stainless steel.

I. Nameplate: Aluminum or stainless steel nameplate with brass or stainless steel chain for each coil, with the following data engraved or embossed:

1. Manufacturer name, address, telephone number, and website address.
2. Manufacturer model number.
3. Serial number.

4. Manufacturing date.
5. Coil identification (indicated on Drawings).
6. Coil fin length.
7. Coil fin height.
8. Coil weight with fluid/without fluid.
9. Coil casing material and thickness.
10. Coil fin material and thickness.
11. Coil tube material and thickness.
12. Coil header material and thickness.

~~J. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating. See Drawings for coils requiring a corrosion-resistant coating.~~ *REVISED BY ADDENDUM No. 3*

K. ~~Coating: Corrosion resistant.~~ *REVISED BY ADDENDUM No. 3*

L. *Casing: Galvanized Steel. REVISED BY ADDENDUM No. 3*

2.3 MATERIALS

A. Aluminum: ASTM B209.

B. Copper Tube: ASTM B75/ASTM 75M annealed temper or ASTM B280 drawn temper.

C. Copper Sheet: ASTM B152.

D. 90/10 Cupronickel Alloy: ASTM B122/ASTM B122M.

E. Steel:

1. Pipe Connections: ASTM A53/A53M.

F. Corrosion-Resistant Coating: Where indicated on Drawings, coat coils with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test in accordance with ASTM B117.

1. Standards:

a. ASTM B117 for salt spray.
b. ASTM D2794 for minimum impact resistance of 100 in. lb.
c. ASTM D3359 for cross-hatch adhesion of 5B.

2. Application: Spray.
3. Thickness: 1 mil.
4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.4 SOURCE QUALITY CONTROL

A. Hydronic Coils: Factory tested with air while coil is completely submerged underwater to design pressure indicated, but not less than 300-psig internal pressure.

B. Coils to display a tag with inspector's identification as proof of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

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

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed in accordance with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install stainless steel drain pan under each cooling coil.

1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.
2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.
3. Extend drain pan upstream and downstream from coil face.
4. Extend drain pan under coil headers and exposed supply piping.

D. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.

E. Straighten bent fins on air coils.

F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping.

END OF SECTION 238216.11

SECTION 238236 - FINNED-TUBE RADIATION HEATERS *REVISED BY ADDENDUM No. 3*

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. Section includes hydronic, finned-tube radiation heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details and dimensions of custom-fabricated enclosures.
4. Indicate location and size of each field connection.
5. Indicate location and arrangement of piping valves and specialties.
6. Indicate location and arrangement of integral controls.
7. Include enclosure joints, corner pieces, access doors, and other accessories.
8. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.

E. Color Samples for Verification: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
2. Method of attaching finned-tube radiation heaters to building structure.
3. Penetrations of fire-rated wall and floor assemblies.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Slant/Fin Corp.
2. Sterling HVAC Products; a Mestek company.
3. Zehnder-Rittling.

B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

C. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

D. Front Panel: Minimum 0.0528-inch- Insert thickness thick steel.

E. Wall-Mounted Back Panel: Minimum 0.0329-inch- thick steel, full height, with full-length channel support for front panel without exposed fasteners.

F. Floor-Mounted Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.

G. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

H. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.

~~I. Damper: Knob-operated internal damper at enclosure outlet.~~ *REVISED BY ADDENDUM No. 3*

J. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.

K. Enclosure Color: Anodized finish, color as selected by architect from manufacturer's standard colors.

L. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.

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

3.2 BASEBOARD RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

G. Install valves within reach of access door provided in enclosure.

H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

I. Install piping within pedestals for freestanding units.

3.3 FINNED-TUBE RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

G. Install valves within reach of access door provided in enclosure.

H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

I. Install piping within pedestals for freestanding units.

3.4 FIELD QUALITY CONTROL

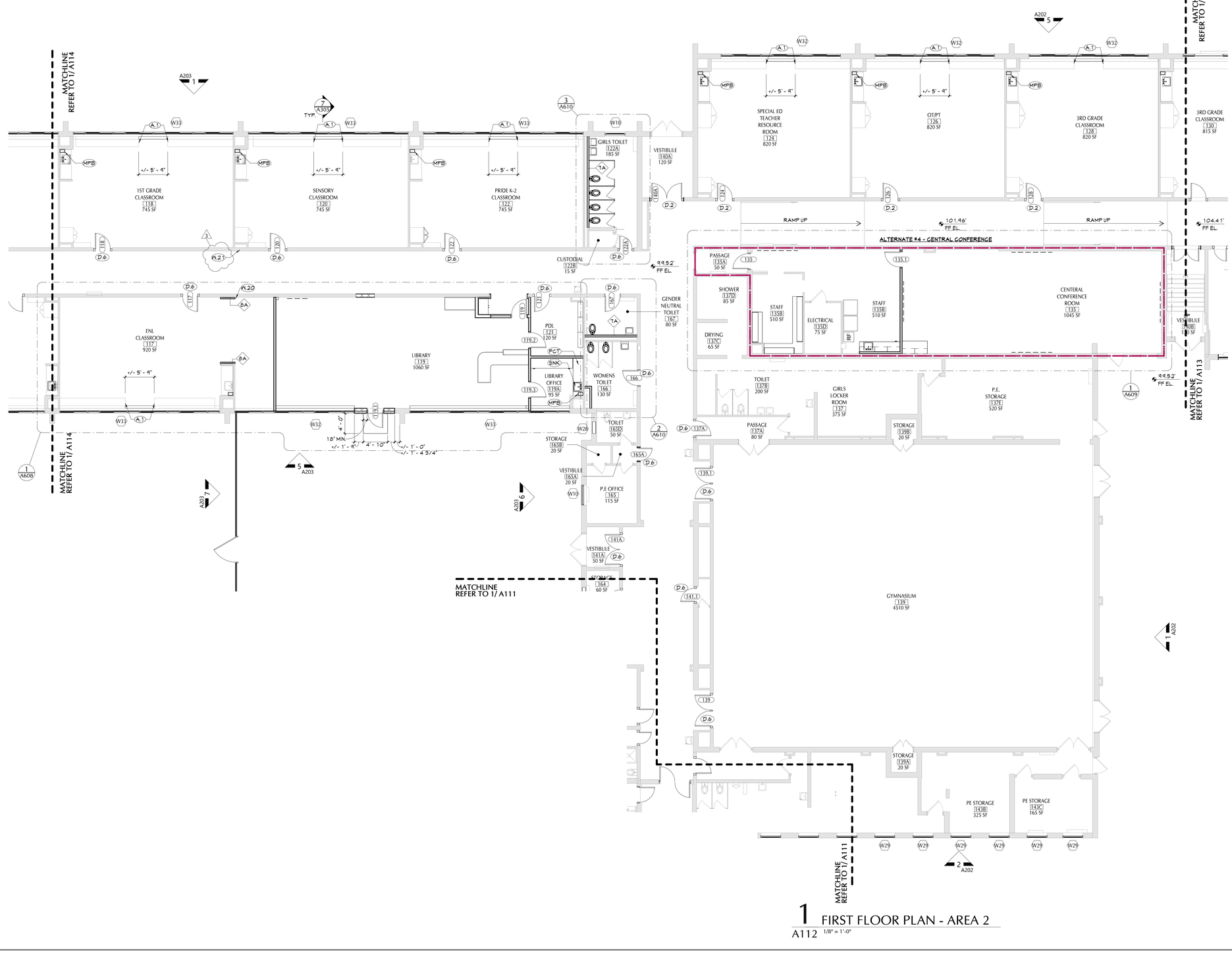
A. Perform the following field tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238236



1 FIRST FLOOR PLAN - AREA 2

A112 1/8" = 1'-0"

GENERAL NOTES

1. REFER TO SHEET 2-G001 FOR ADDITIONAL GENERAL NOTES.

KEY NOTES

#	DESCRIPTION
A.1	PROVIDE FINISHED BASE CABINET END PANEL AT EXPOSED CASEWORK WHERE UNIT VENTILATORS ARE BEING REMOVED. PANEL FINISH TO MATCH EXISTING ADJACENT. PATCH AND PAINT ADJACENT WALL AS REQUIRED.
D.2	PROVIDE NEW WOOD GRAIN HOLLOW METAL DOOR, HARDWARE, EXISTING HOLLOW METAL FRAME TO REMAIN.
D.6	PROVIDE NEW WOOD GRAIN HOLLOW METAL DOOR, HARDWARE. PROVIDE NEW HOLLOW METAL FRAME. REINSTALL SALVAGED WOOD DOOR HEAD AND JAMB TRIM WITH NEW WOOD BLOCKING AND TYPE X GWB ONCE THE NEW DOOR IS INSTALLED.
MPB	MILL-WORK PIPE ENCLOSURE BOX FROM BASE CABINET, TO UPPER CABINET, TO CEILING. COORDINATE WITH PLUMBING.
PCT	PLAM COUNTERTOP AND 4" BACKSPLASH, CONTINUOUS
SNK	SINK, REFER TO PLUMBING DRAWINGS
K.20	UPON REMOVAL OF WALL AND ASSOCIATED CASEWORK, PATCH WALL FINISH TO MATCH ADJACENT WALL FINISH.
K.21	AFTER REMOVAL OF GRILLE, PATCH WALL (2x2 APPROX.) WITH TYPE 4B PARTITION, FINISH TO MATCH ADJACENT WALLS, TYPICAL OF 16 LOCATIONS AT AREA 2 & 4, COORDINATE W/ 'M' DRAWINGS.

KEY PLAN

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PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

#	DATE	DESCRIPTION
3	11/29/2023	BID ADDENDUM 3
2	11/17/2023	BID ADDENDUM 2

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Checked By:	PN
Proj. #:	13-12-01-04-0-001-024
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Issued for Bid:	11/1/2023

Sheet Title

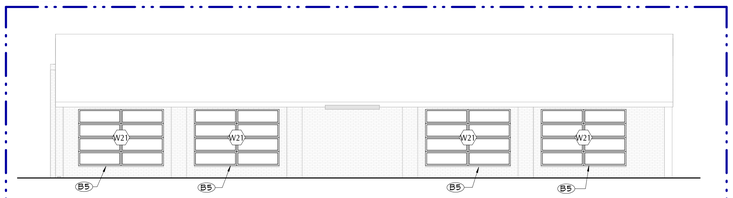
PARTIAL FIRST FLOOR PLAN - AREA '2'

Sheet No.

PES
A112

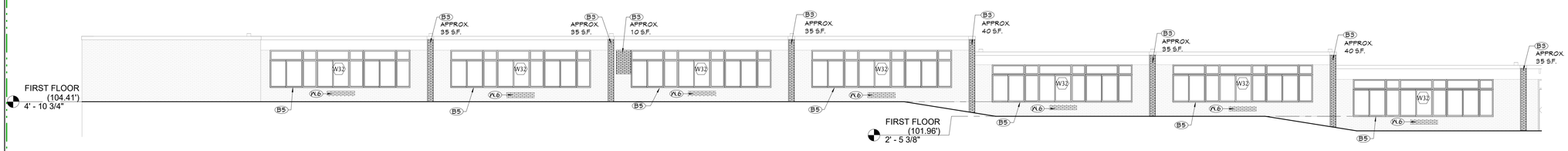
CONSTRUCTION DOCUMENTS

ALTERNATE# 1B - WINDOW REPLACEMENTS

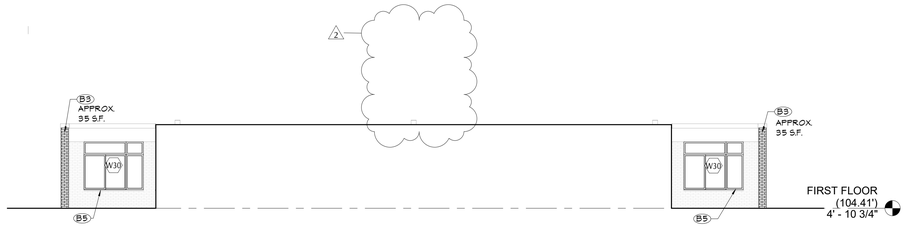


6 PARTIAL ELEVATION - WEST GYM
A202 1/8" = 1'-0"

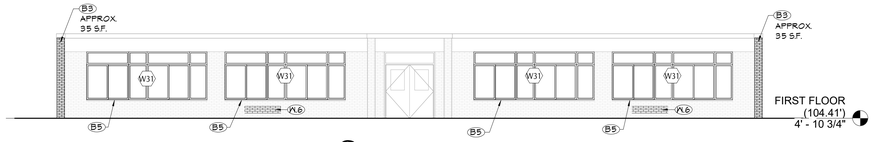
ALTERNATE# 1C - WINDOW REPLACEMENTS



5 PARTIAL ELEVATION - WEST
A202 1/8" = 1'-0"

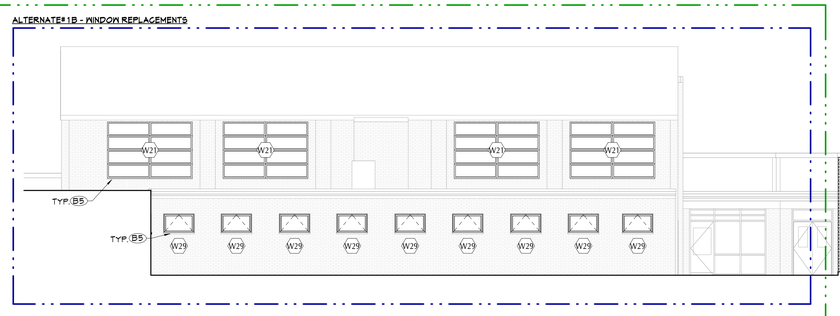


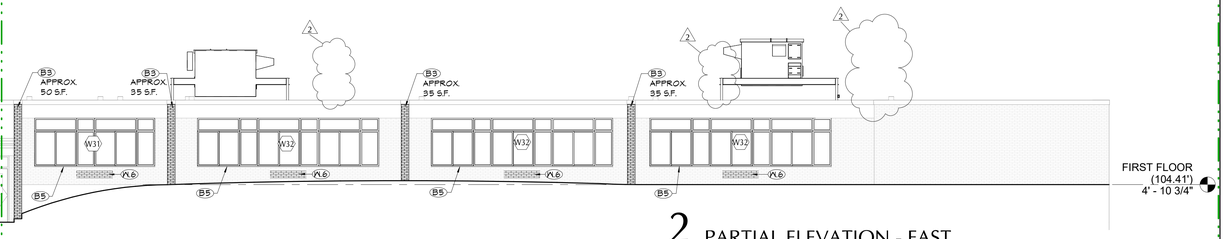
4 PARTIAL ELEVATION - SOUTH
A202 1/8" = 1'-0"



3 PARTIAL ELEVATION - NORTH
A202 1/8" = 1'-0"

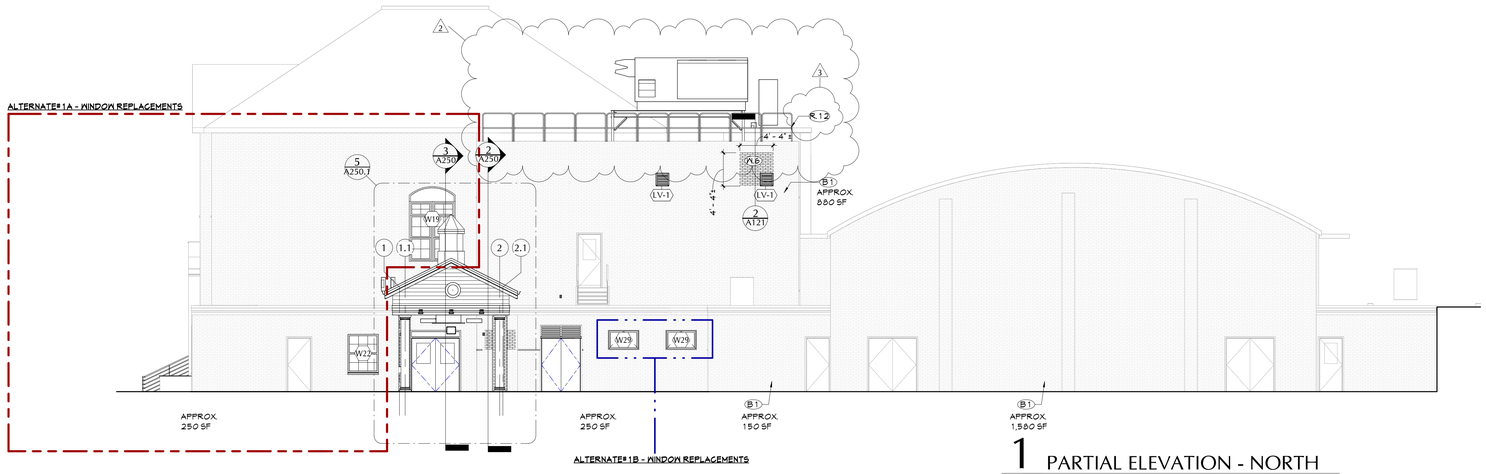
ALTERNATE# 1B - WINDOW REPLACEMENTS





2 PARTIAL ELEVATION - EAST
A202 1/8" = 1'-0"

ALTERNATE# 1A - WINDOW REPLACEMENTS



1 PARTIAL ELEVATION - NORTH
A202 1/8" = 1'-0"

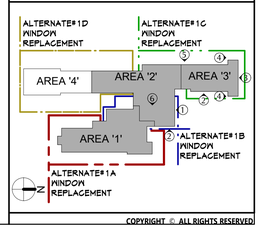
GENERAL NOTES

1. REFER TO SHEET 2-G001 FOR ADDITIONAL GENERAL NOTES.

KEY NOTES

#	DESCRIPTION
B1	CLEAN EXISTING BRICK AND STONEWORK.
B3	REPLACE BROKEN BRICKS, RAKE AND REPOINT EXISTING BRICK.
B5	PROVIDE NEW SEALANT AT ALL STONE SILL JOINTS.
R.12	42" HIGH GUARDRAIL BASIS OF DESIGN SAFETYRAIL 200 BY BLUEWATER MANUFACTURING. REFER TO DETAIL 9/A450.
R.6	PROVIDE BRICK VENEER INFILL AT LOCATION OF WINDOW/LOUVER REMOVAL. BRICK AND MORTAR TO MATCH ADJACENT, TOOTH-IN.

KEY PLAN



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2020 CAPITAL PROJECT - PHASE 3

Project Title

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3	11/29/2023	BID ADDENDUM 3
2	11/22/2023	BID ADDENDUM 2

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Sheet Title
EXTERIOR ELEVATIONS

Sheet No.
PES
A202

CONSTRUCTION DOCUMENTS

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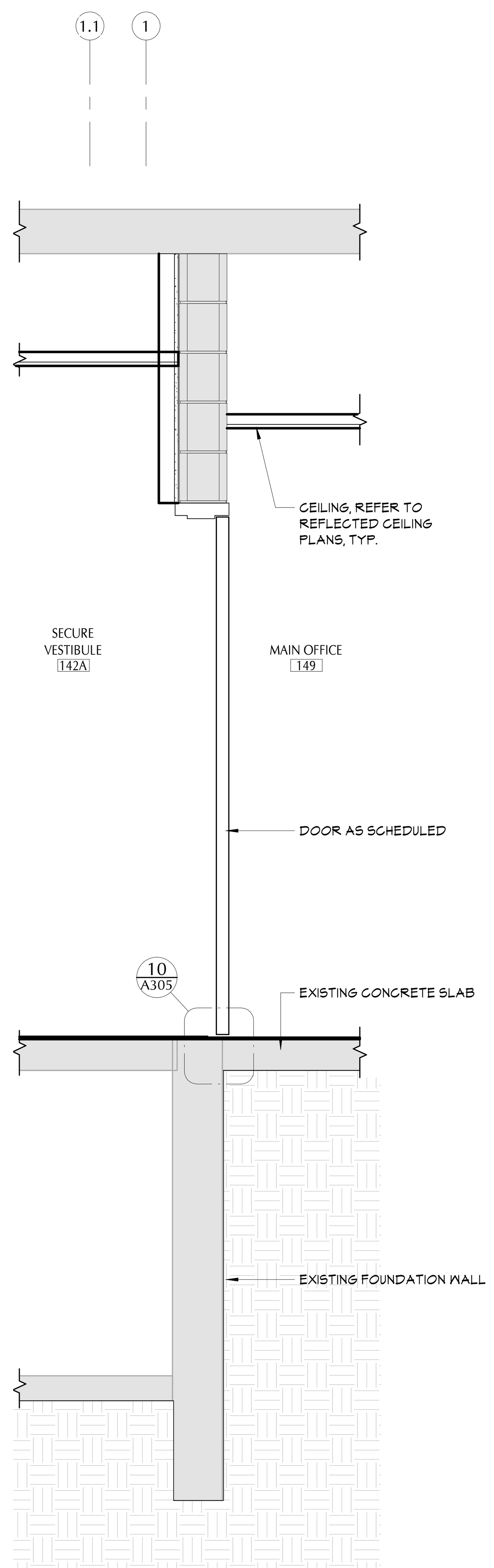
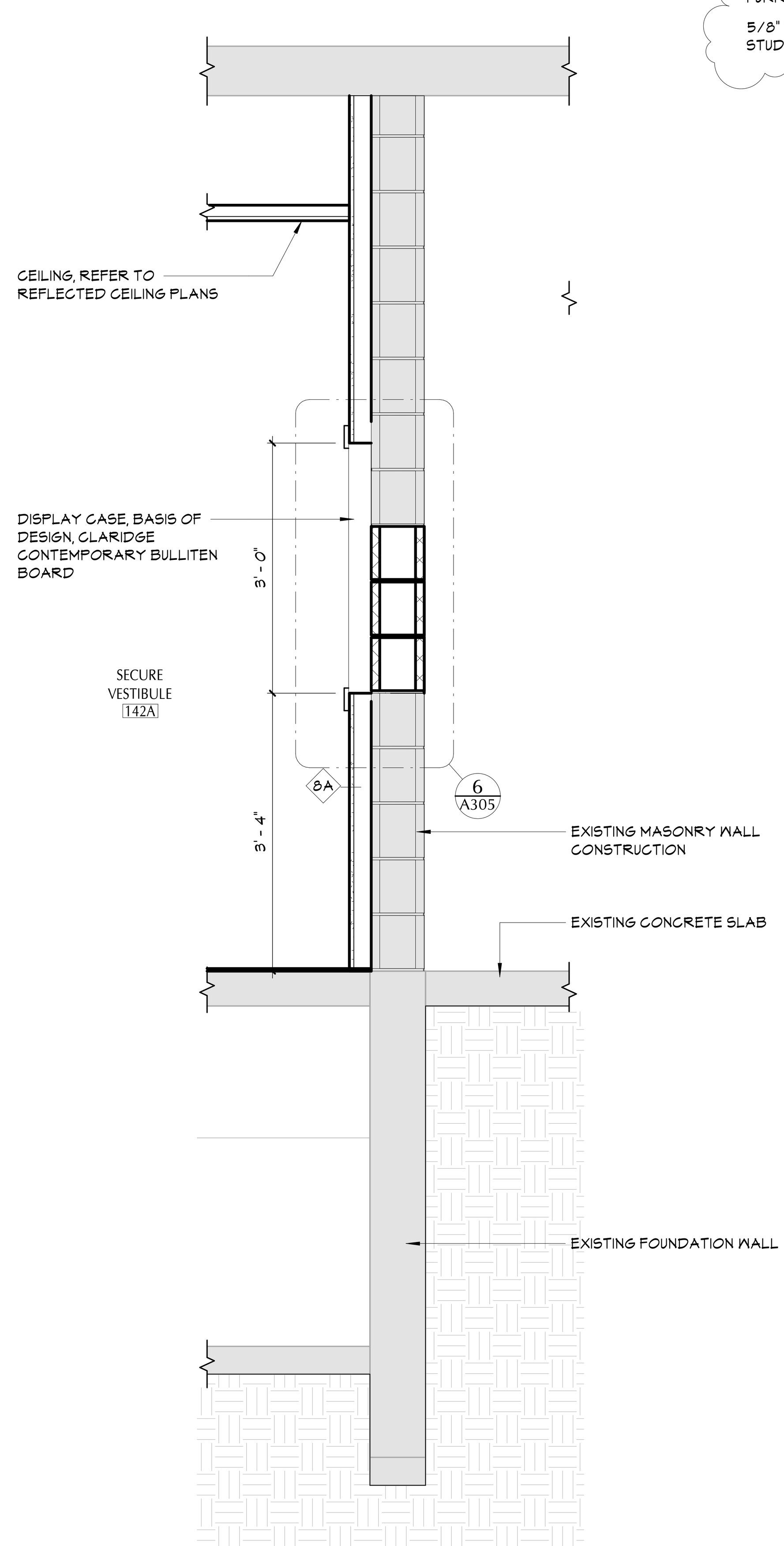
ALTERNATE #2 - VESTIBULE



5 WALL SECTION
A302 3/4" = 1'-0"



4 WALL SECTION
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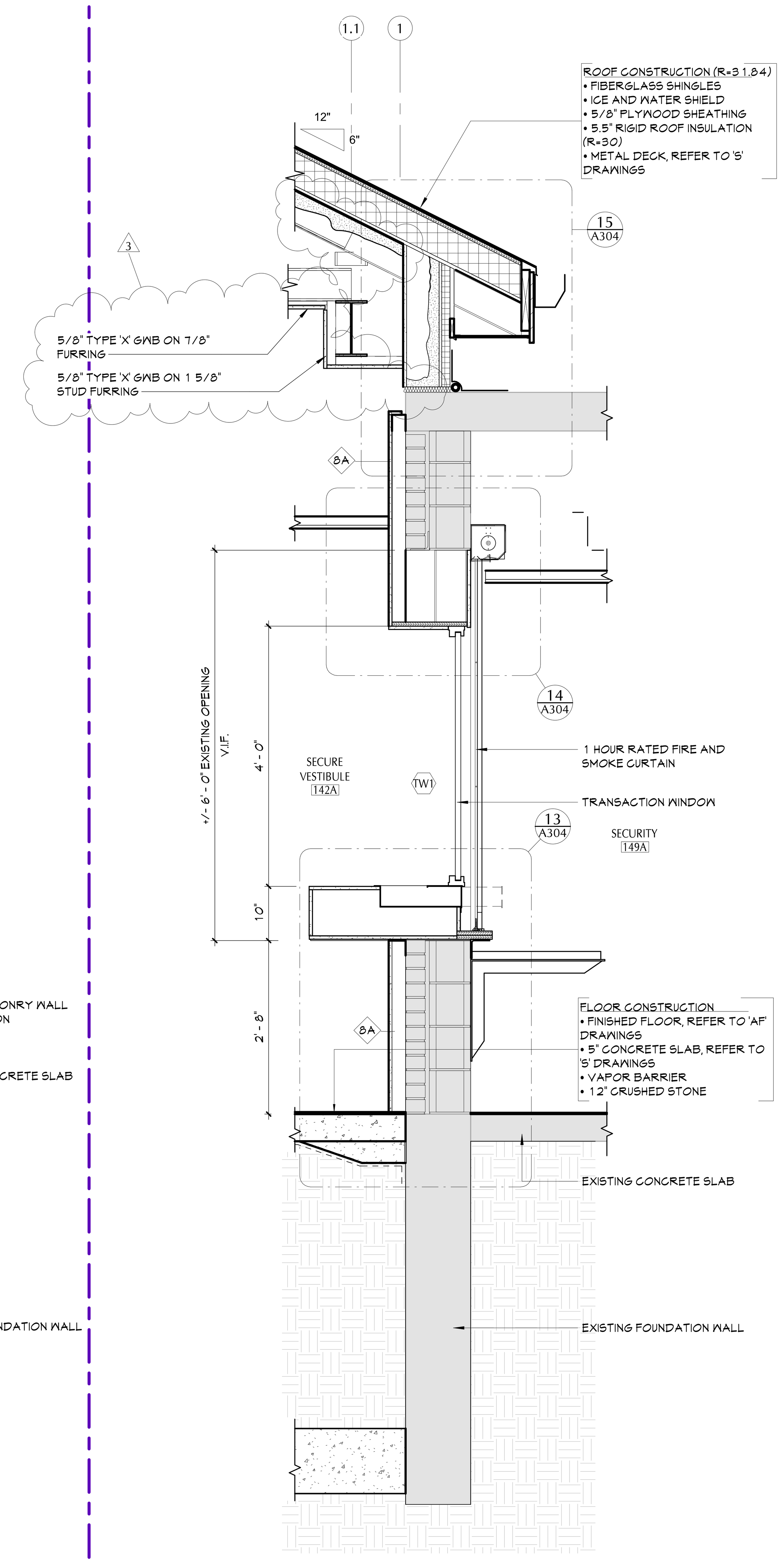

3 WALL SECTION
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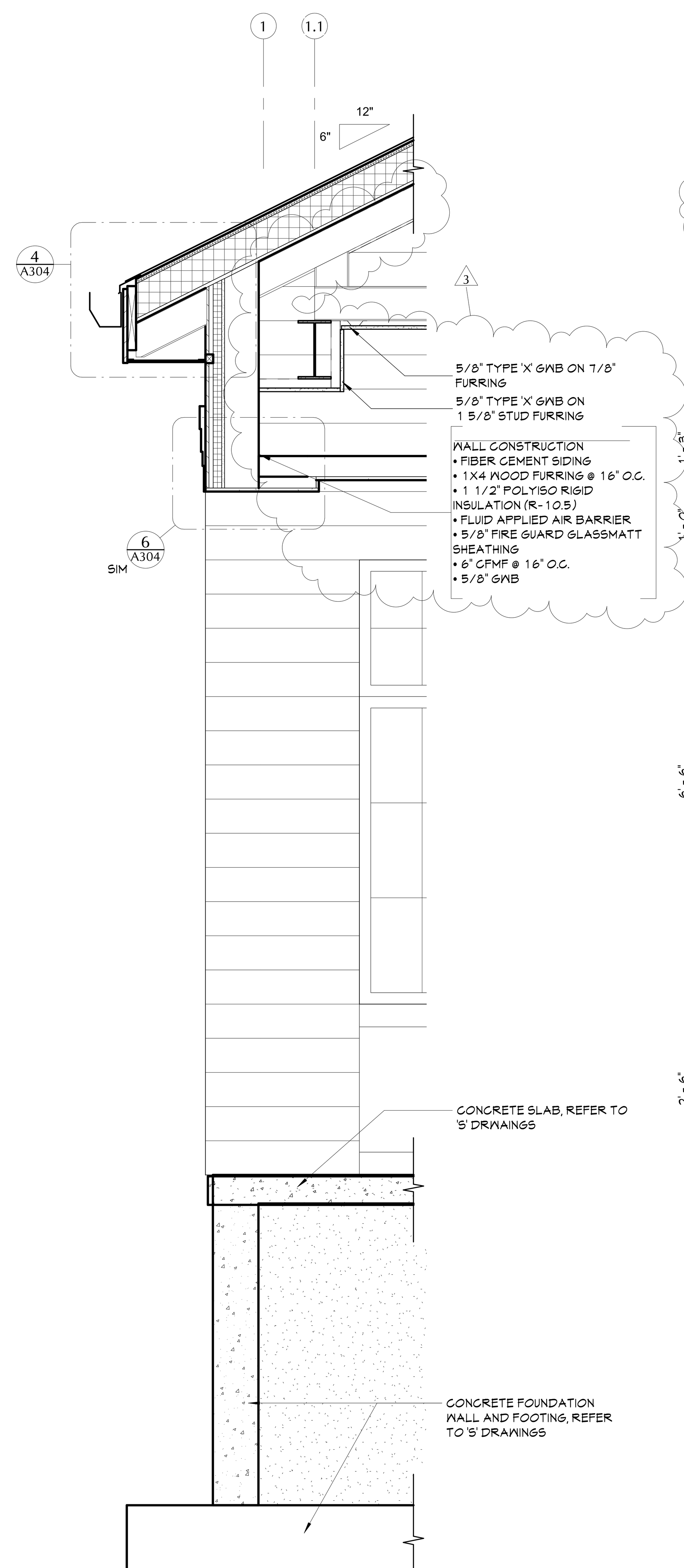

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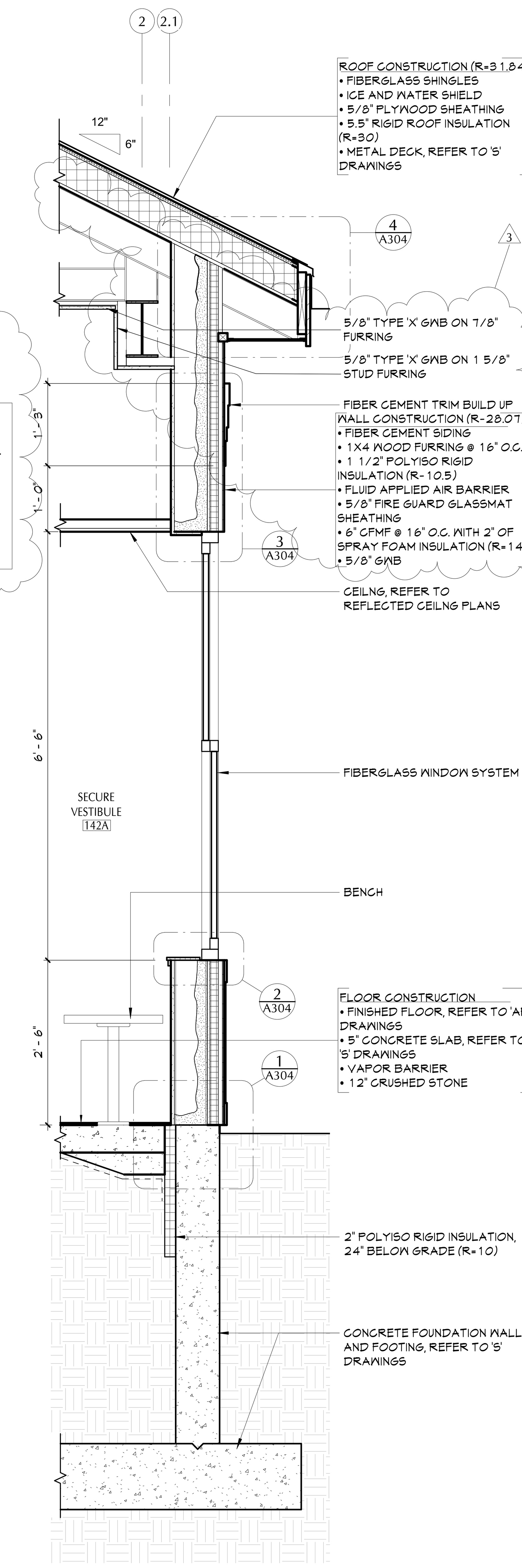
A302 3/4" = 1'-0"



1 WALL SECTION
A302 3/4" = 1'-0"

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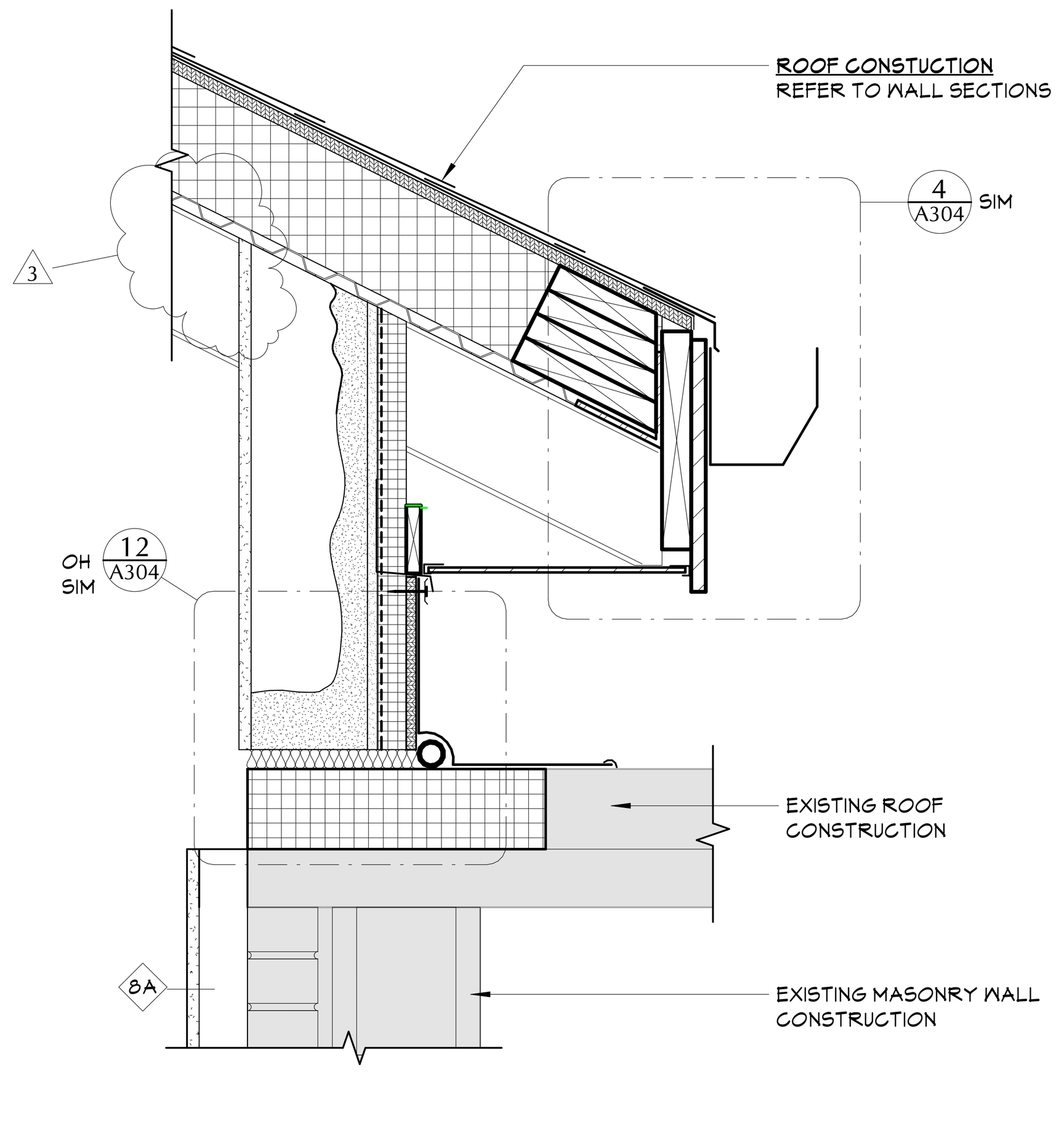
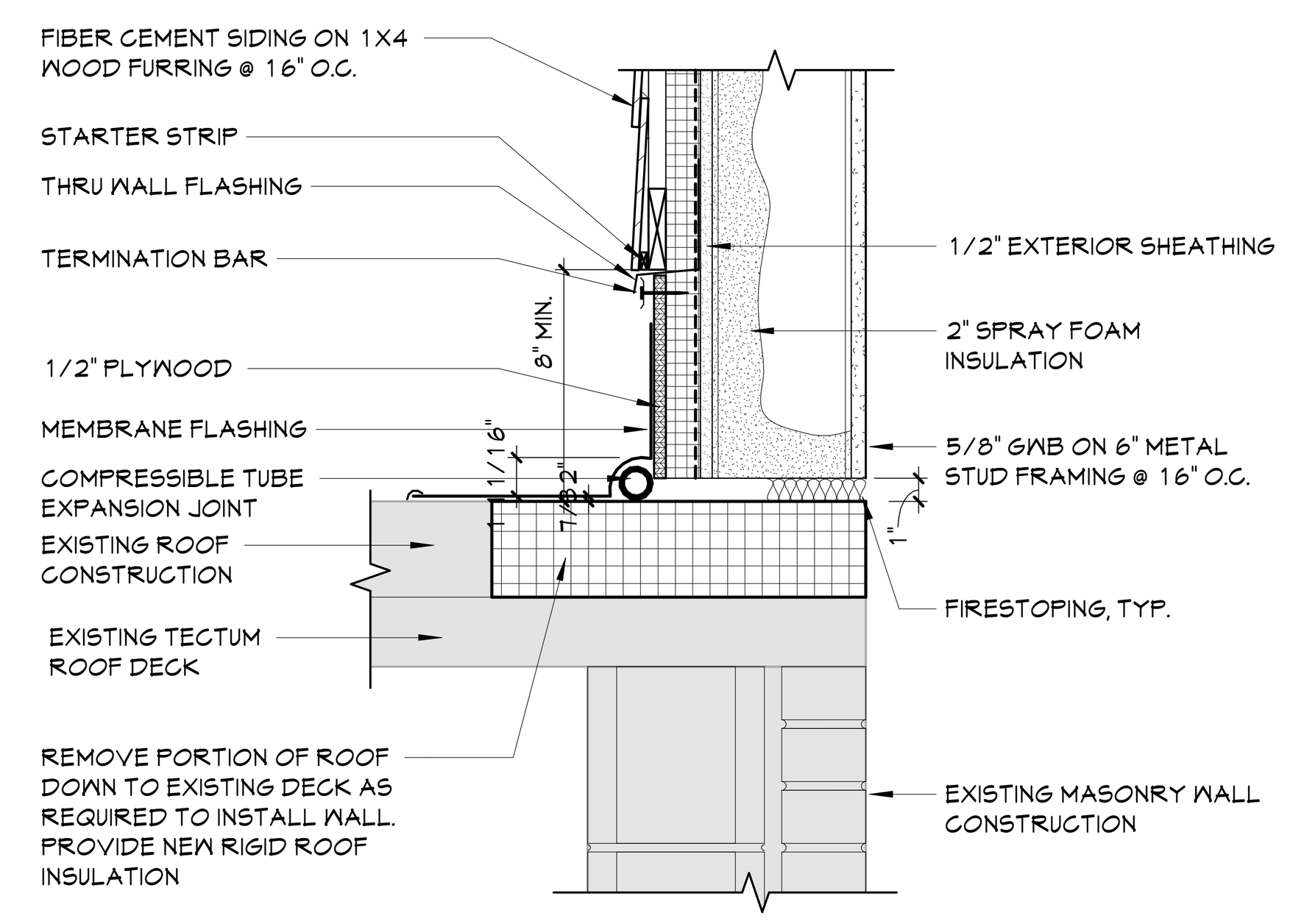
Sheet Title
WALL SECTIONS

Sheet No.
PES A302

CONSTRUCTION DOCUMENTS



15 SECTION DETAIL
A304 1 1/2" = 1'-0"



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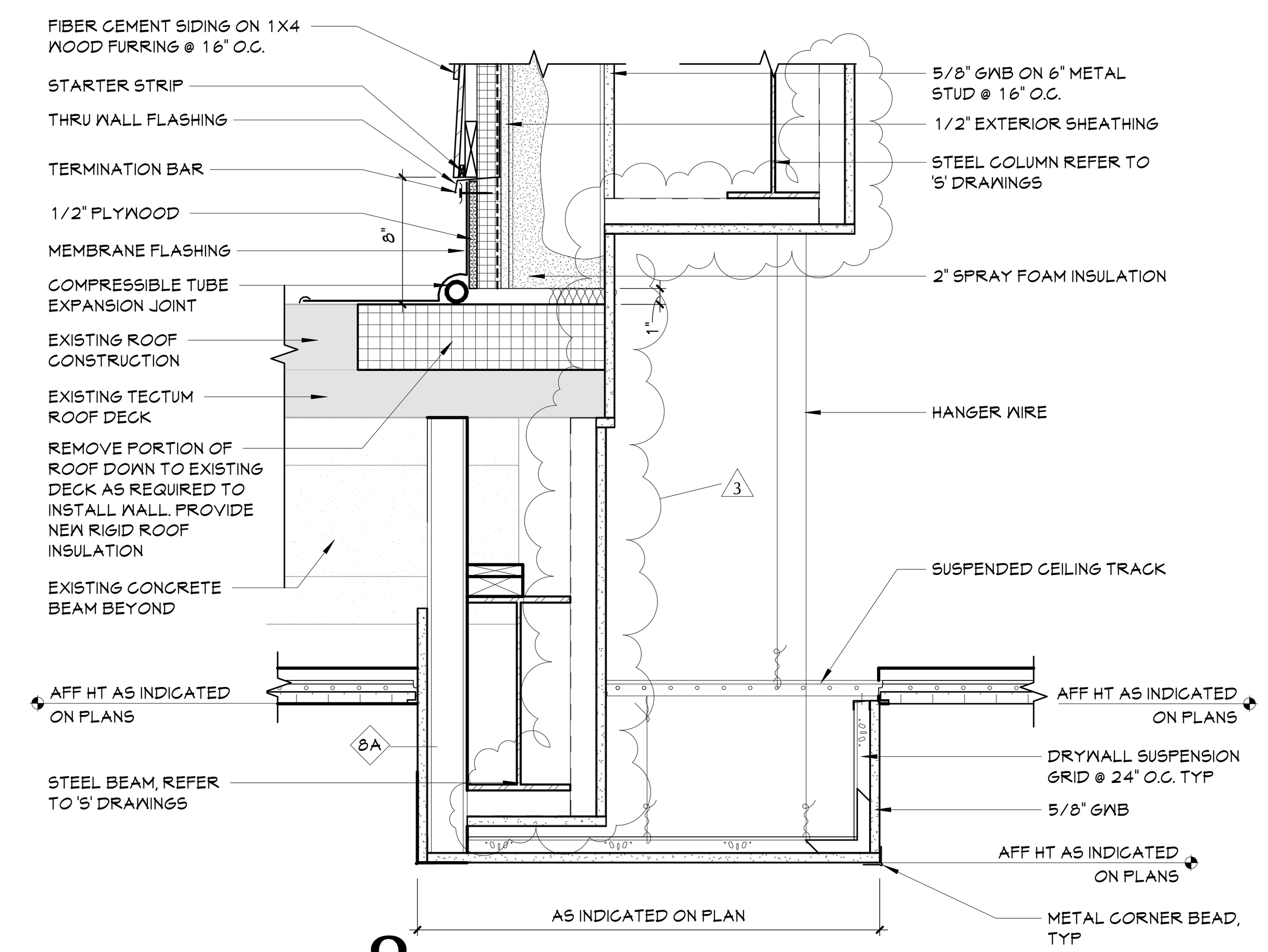
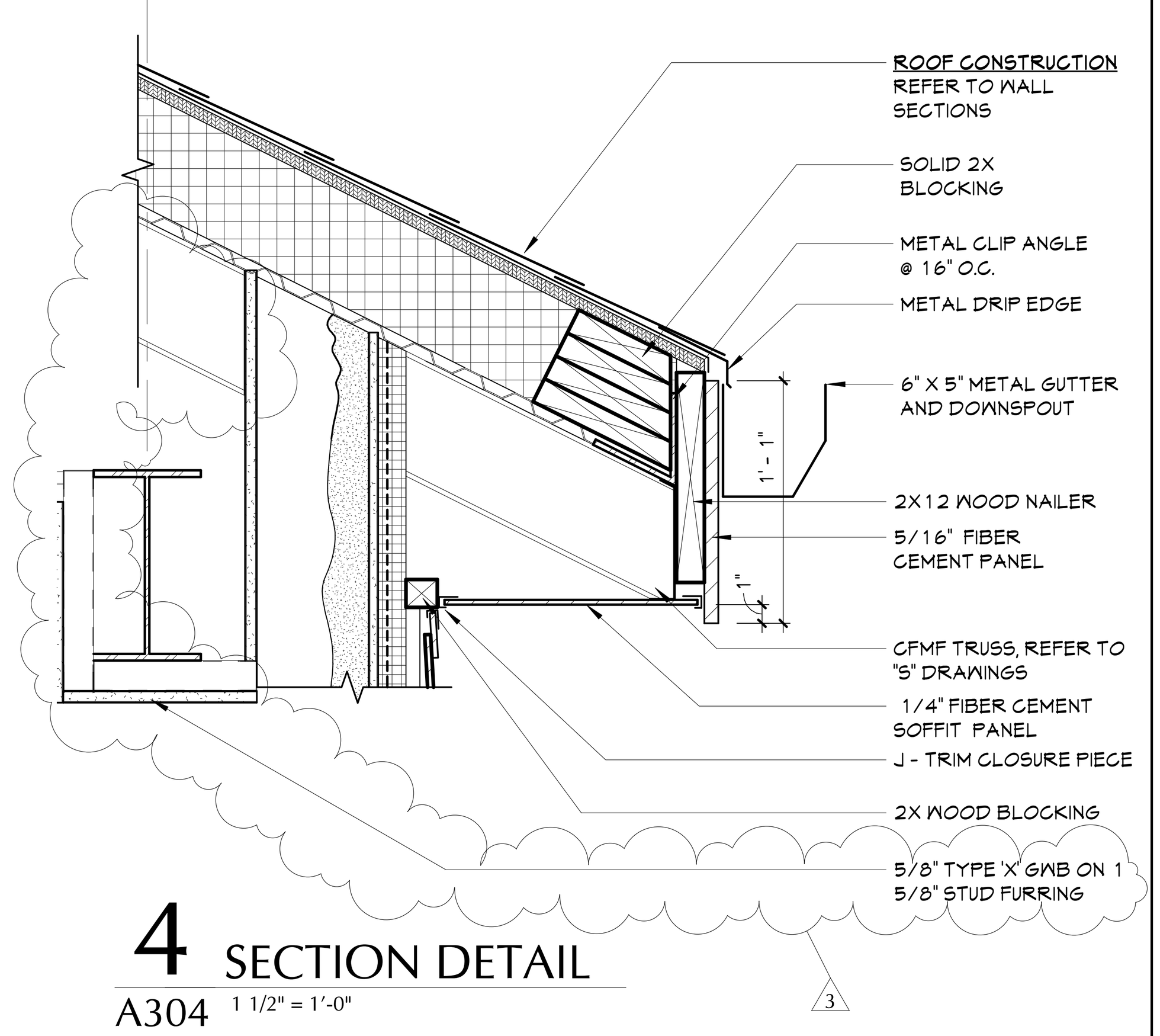


8 SECTION DETAIL
A304 1 1/2" = 1'-0"

NOTE: AT CANOPY BASE BID ROOF SECTION 5.5" RIGID INSULATION IS OMITTED, FASTEN 5/8" PLYWOOD DIRECTLY TO METAL DECK



4 SECTION DETAIL
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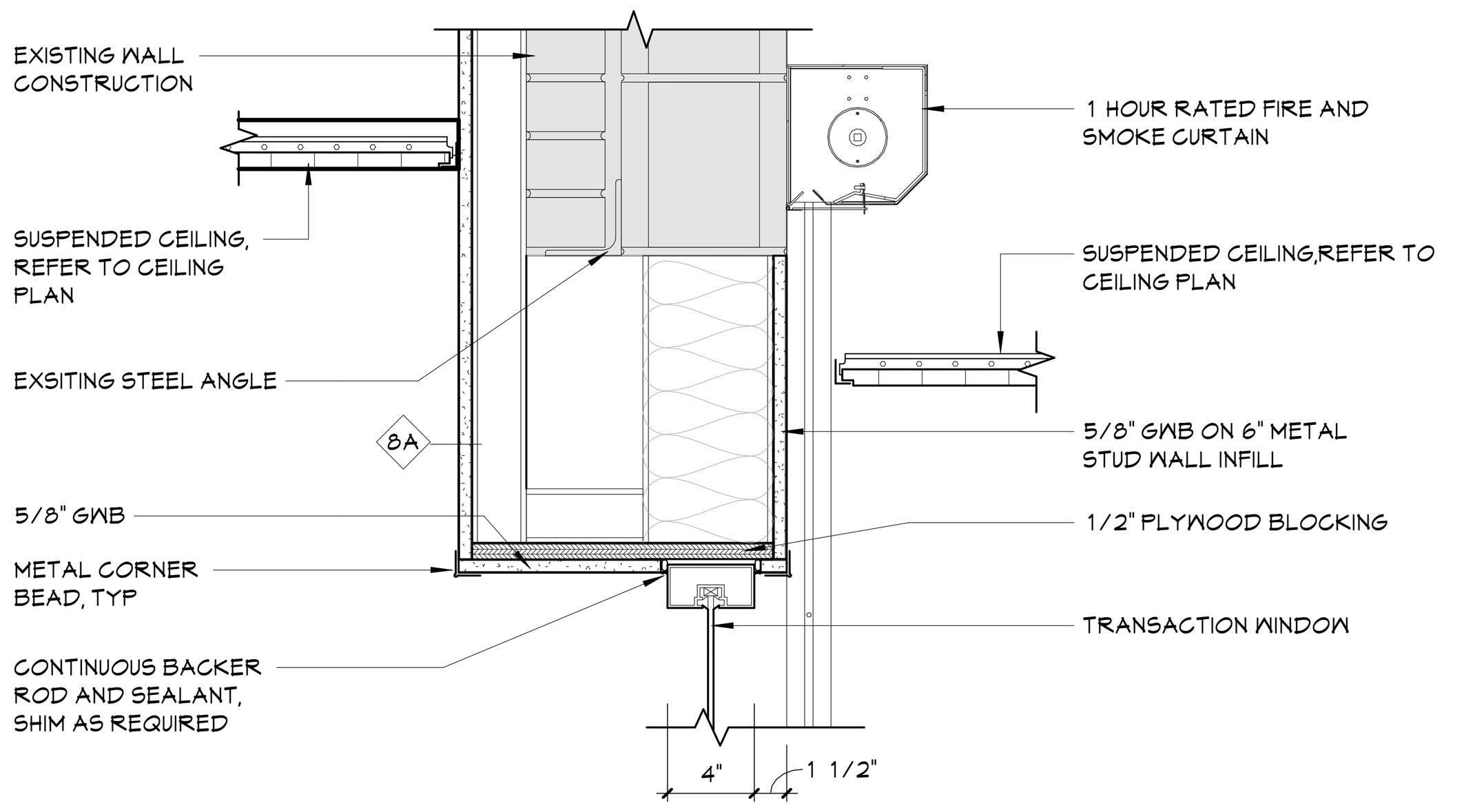

14 SECTION DETAIL
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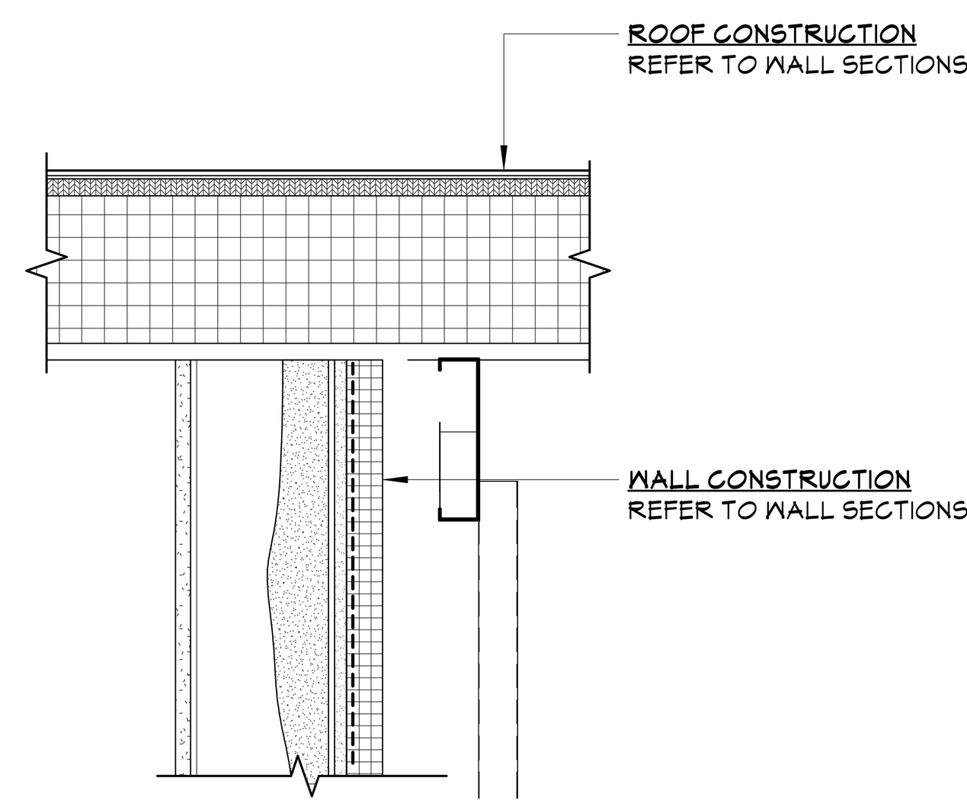

11 SECTION DETAIL
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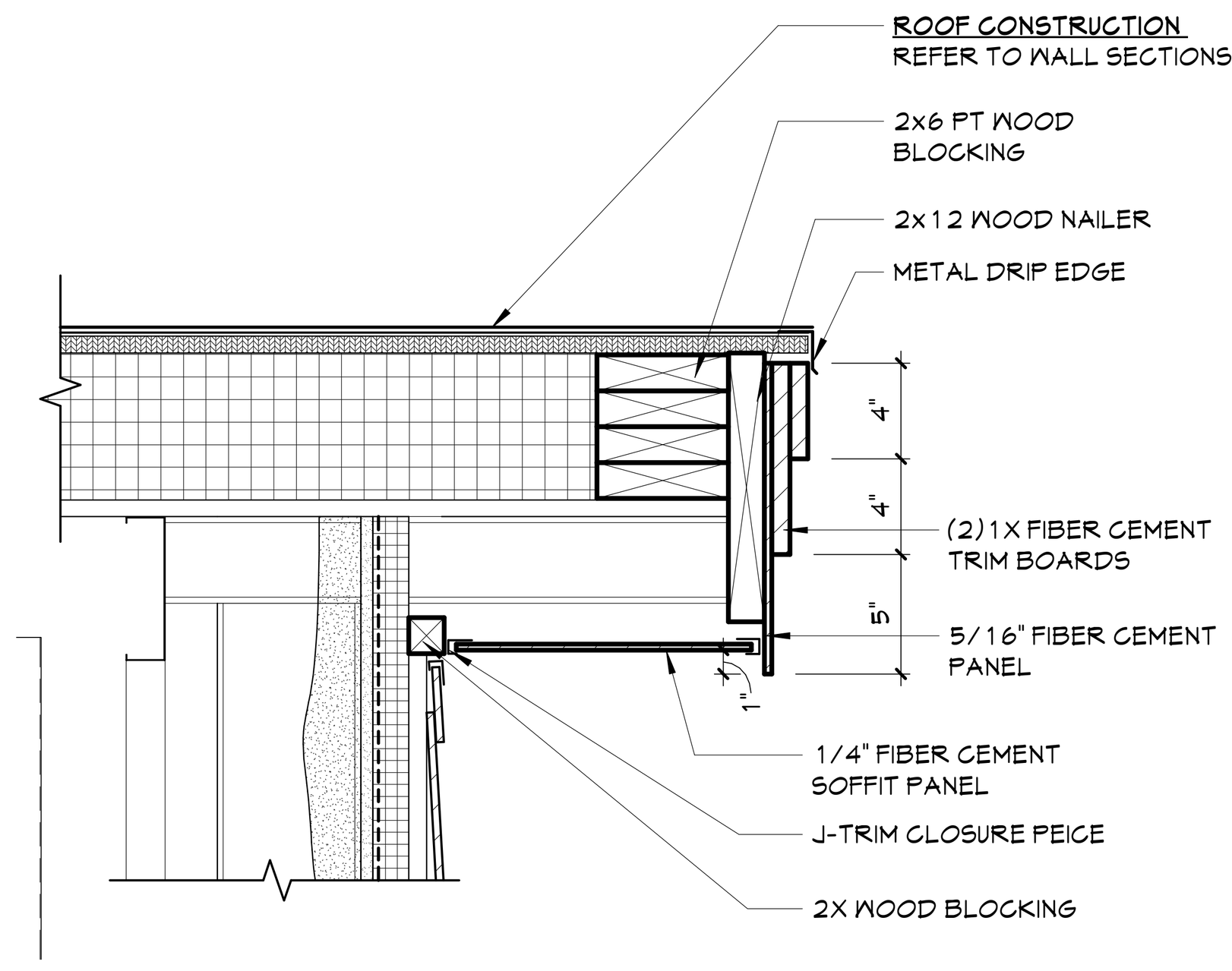

7 SECTION DETAIL
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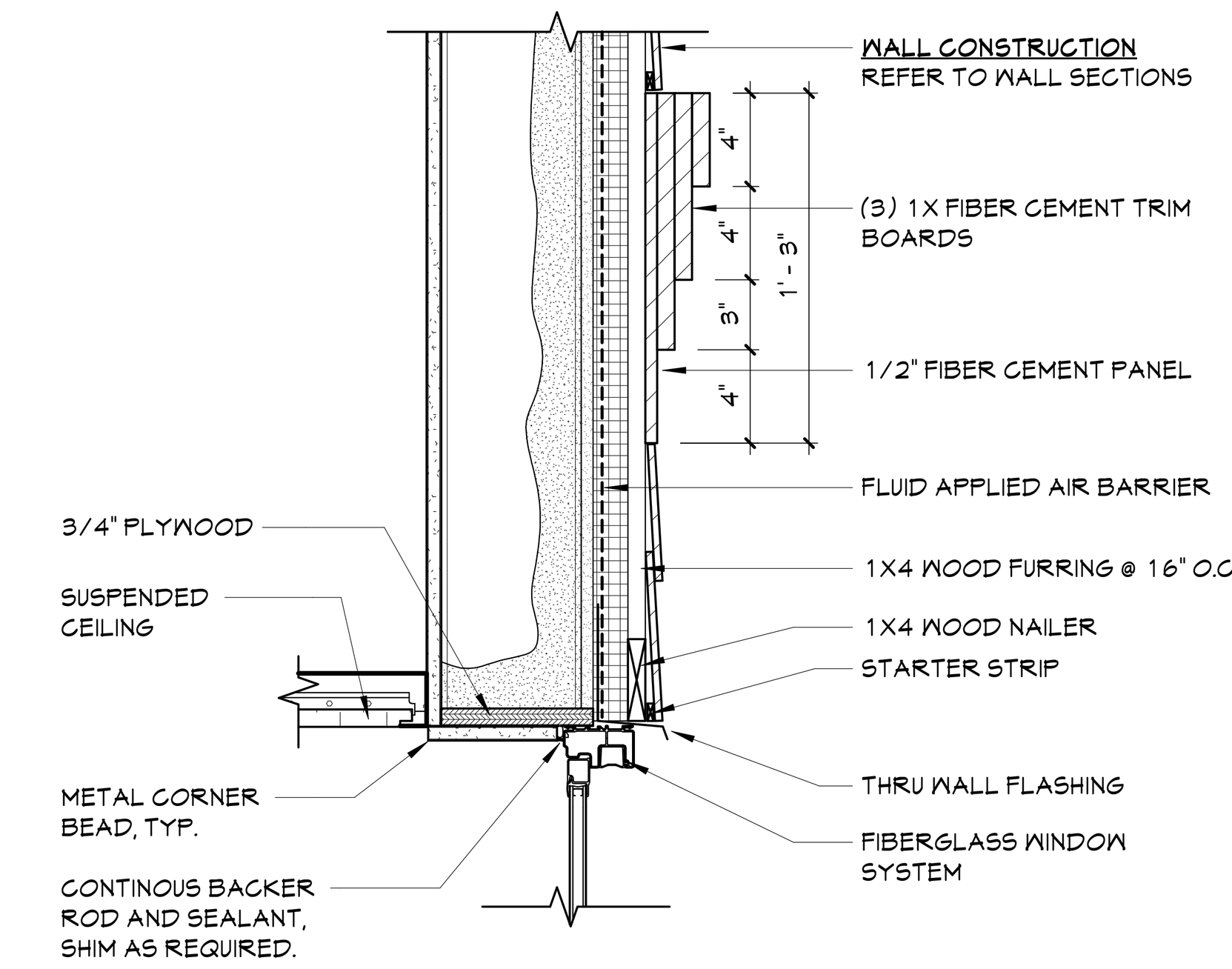
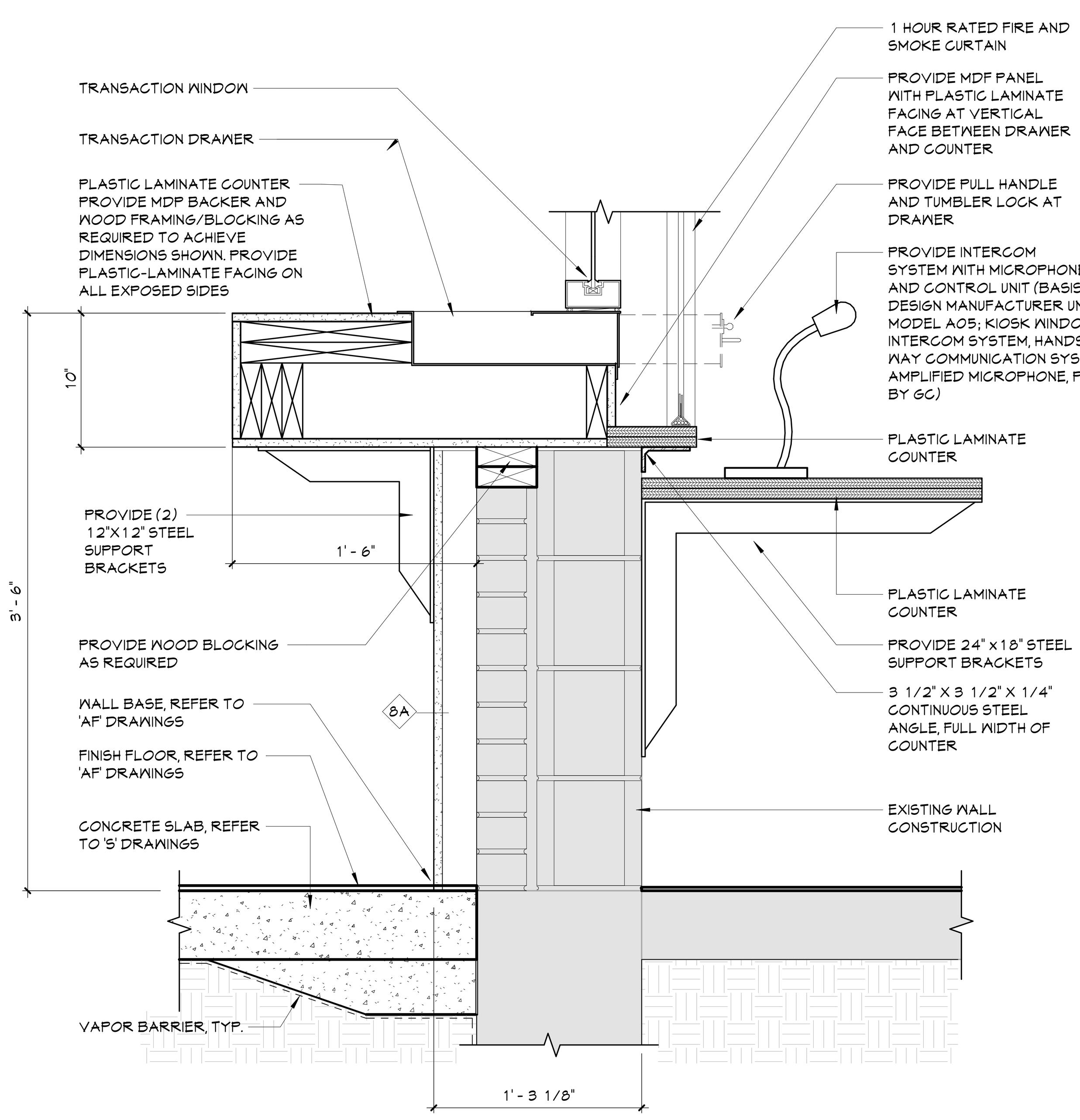


3 SECTION DETAIL
A304 1 1/2" = 1'-0"



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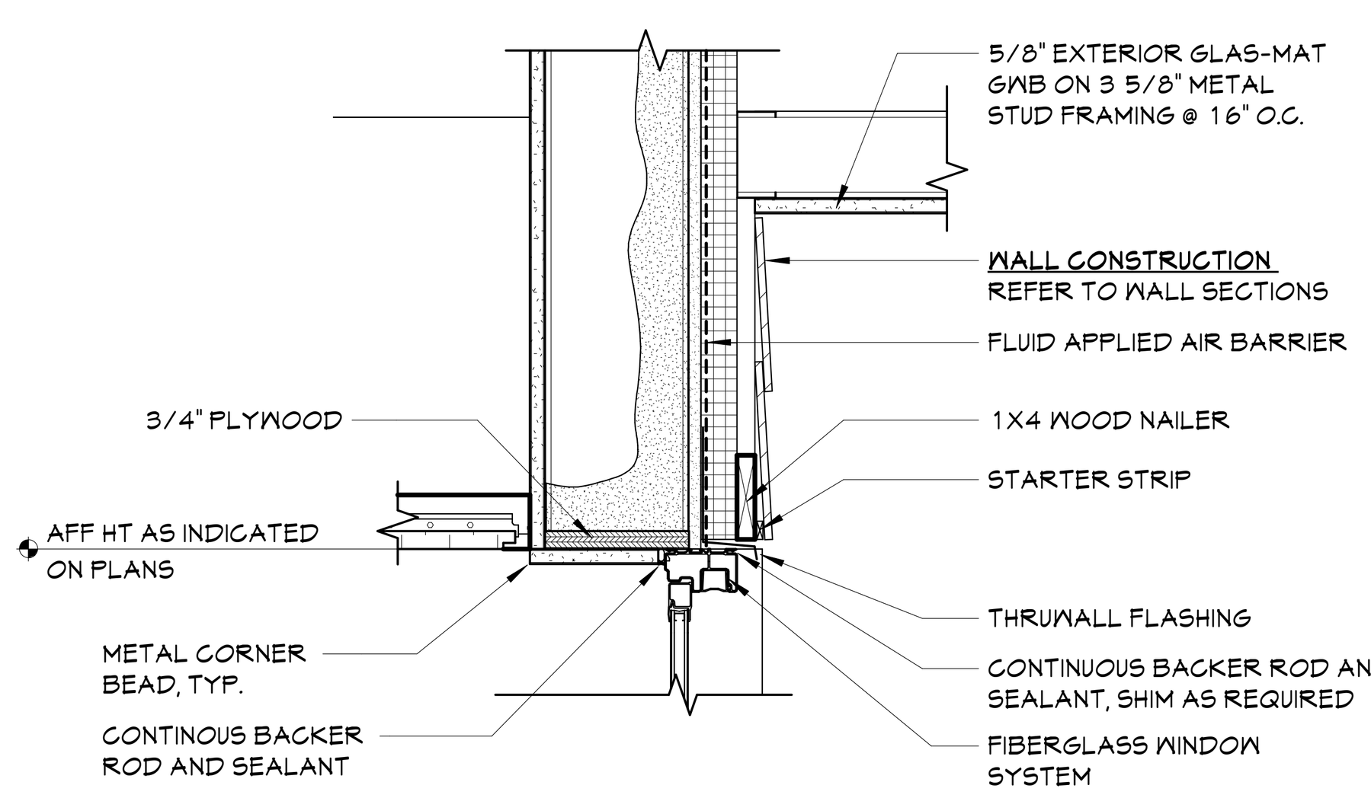

10 SECTION DETAIL
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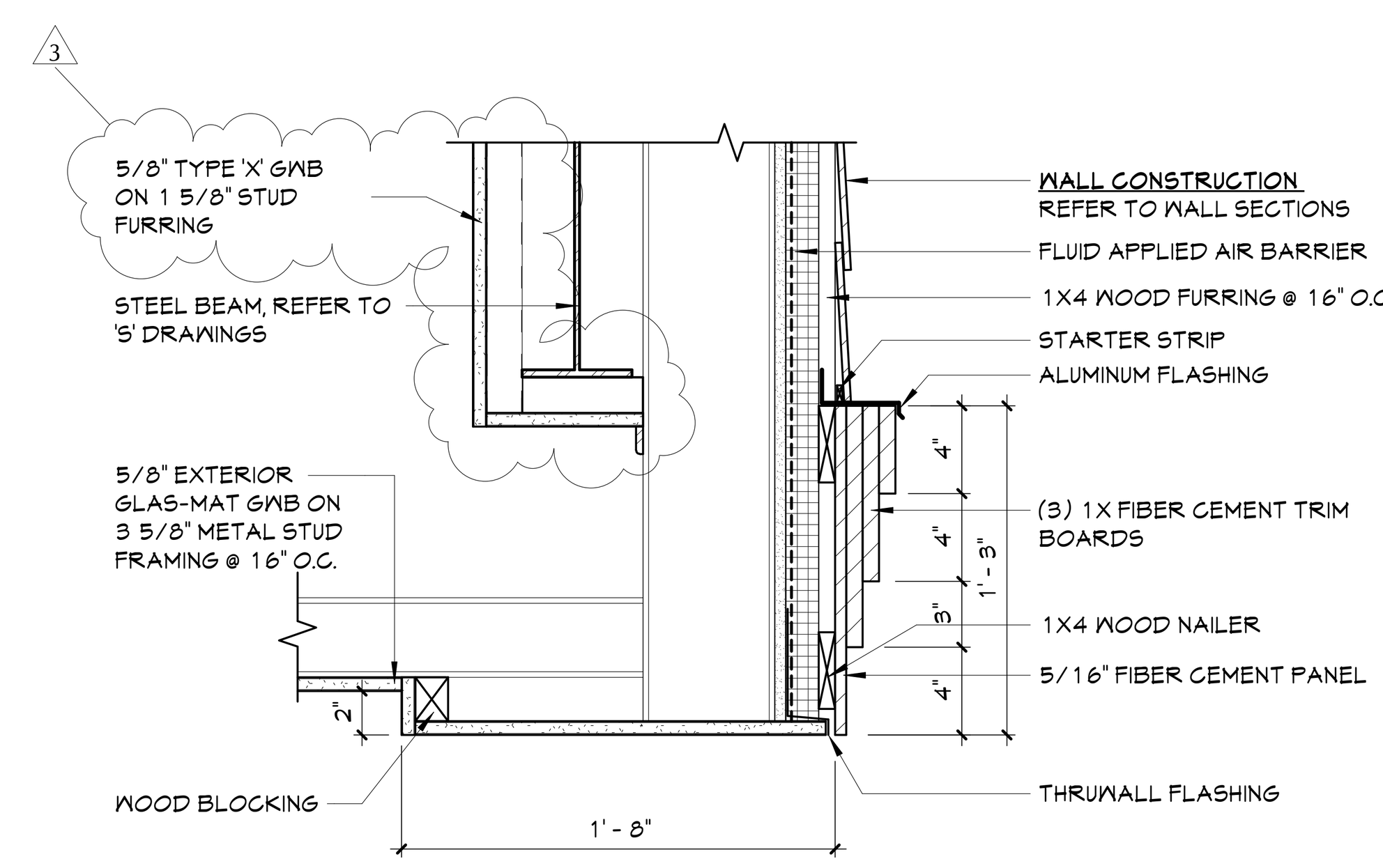

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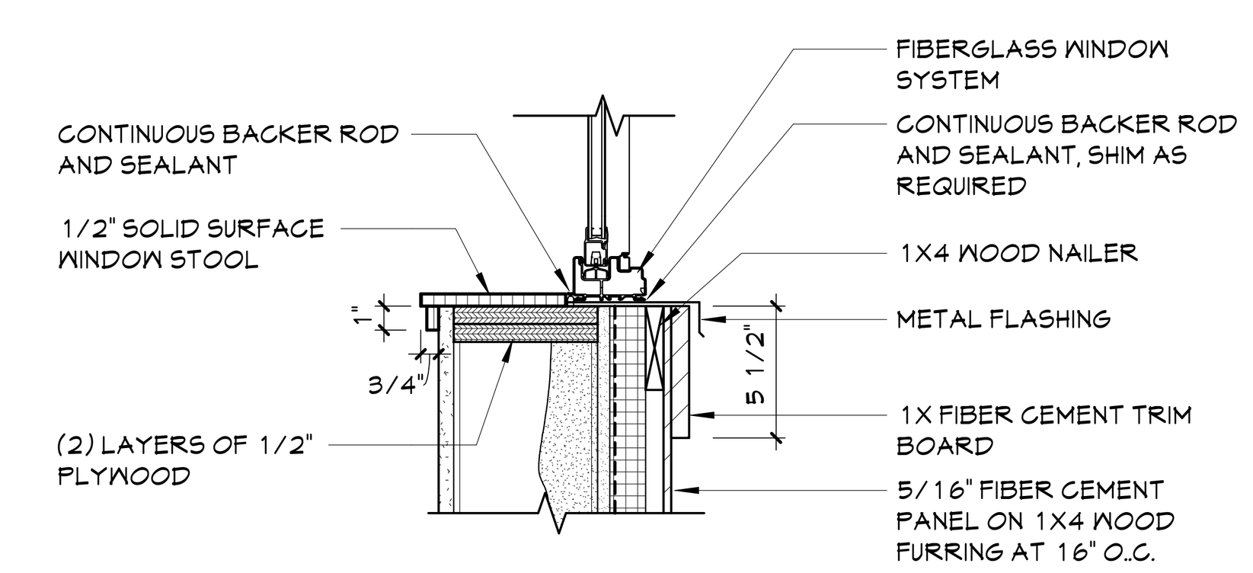

2 SECTION DETAIL
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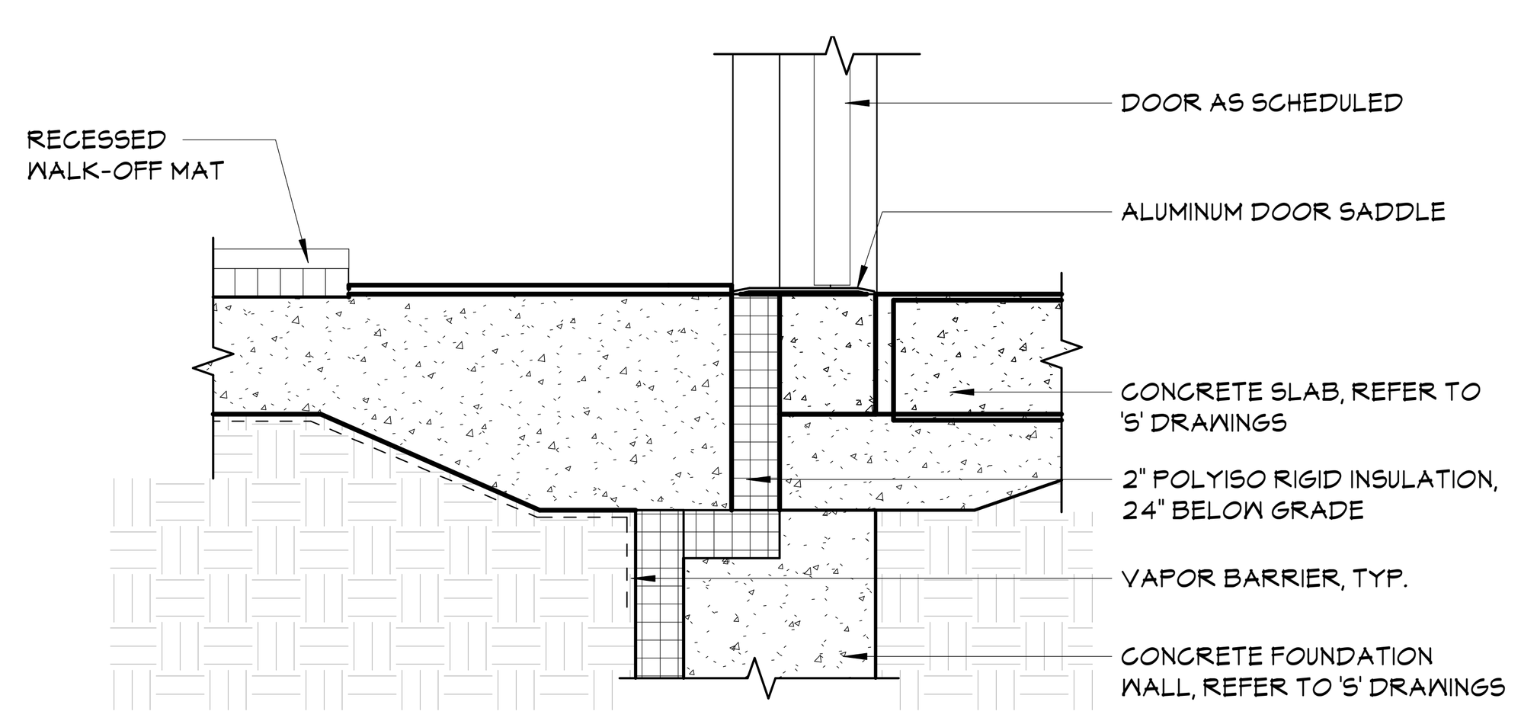

9 SECTION DETAIL
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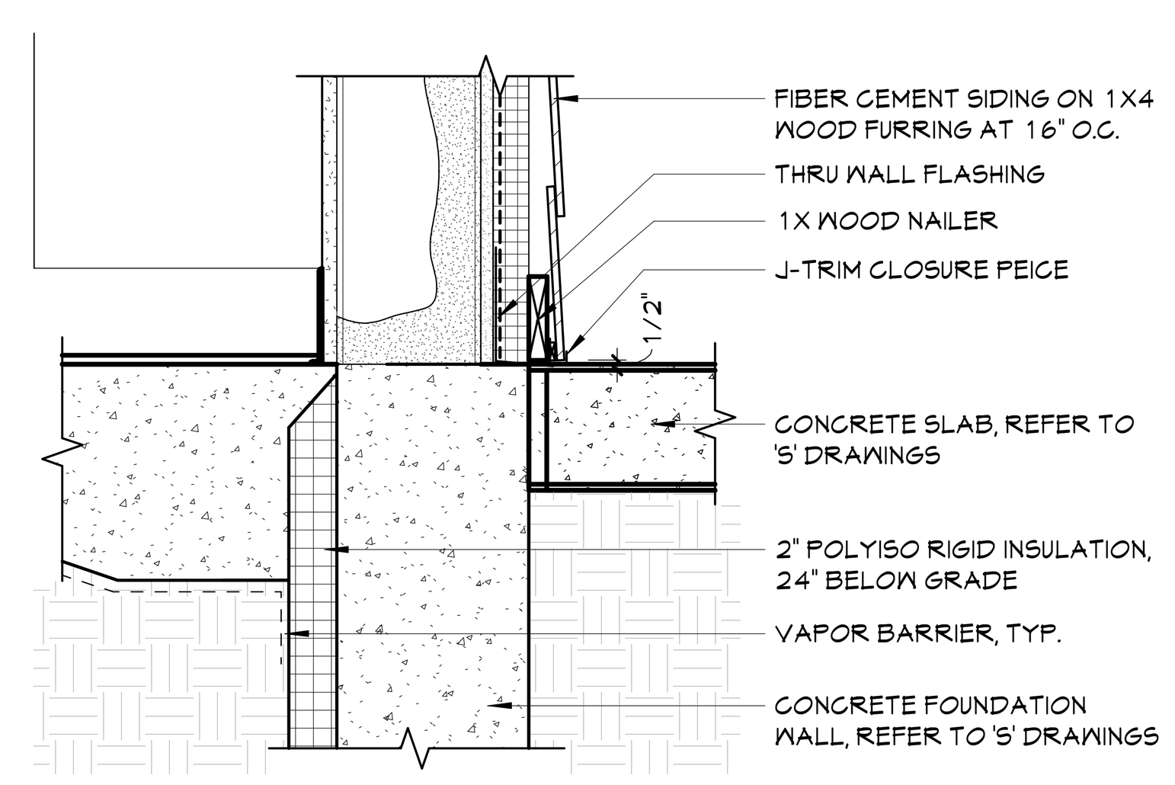
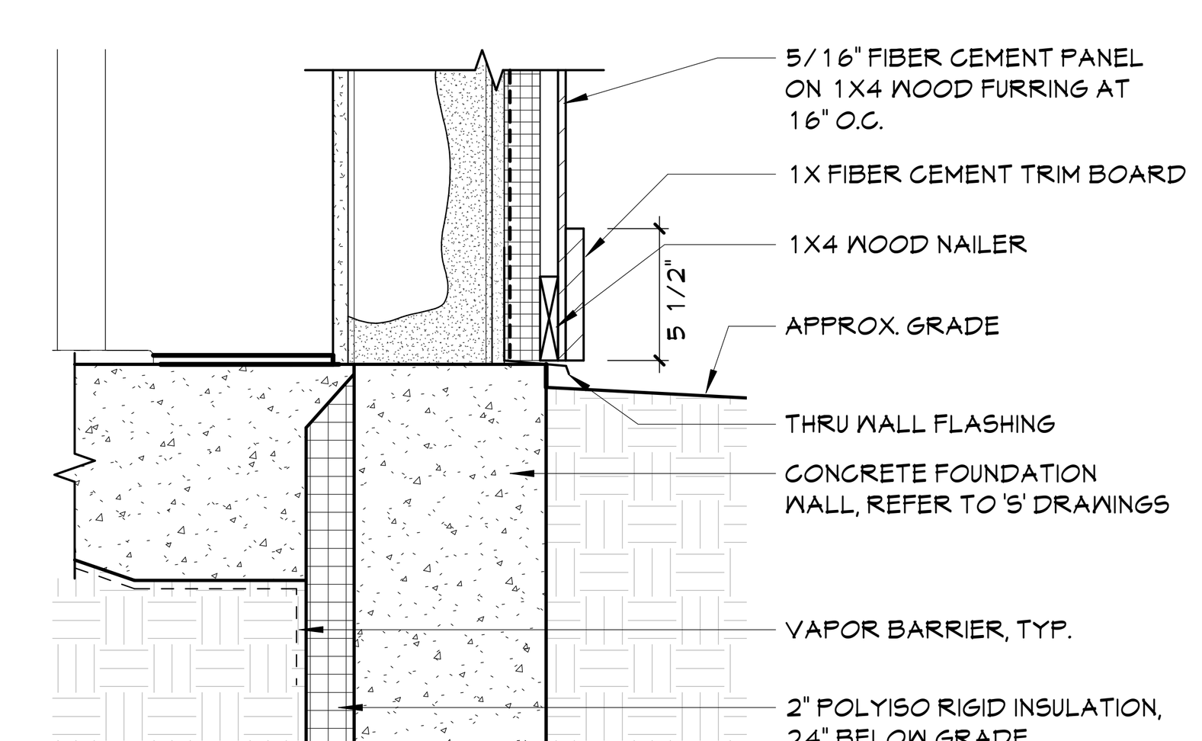


5 SECTION DETAIL
A304 1 1/2" = 1'-0"



1 SECTION DETAIL
A304 1 1/2" = 1'-0"

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2020 CAPITAL PROJECT - PHASE 3

Project Title

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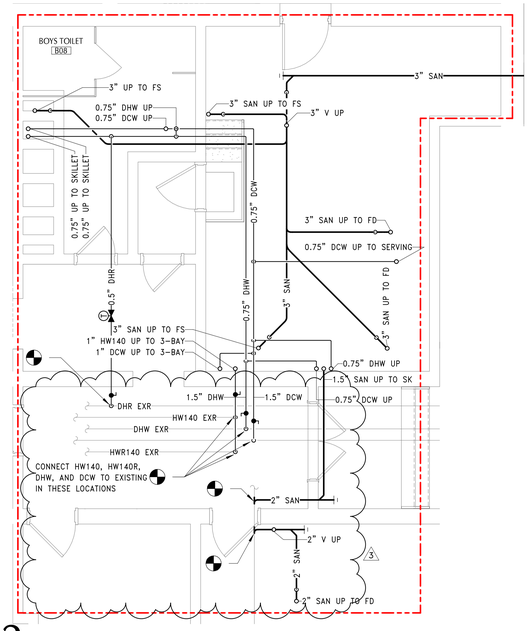
Sheet Title
SECTION DETAILS

Sheet No.
PES A304

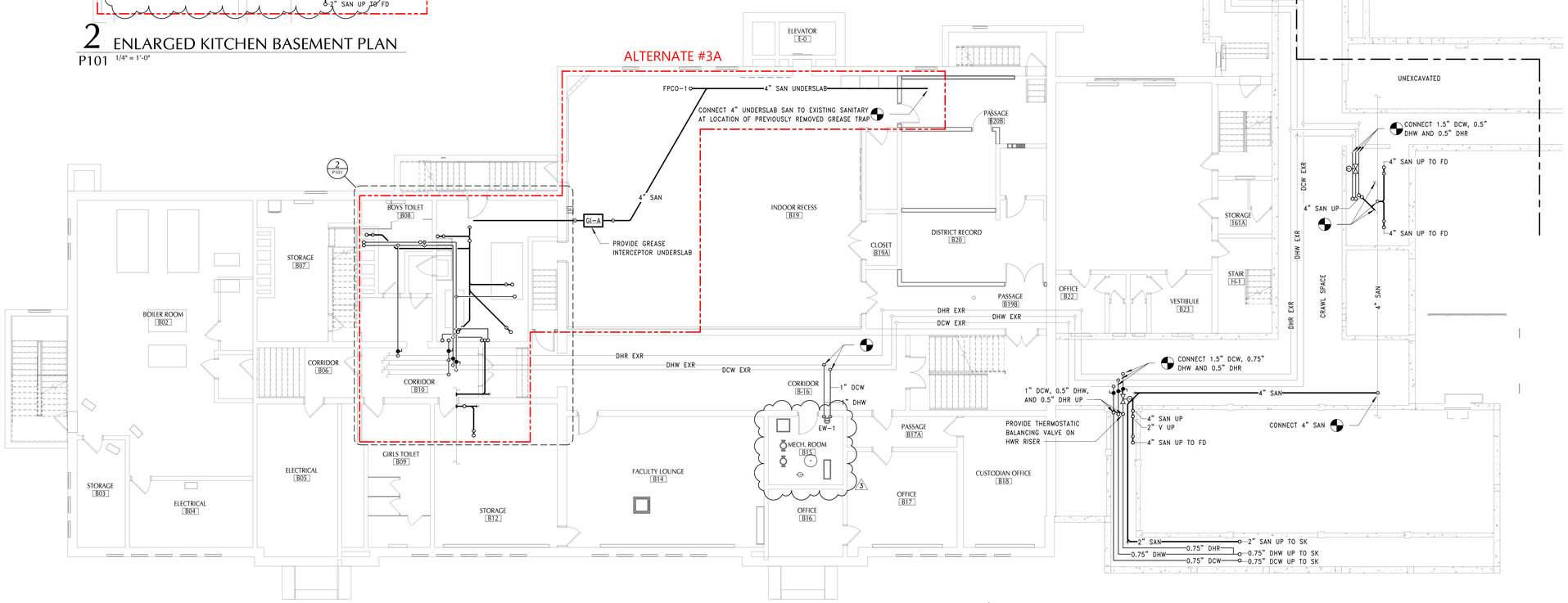
CONSTRUCTION DOCUMENTS

ALTERNATE #3A



2 ENLARGED KITCHEN BASEMENT PLAN
P101 1/4" = 1'-0"

ALTERNATE #3A



1 GROUND FLOOR PLAN - AREA '1'
P101 1/8" = 1'-0"

KEY NOTES

KEY PLAN

N

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PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

ZACHARY ROBERT GESSNER
LICENSED PROFESSIONAL ENGINEER
097797
Expires : 06/30/2025

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Sheet Title
GROUND FLOOR PLAN - AREA '1'

Sheet No.
PES
P101

CONSTRUCTION DOCUMENTS

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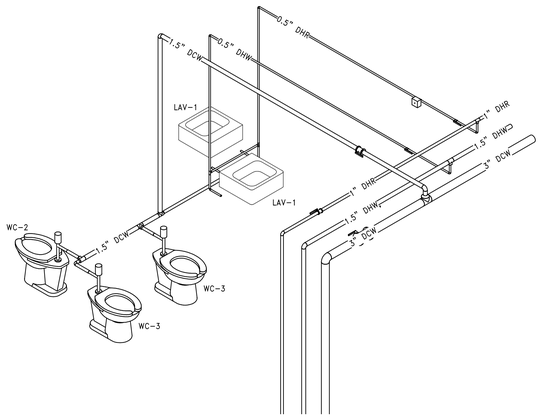
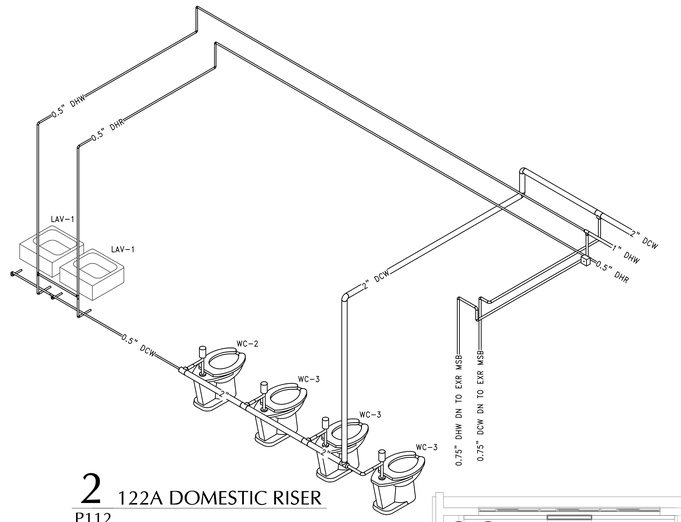
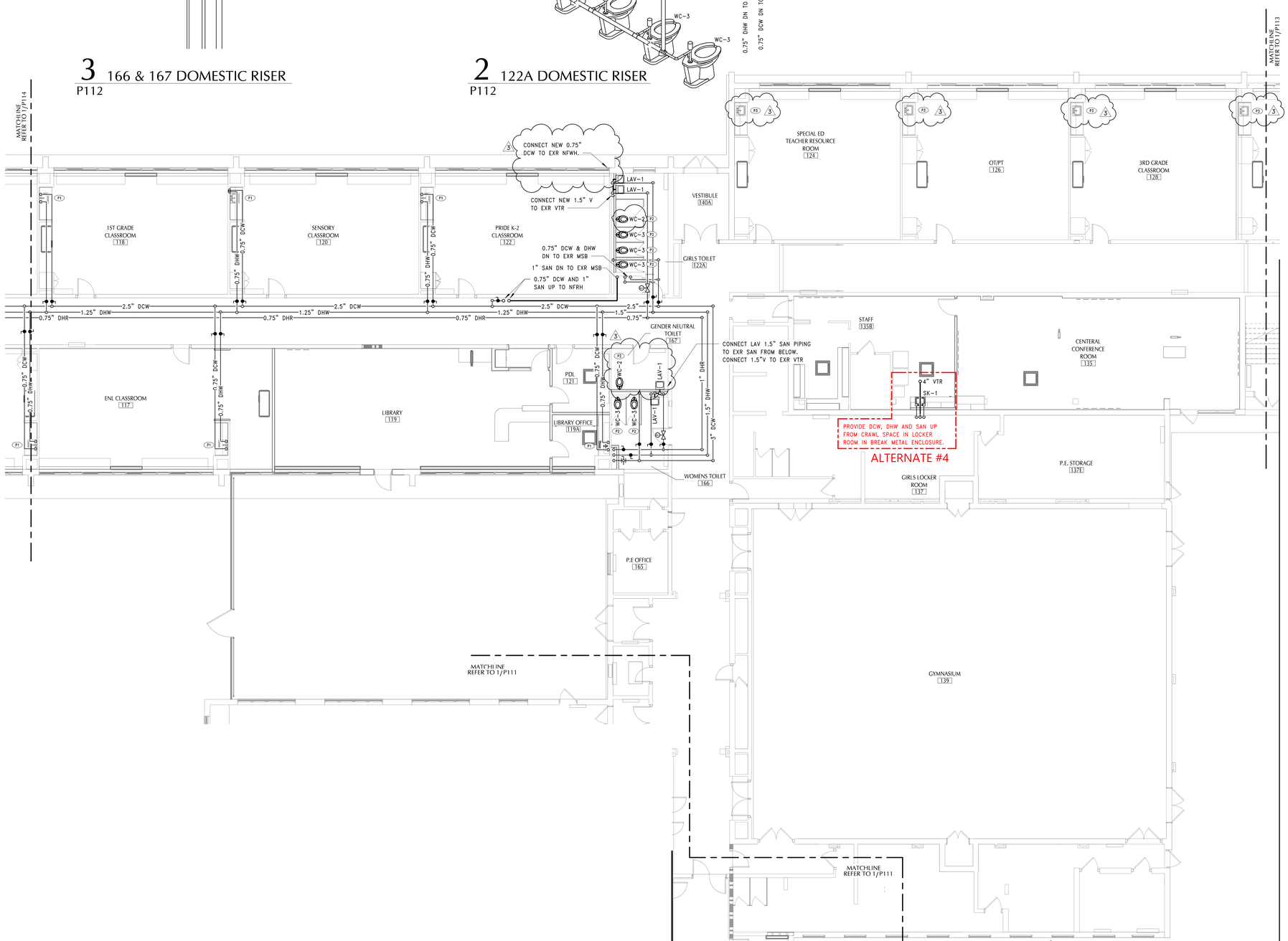


3 166 & 167 DOMESTIC RISER
P112



2 122A DOMESTIC RISER
P112



1 FIRST FLOOR PLAN - AREA '2'
P112 1/8" = 1'-0"

KEY NOTES

P1	ROUTE DCW AND DWH DOWN THROUGH BOTTOM OF CABINET AND INTO COUNTERTOP AND CONNECT TO EXISTING SINK. PROVIDE INDIRECT DRAIN UP FROM TAIL PIECE OF EXISTING SINK (SIMILAR TO DETAIL 6/P601) AND TERMINATE ABOVE COUNTERTOP. PROVIDE REMOVABLE BREAKMETAL CHASE AROUND ALL PIPING.
P2	CONNECT TO SANITARY AT FLOOR IN SAME LOCATION.
P3	PROVIDE INDIRECT DRAIN UP FROM TAIL PIECE OF EXISTING SINK (SIMILAR TO DETAIL 6/P601) AND TERMINATE ABOVE COUNTERTOP. PROVIDE REMOVABLE BREAKMETAL CHASE AROUND ALL PIPING.

KEY PLAN

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FIRST FLOOR PLAN - AREA '2'

Sheet No.
PES P112

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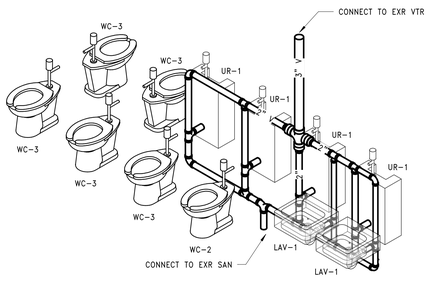
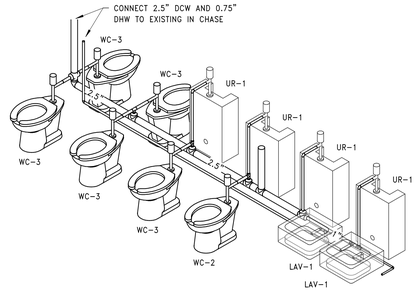
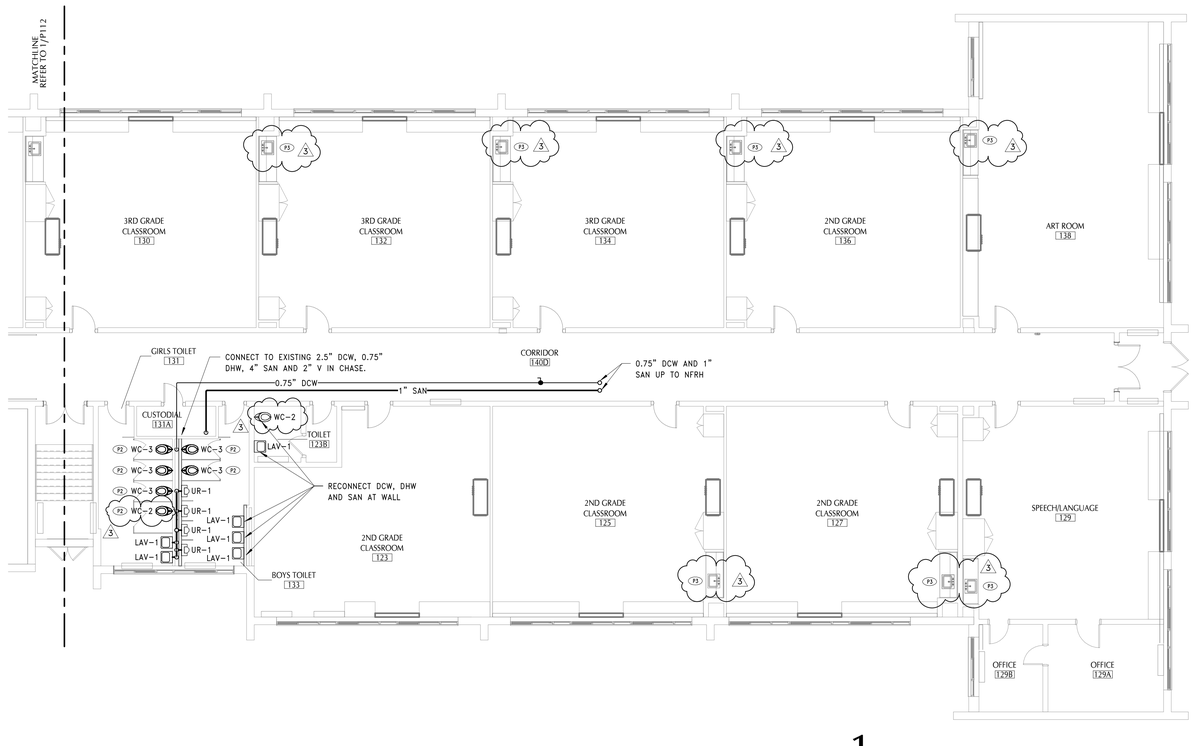


3 131 & 133 SANITARY RISER
P113



2 131 &133 DOMESTIC RISER
P113



1 FIRST FLOOR PLAN - AREA '3'
P113 1/8" = 1'-0"

KEY NOTES

P2	CONNECT TO SANITARY AT FLOOR IN SAME LOCATION.
P3	PROVIDE INDIRECT DRAIN UP FROM TAIL PIECE OF EXISTING SINK (SIMILAR TO DETAIL 6/P601) AND TERMINATE ABOVE COUNTERTOP. PROVIDE REMOVABLE BREAKMETAL CHASE AROUND ALL PIPING.

3

KEY PLAN

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Sheet Title

FIRST FLOOR PLAN - AREA '3'

Sheet No.

PES
P113

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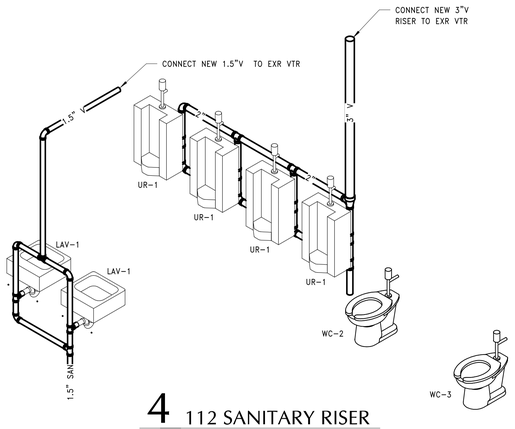
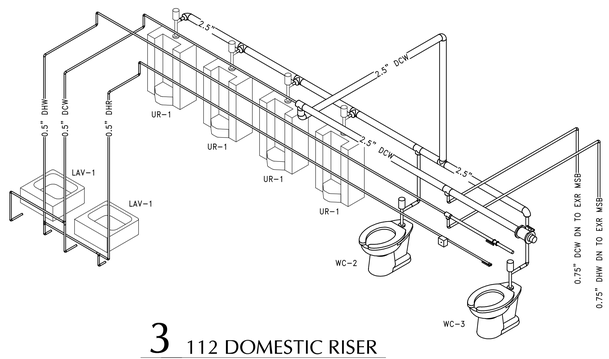
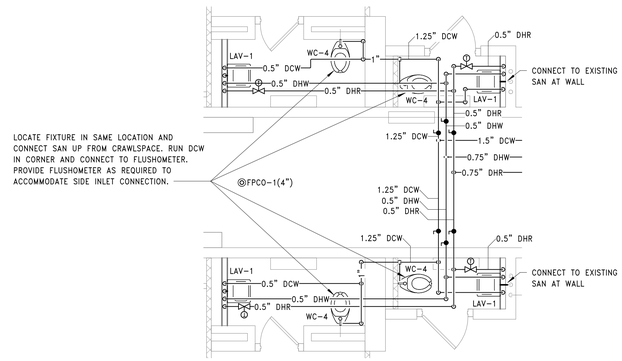


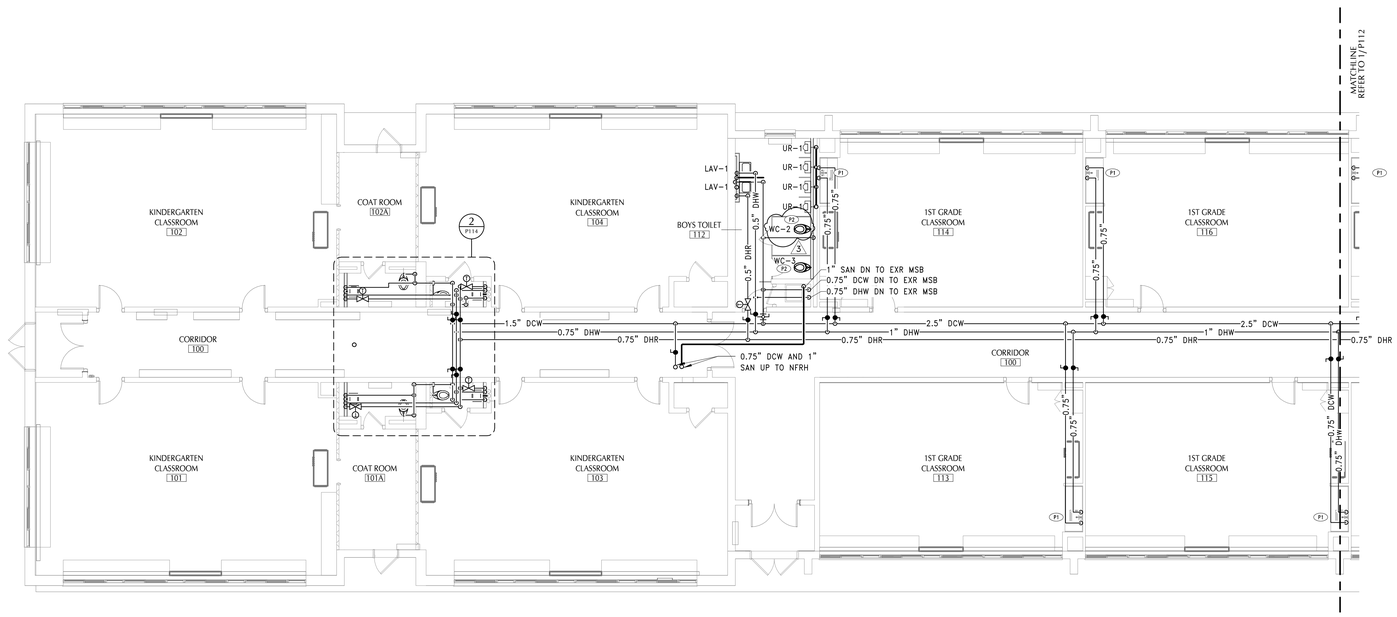
4 112 SANITARY RISER
P114



3 112 DOMESTIC RISER
P114



2 ENLARGED KINDERGARTEN BATHROOM PLAN
P114 1/4" = 1'-0"



1 FIRST FLOOR PLAN - AREA '4'
P114 1/8" = 1'-0"

KEY NOTES

P1	ROUTE DCW AND DWH DOWN THROUGH BOTTOM OF CABINET AND INTO COUNTERTOP AND CONNECT TO EXISTING SINK. PROVIDE INDIRECT DRAIN UP FROM TAIL PIECE OF EXISTING SINK (SIMILAR TO DETAIL 6/P601) AND TERMINATE ABOVE COUNTERTOP. PROVIDE REMOVABLE BREAKMETAL CHASE AROUND ALL PIPING.
P2	CONNECT TO SANITARY AT FLOOR IN SAME LOCATION.

KEY PLAN

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PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

ZACHARY ROBERT ALLISON
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097797
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Sheet Title
FIRST FLOOR PLAN - AREA '4'

Sheet No.
PES
P114

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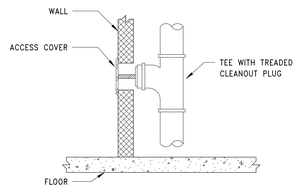
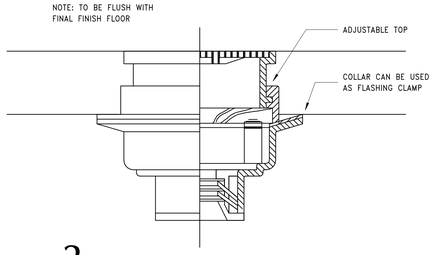
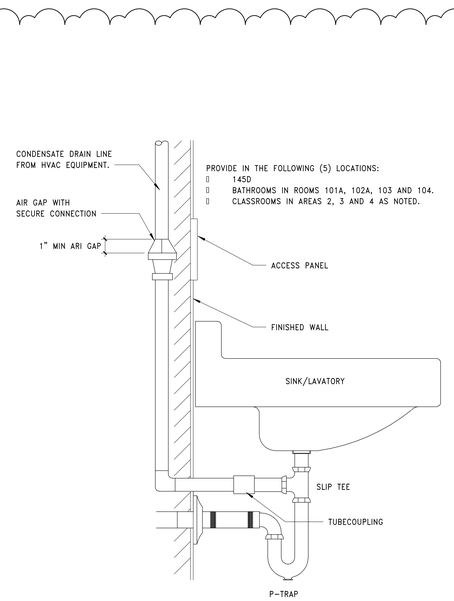


NOTES:
PROVIDE WALL CLEANOUT AT THE BASE OF EACH RISER.

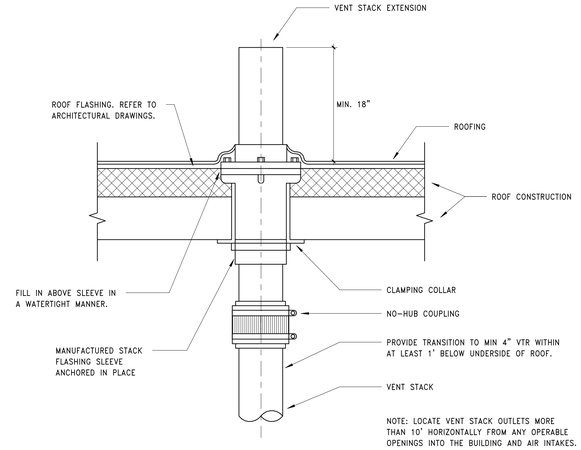
4 WALL CLEANOUT
P601 NTS



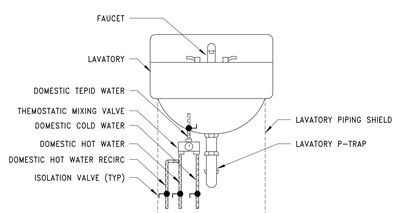
3 FLOOR DRAIN WITH ADJUSTABLE TOP
P601 NTS



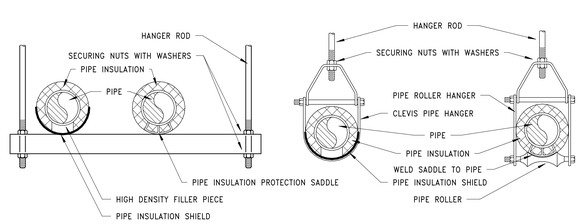
6 CONDENSATE PIPING AT SINK DETAIL
P601 NTS



2 VENT THRU ROOF
P601 NTS



5 LAVATORY PIPING SCHEMATIC
P601 1/4" = 1'-0"



1 DETAIL - PIPE HANGERS
P601 NTS

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Sheet Title
DETAILS

Sheet No.
PES
P601

CONSTRUCTION DOCUMENTS

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PLUMBING SPECIALTIES SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	MODEL
	WALL HYDRANT	ZURN	Z1330XL
FD-1	FLOOR DRAIN	ZURN	ZS415BS
FPCO-1	FLOOR CLEAN OUT	ZURN	Z1400
FS-1	FLOOR SINK	ZURN	Z1750-Z
NFRH-1	NON-FREEZE ROOF HYDRANT	ZURN	Z1388XL
WCO-1	WALL CLEAN OUT	ZURN	Z1441

GREASE INTERCEPTOR SCHEDULE

TAG	TYPE	GPM	TOTAL VOLUME GALLONS	GREASE CAPACITY LBS	INLET in.	OUTLET in.	MANUFACTURER	MODEL	NOTES
GI-A	PDI	50	50	100	3	3	ZURN	Z1170	

PLUMBING FIXTURE SCHEDULE

TAG	DESCRIPTION	MATERIAL	MOUNTING	FAUCET / FLUSHOMETER	GPM/GPF	RUN OUT SIZES			MANUFACTURER	MODEL
						COLD WATER	HOT WATER	WASTE		
EW-1	EYEWASH	Stainless Steel, Polished	WALL	N/A	3.5	1"	1"	2"	GUARDIAN	GBF1724
LAV-1	LAVATORY	Vitreous China	WALL	BATTERY - FAUCET	0.5	0.5"	0.5"	1.5"	ZURN	Z5340
SK-1	SINK - 22"x19.5x6"	Stainless Steel, Polished	COUNTER TOP	MANUAL - FAUCET	1.5	0.75"	0.75"	2"	ELKAY	LRAD2219
UR-1	URINAL	Vitreous China	WALL	BATTERY - FLUSH VALVE	0.125	0.75"		2"	ZURN	Z5755
WC-1	WATER CLOSET	Vitreous China	WALL	BATTERY - FLUSH VALVE	1.28	1"		4"	ZURN	Z5615
WC-2	WATER CLOSET	Vitreous China	FLOOR	BATTERY - FLUSH VALVE	1.28	1"		4"	ZURN	Z5665
WC-3	WATER CLOSET	Vitreous China	FLOOR	BATTERY - FLUSH VALVE	1.28	1"		4"	ZURN	Z5654
WC-4	WATER CLOSET	Vitreous China	FLOOR	BATTERY - FLUSH VALVE	1.28	1"		4"	ZURN	Z5675

3

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Project Title
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2020 CAPITAL PROJECT - PHASE 3

STATE OF NEW YORK · ZACHARY ROBERT WALDRON · LICENSED PROFESSIONAL ENGINEER · 097797
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Sheet Title
SCHEDULES

Sheet No.
PES
P901

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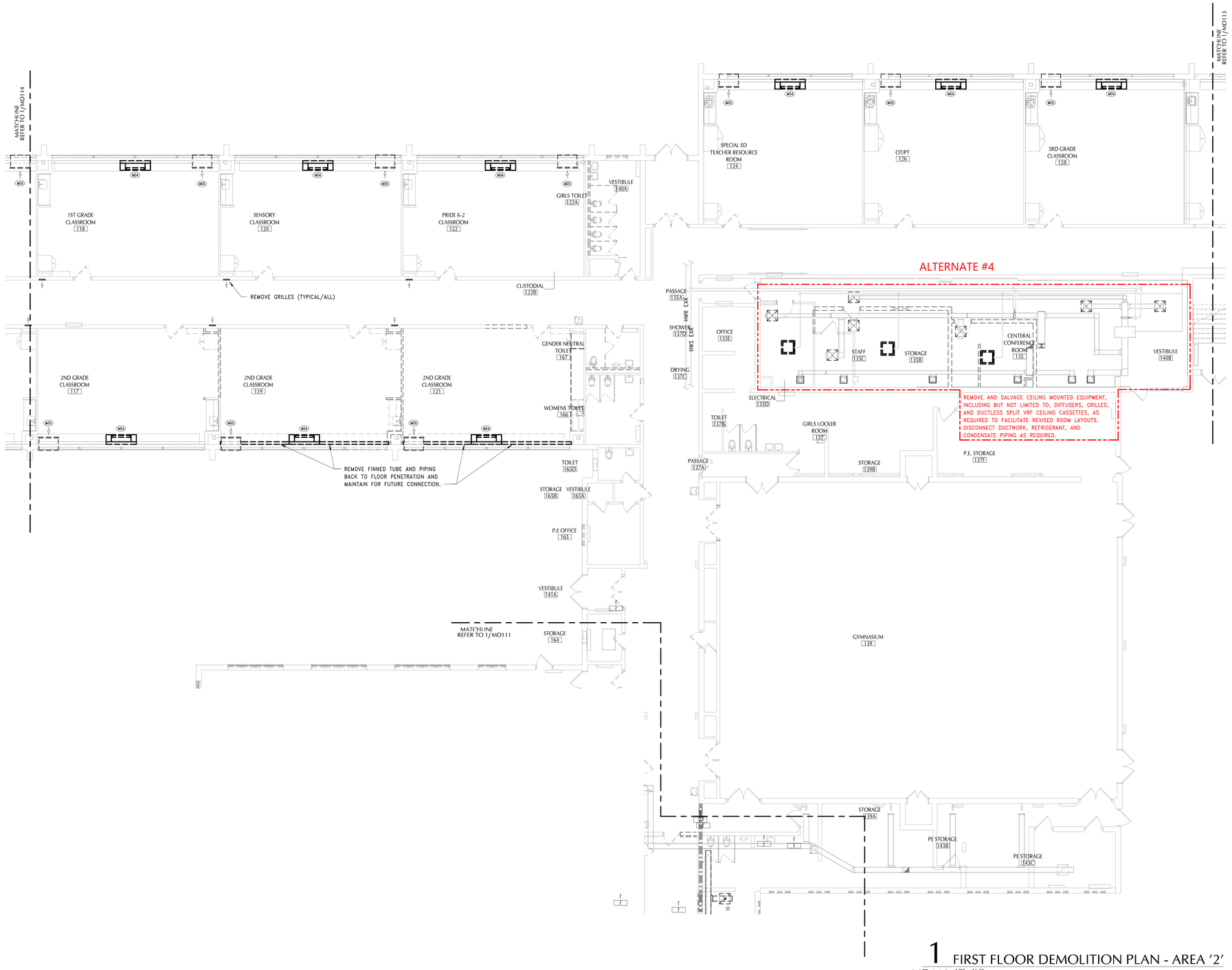
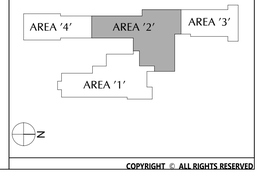


1 FIRST FLOOR DEMOLITION PLAN - AREA '2'
MD112 1/8" = 1'-0"

KEY NOTES

MD4	REMOVE UNIT VENTILATOR, ASSOCIATED PIPING, TRIM, CONTROLS (PER DETAILS OR AS OTHERWISE NECESSARY) TO FACILITATE THE RECONNECTION OF THE EXR FINNED TUBE.
3 MD5	REMOVE AND RE-USE GRILLE, MOTORIZED DAMPER AND DUCTWORK.

KEY PLAN



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2020 CAPITAL PROJECT - PHASE 3

Project Title

STATE OF NEW YORK
ZACHARY ROBERT NELSON DRIMMER
LICENSED PROFESSIONAL ENGINEER
097797
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Sheet Title
FIRST FLOOR DEMOLITION PLAN - AREA '2'

Sheet No.
PES MD112

CONSTRUCTION DOCUMENTS

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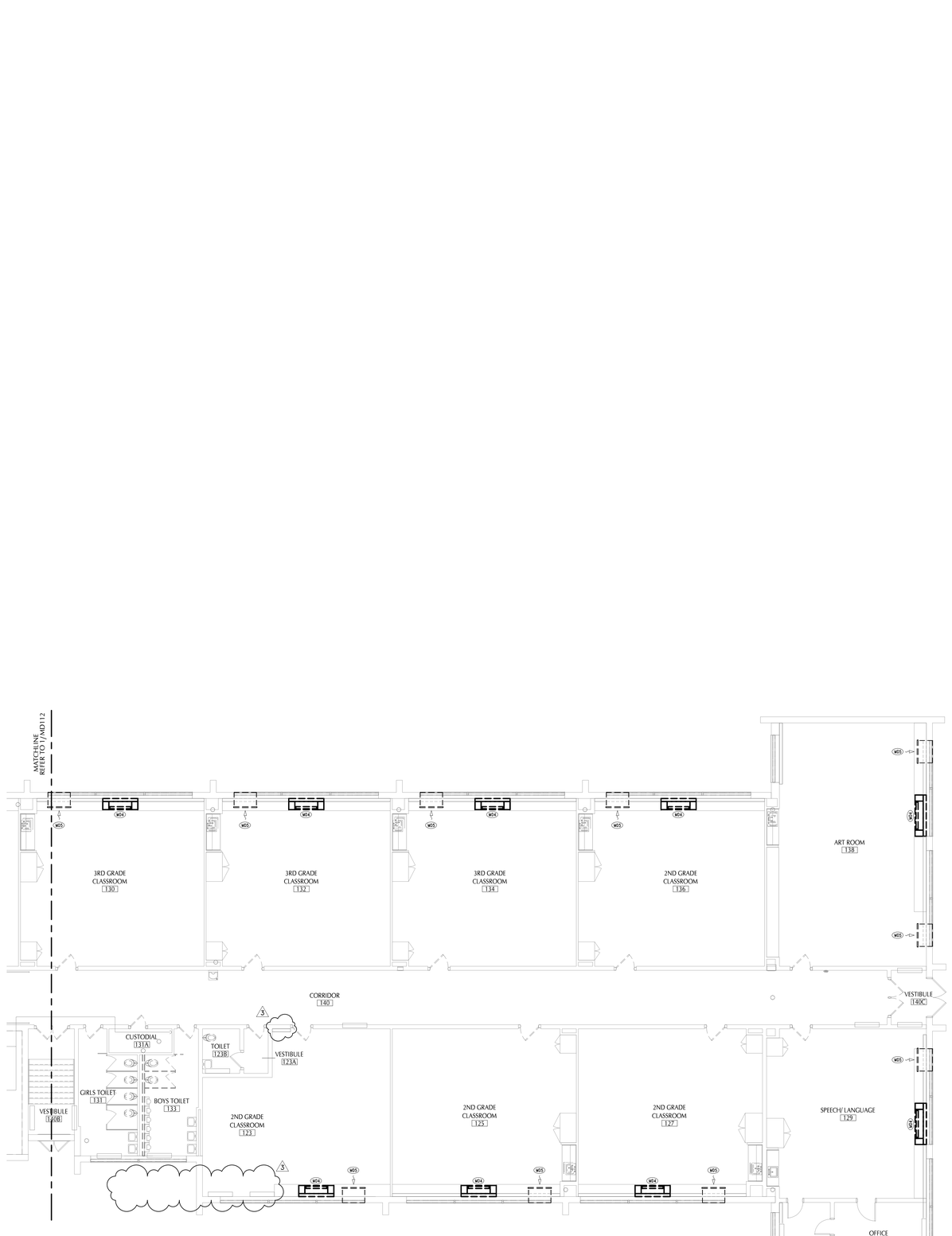
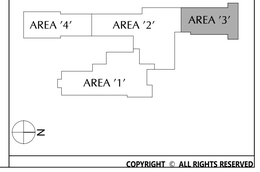
KEY NOTES

3	MD4	REMOVE UNIT VENTILATOR, ASSOCIATED PIPING, TRIM, CONTROLS (PER DETAILS OR AS OTHERWISE NECESSARY) TO FACILITATE THE RECONNECTION OF THE EXR FINNED TUBE.
	MD5	REMOVE AA/AS RELIEF GRILLE, MOTORIZED DAMPER AND DUCTWORK.



1 FIRST FLOOR DEMOLITION PLAN - AREA '3'
MD113 1/8" = 1'-0"

KEY PLAN



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2020 CAPITAL PROJECT - PHASE 3

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Sheet Title
FIRST FLOOR DEMOLITION PLAN - AREA '3'

Sheet No.
PES
MD113

CONSTRUCTION DOCUMENTS

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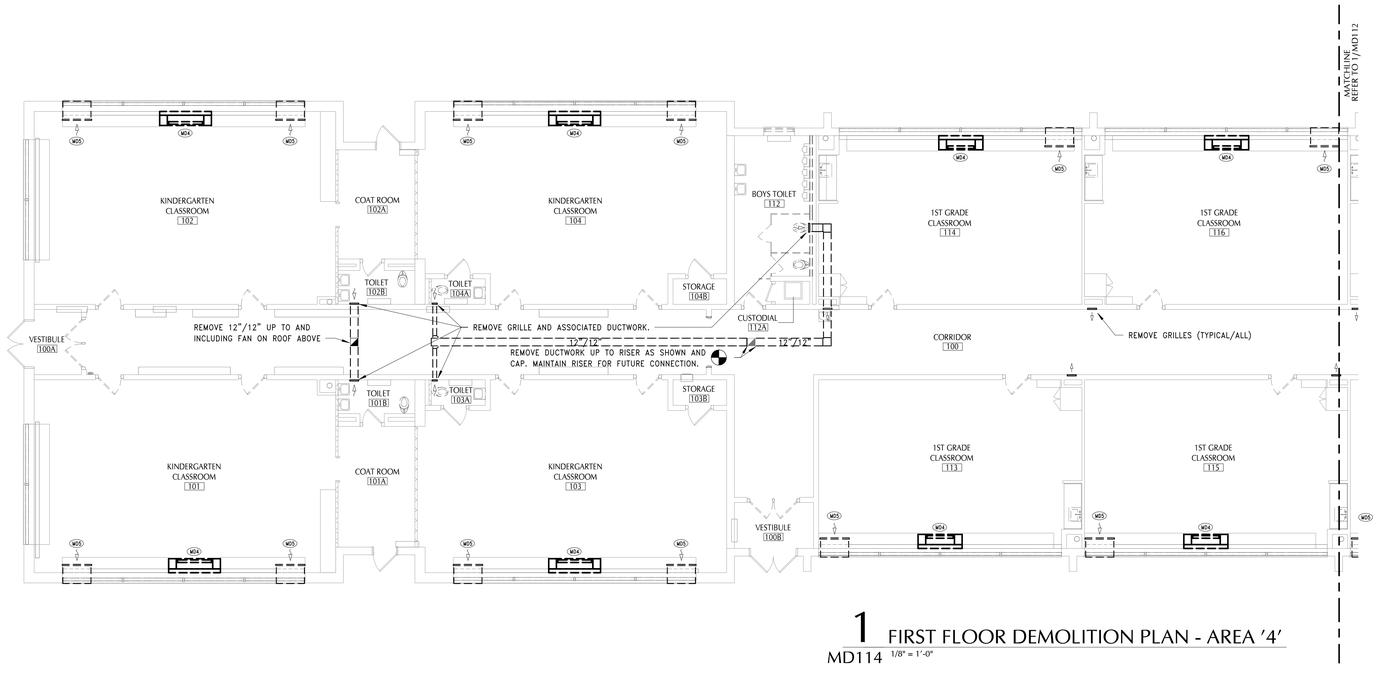
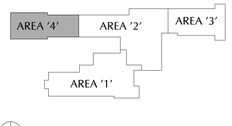
KEY NOTES

	MD4	REMOVE UNIT VENTILATOR, ASSOCIATED PIPING, TRIM, CONTROLS (PER DETAILS OR AS OTHERWISE NECESSARY) TO FACILITATE THE RECONNECTION OF THE EXR FINNED TUBE.
3	MD5	REMOVE 44"x6 RETURN GRILLE, MOTORIZED DAMPER AND DUCTWORK.



1 FIRST FLOOR DEMOLITION PLAN - AREA '4'
MD114 1/8" = 1'-0"

KEY PLAN



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Sheet Title
FIRST FLOOR DEMOLITION PLAN - AREA '4'

Sheet No.
PES
MD114

CONSTRUCTION DOCUMENTS

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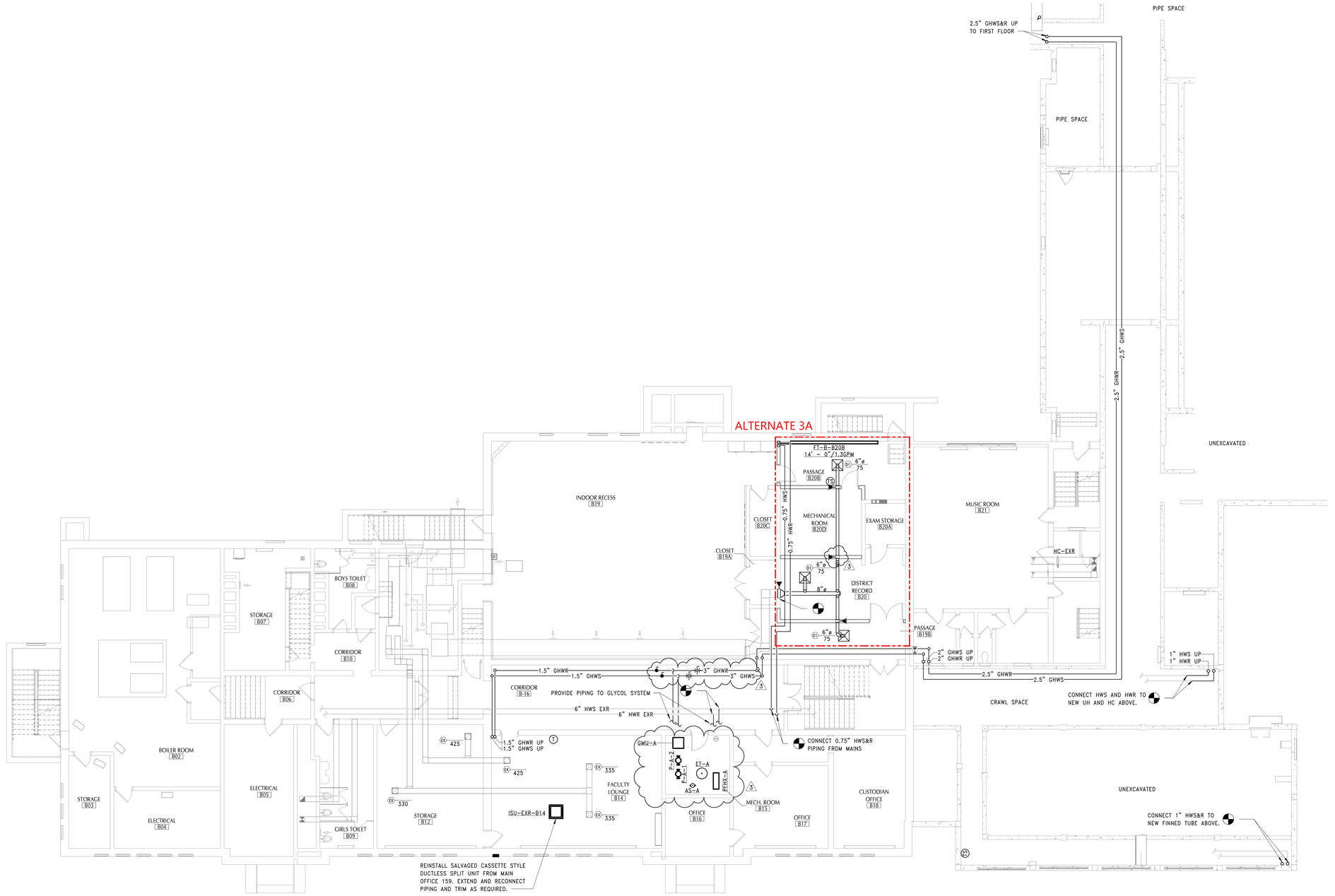
SHEET NOTES

KEY NOTES



1 GROUND FLOOR PLAN - AREA '1'
M101 1/8" = 1'-0"

KEY PLAN

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ZACHARY ROBERT WILSON
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LICENSED PROFESSIONAL ENGINEER
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Sheet Title
GROUND FLOOR PLAN - AREA '1'

Sheet No.
PES
M101

CONSTRUCTION DOCUMENTS

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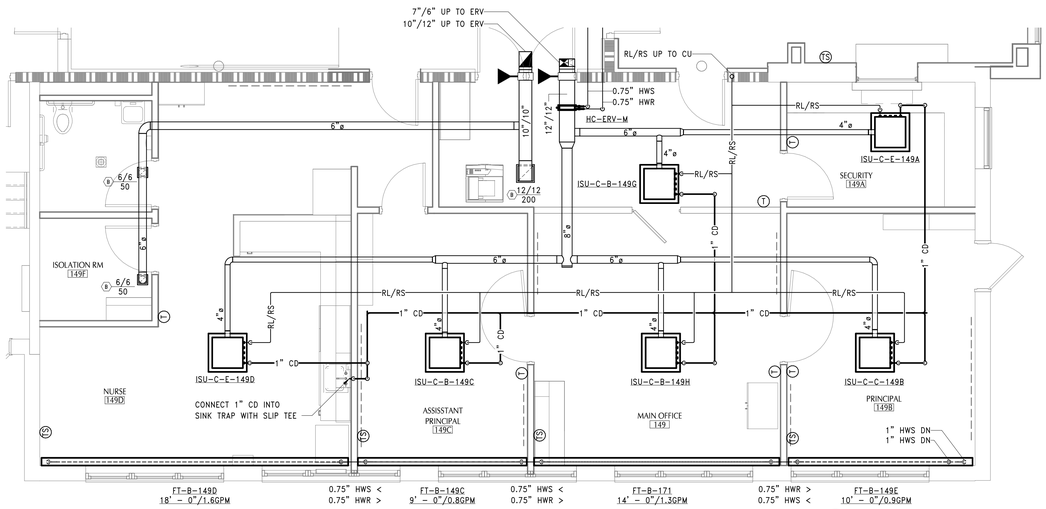
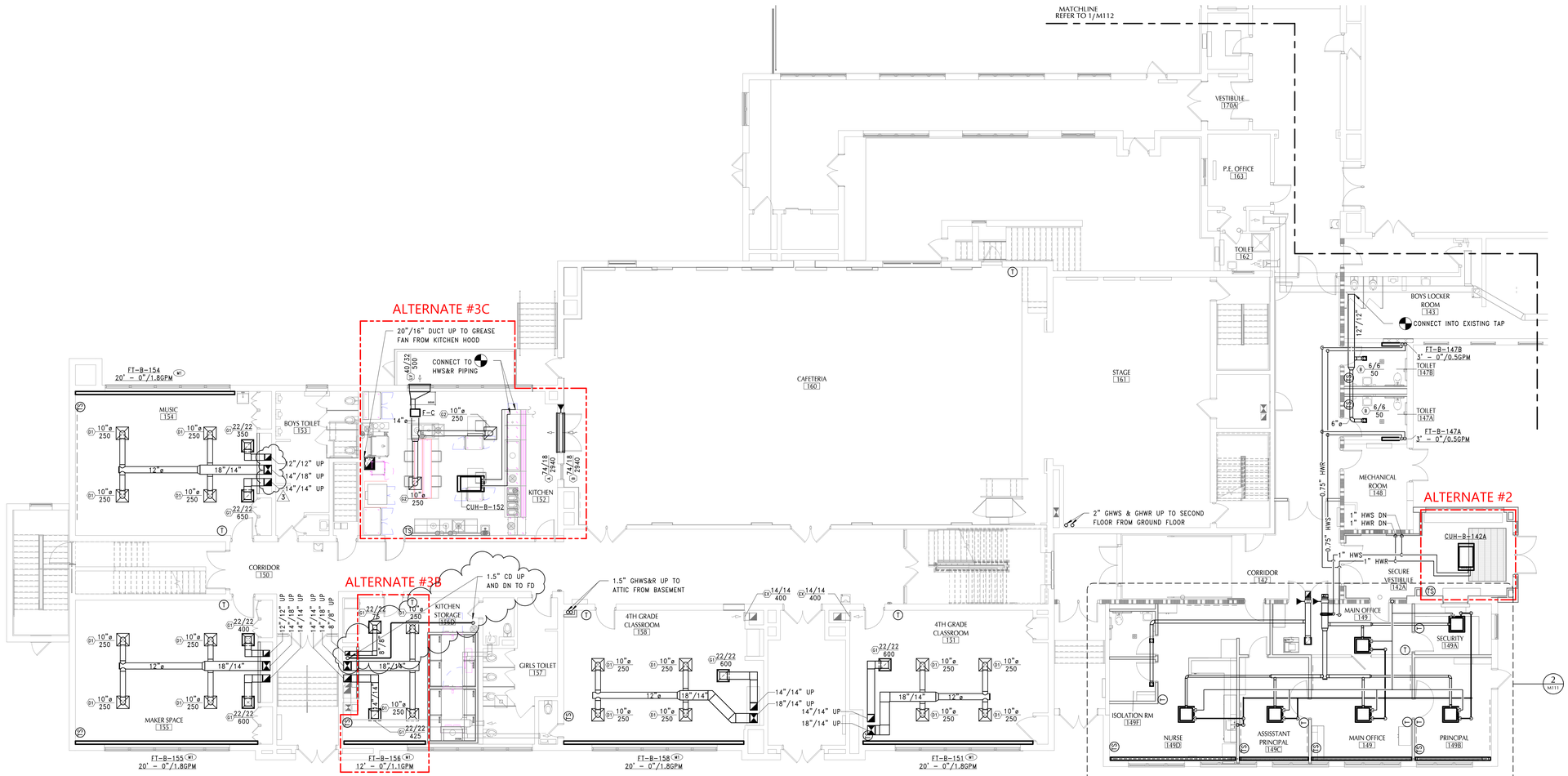


2 ENLARGED FLOOR PLAN
M111 1/4" = 1'-0"



1 FIRST FLOOR PLAN - AREA '1'
M111 1/8" = 1'-0"

SHEET NOTES

ALTERNATE 2:
- ACCEPTED: PROVIDE SCOPE AS SHOWN WITHIN BOUNDARY.
- NOT ACCEPTED: PROVIDE SCOPE ASSOCIATED WITH CUH-B-142A INCLUDING BUT NOT LIMITED TO PIPING, LOCATE UNIT IN EXISTING VESTIBULE AND COORDINATE FINAL LOCATION IN FIELD.

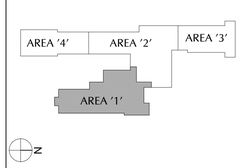
ALTERNATE 3B:
- ACCEPTED: PROVIDE SCOPE AS SHOWN WITHIN BOUNDARY.
- NOT ACCEPTED: PROVIDE DUCTWORK AND DIFFUSER SCOPE SHOWN WITHIN BOUNDARY AND COORDINATE WITH EXISTING NURSE'S SUITE LAYOUT, EXISTING FINNED TO REMAIN.

ALTERNATE 3C:
- ACCEPTED: PROVIDE SCOPE AS SHOWN WITHIN BOUNDARY.
- NOT ACCEPTED: PROVIDE SCOPE ASSOCIATED WITH F-C INCLUDING BUT NOT LIMITED TO DUCTWORK DIFFUSERS AND LOUVERS.

KEY NOTES

M1	PROVIDE FINNED TUBE IN SAME LOCATION AS EXISTING. CONNECT TO EXISTING PIPING.

KEY PLAN



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PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

STATE OF NEW YORK
ZACHARY ROBERT WILSON
097797
LICENSED PROFESSIONAL ENGINEER
Expires : 06/30/2025

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Sheet Title

FIRST FLOOR PLAN - AREA '1'

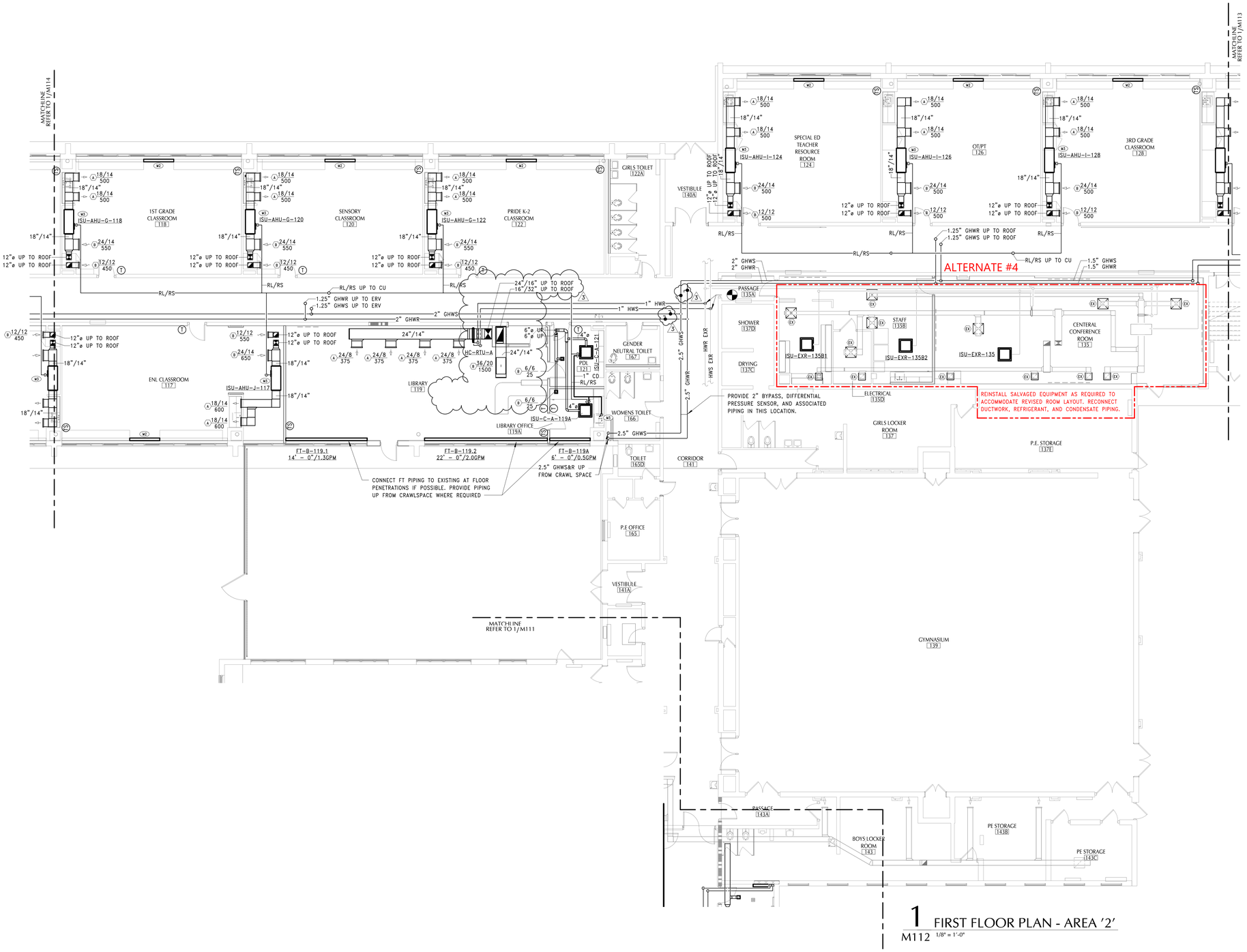
Sheet No.

PES
M111

CONSTRUCTION DOCUMENTS

KEY NOTES

3	M2	PROVIDE 16-GAUGE BRAKE-METAL ENCLOSURE, FIELD VERIFY DEPTH AND MATCH EXISTING COUNTER HEIGHT. PROVIDE PIPING, TRIM, CONTROLS (PER DETAILS, OR AS OTHERWISE NECESSARY) TO FACILITATE THE RECONNECTION OF THE EXR FINNED TUBE.
	M3	1 INCH SD TO INDIRECT CONNECTION LOCATED WITHIN PIPE ENCLOSURE.



1 FIRST FLOOR PLAN - AREA '2'
M112 1/8" = 1'-0"

KEY PLAN

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Sheet Title
FIRST FLOOR PLAN - AREA '2'

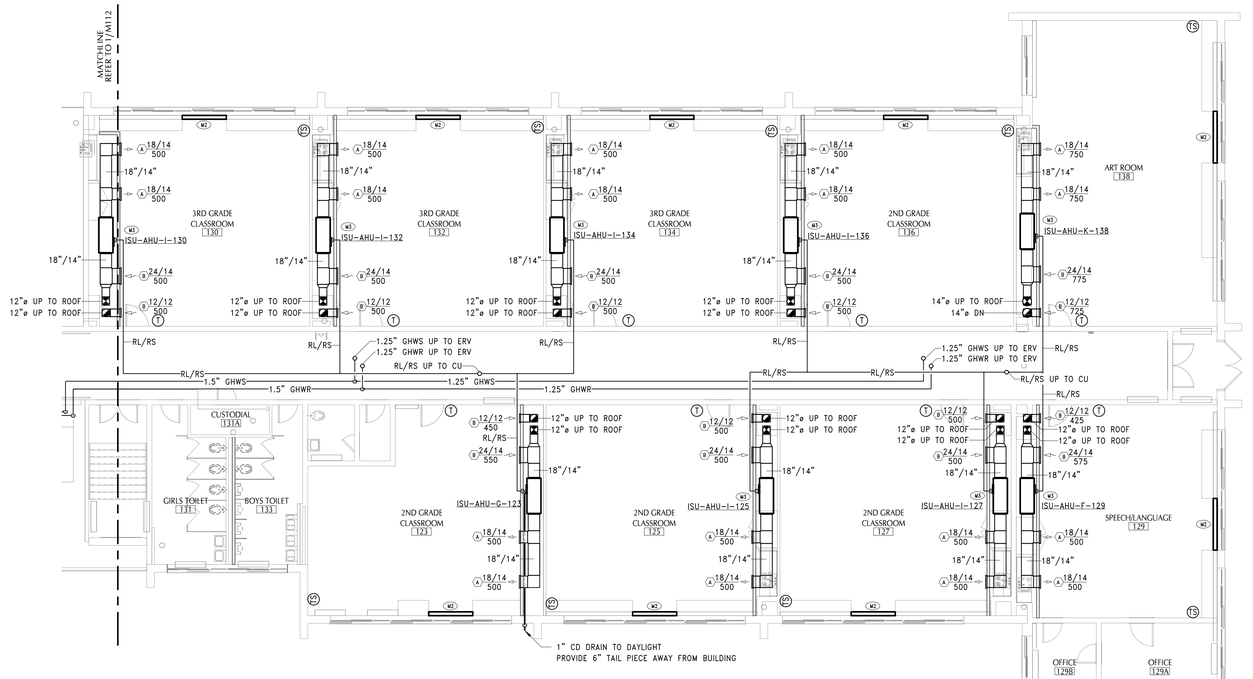
Sheet No.
PES M112

CONSTRUCTION DOCUMENTS

C:\Users\cjslabbert\Documents\208-2101_PCSD_ES_MEP_cjslabbert.rvt

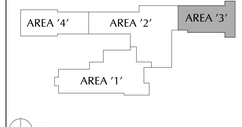
KEY NOTES

3	M2	PROVIDE 16-GAUGE BRAKE-METAL ENCLOSURE, FIELD VERIFY DEPTH AND MATCH EXISTING COUNTER HEIGHT. PROVIDE PIPING, TRIM, CONTROLS (PER DETAILS, OR AS OTHERWISE NECESSARY) TO FACILITATE THE RECONNECTION OF THE EXR FINNED TUBE.
	M3	1" INCH SD TO INDIRECT CONNECTION LOCATED WITHIN PIPE ENCLOSURE.



1 FIRST FLOOR PLAN - AREA '3'
M113 1/8" = 1'-0"

KEY PLAN



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Sheet Title
FIRST FLOOR PLAN - AREA '3'

Sheet No.
PES
M113

CONSTRUCTION DOCUMENTS

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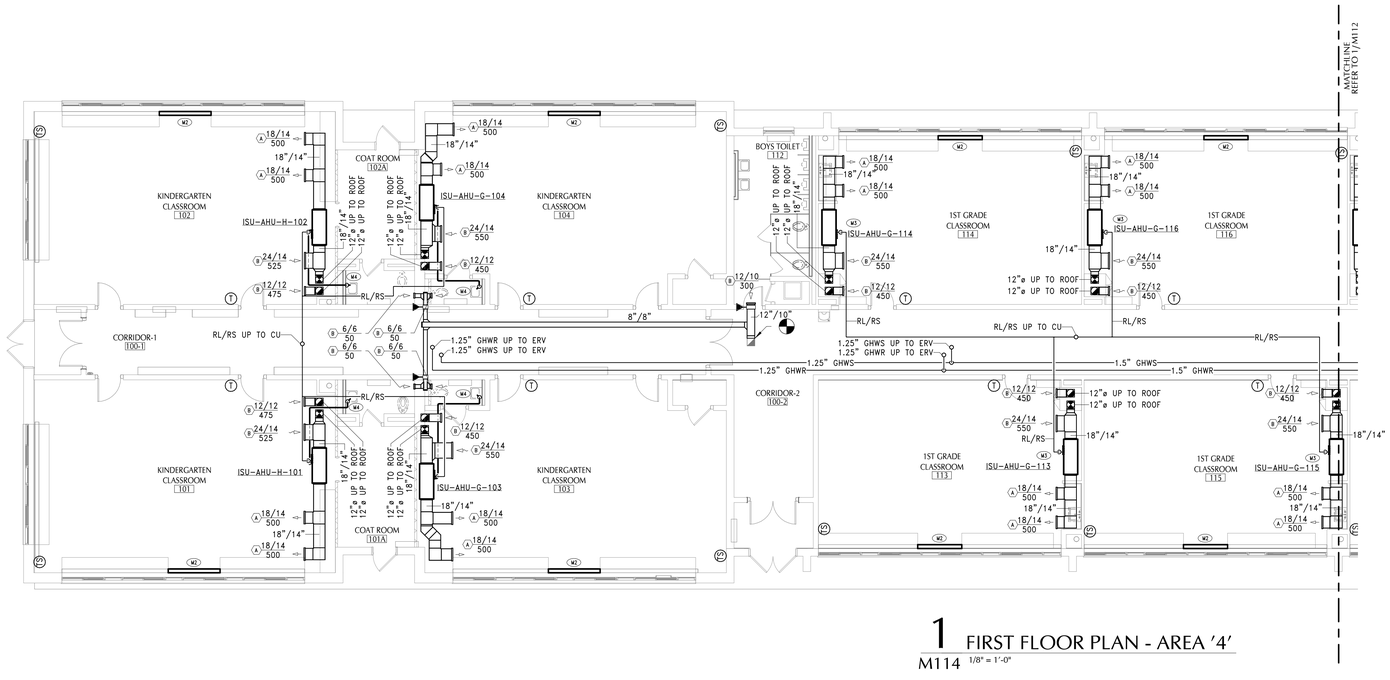
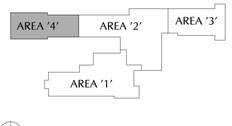
KEY NOTES

M2	PROVIDE 16-GAUGE BRAKE-METAL ENCLOSURE, FIELD VERIFY DEPTH AND MATCH EXISTING COUNTER HEIGHT. PROVIDE PIPING, TRIM, CONTROLS (PER DETAILS, OR AS OTHERWISE NECESSARY) TO FACILITATE THE RECONNECTION OF THE EXR FINNED TUBE.
M3	1-INCH CD TO INDIRECT CONNECTION LOCATED WITHIN PIPE ENCLOSURE.
M4	1-INCH CD DRAIN TO SINK.



1 FIRST FLOOR PLAN - AREA '4'
M114 1/8" = 1'-0"

KEY PLAN



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Sheet Title
FIRST FLOOR PLAN - AREA '4'

Sheet No.
PES
M114

CONSTRUCTION DOCUMENTS

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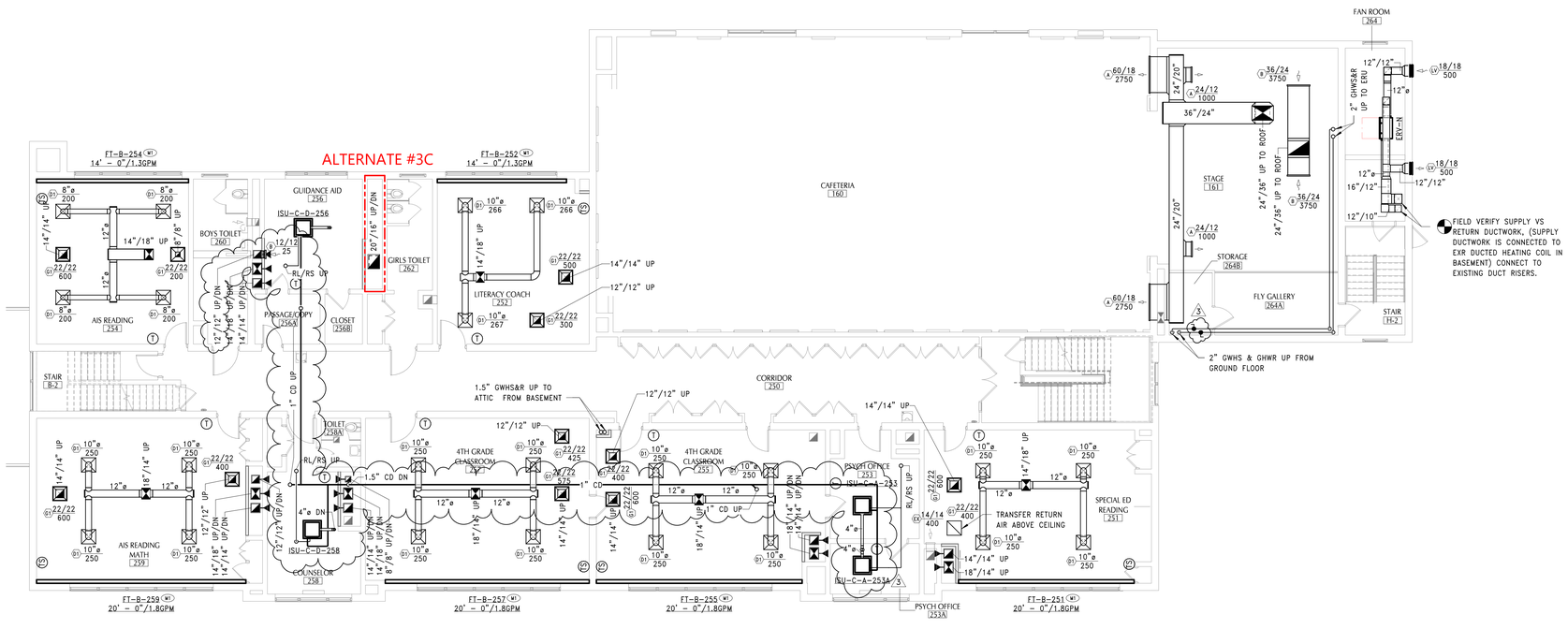
SHEET NOTES

1. FIRE DAMPERS LOCATED AT FLOOR LEVEL FOR MAINTENANCE ACCESS. (TYPICAL /ALL)

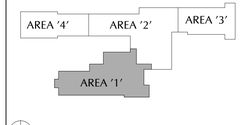
KEY NOTES

M1	PROVIDE FINNED TUBE IN SAME LOCATION AS EXISTING. CONNECT TO EXISTING PIPING.



1 SECOND FLOOR PLAN - AREA '1'
M121 1/8" = 1'-0"

KEY PLAN



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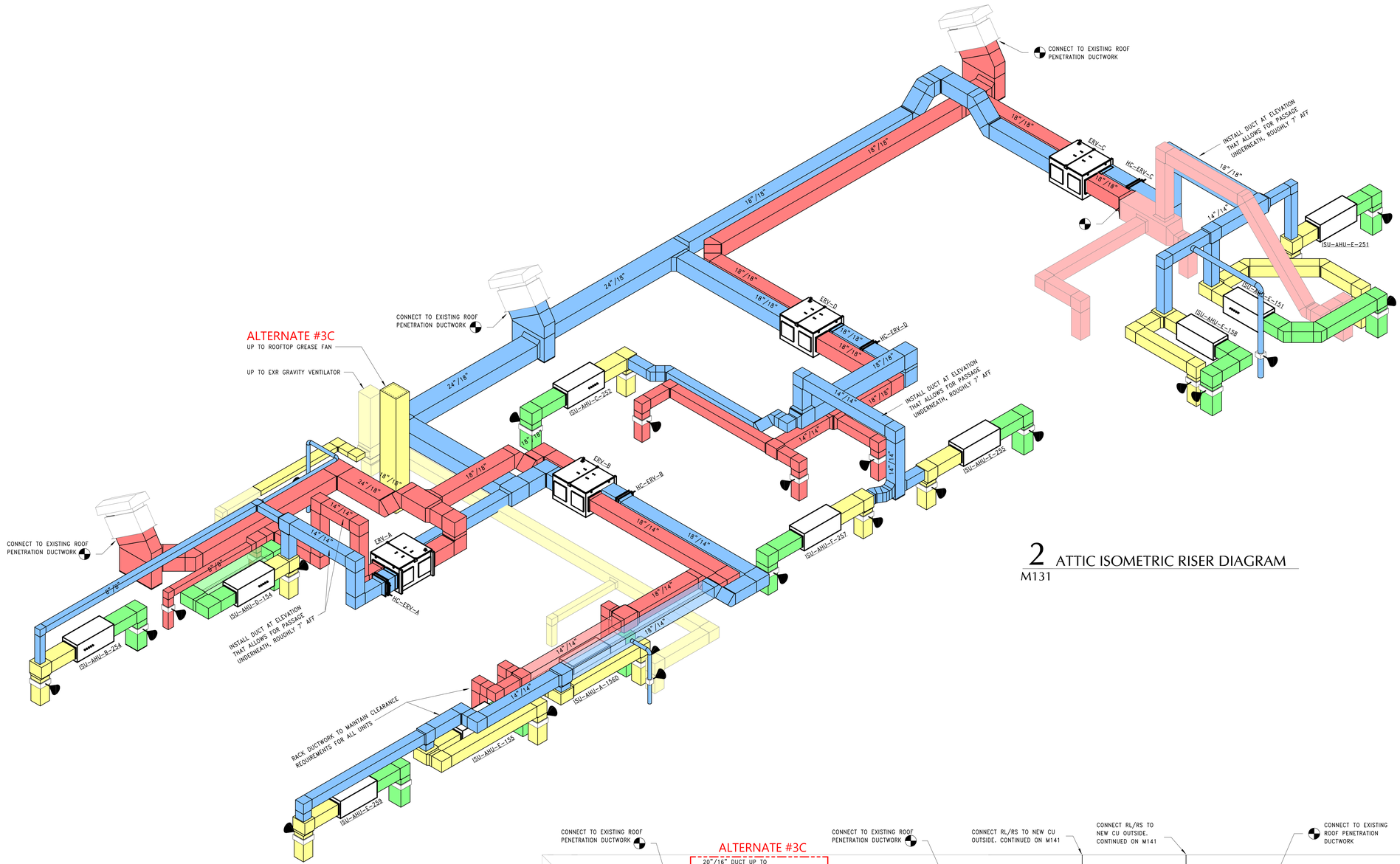
SECOND FLOOR PLAN - AREA '1'

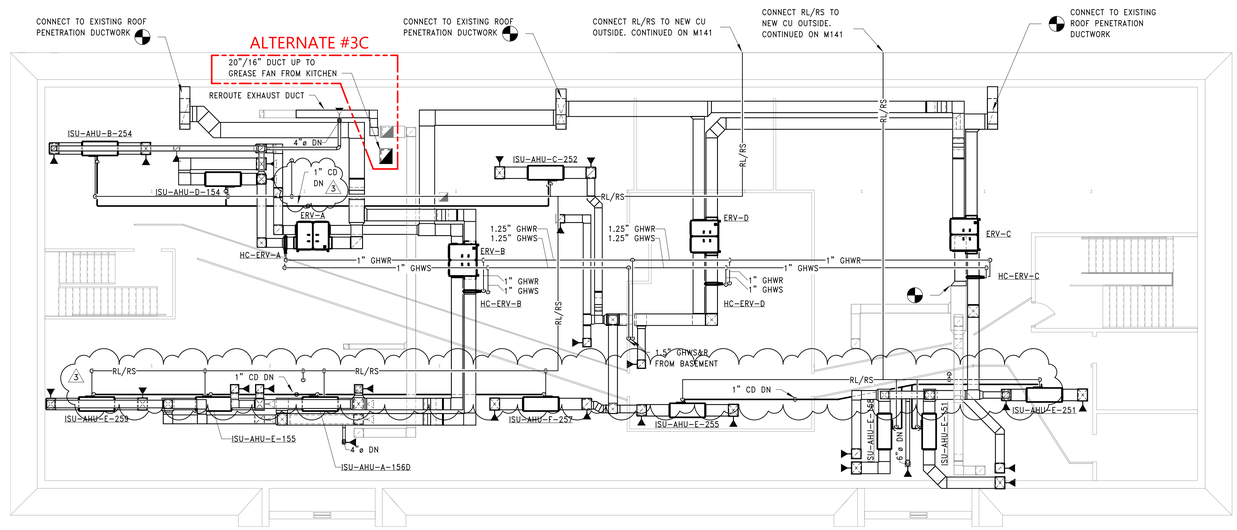
Sheet No.

PES M121

CONSTRUCTION DOCUMENTS



2 ATTIC ISOMETRIC RISER DIAGRAM
M131



1 ATTIC PLAN - AREA '1'
M131 1/8" = 1'-0"

SHEET NOTES

1. FIRE DAMPERS LOCATED AT FLOOR LEVEL FOR MAINTENANCE ACCESS. (TYPICAL /ALL)
2. SUPPORT ALL UNITS AND DUCTWORK LOCATED IN ATTIC 1'-0" MIN. ABOVE ATTIC FLOOR. SUPPORT ALL EQUIPMENT ON VIBRATION ISOLATION STANDS/ CURBS.
3. ISU-AHU SUPPLY AND RETURN DUCT CONNECTIONS ARE 18"/14".
4. SUPPLY AIR DROPS ARE ALL 18"/14".
5. RETURN AIR DROPS ARE ALL 14"/14".
6. FINAL OUTDOOR AIR CONNECTIONS TO ISU RETURN DUCTWORK IS 12"/12" UNLESS OTHERWISE NOTED.
7. EXHAUST AIR DROPS ARE 12"/12" UNLESS OTHERWISE NOTED.

KEY NOTES

KEY PLAN

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Sheet Title
ATTIC PLAN - AREA '1'

Sheet No.
PES
M131

CONSTRUCTION DOCUMENTS

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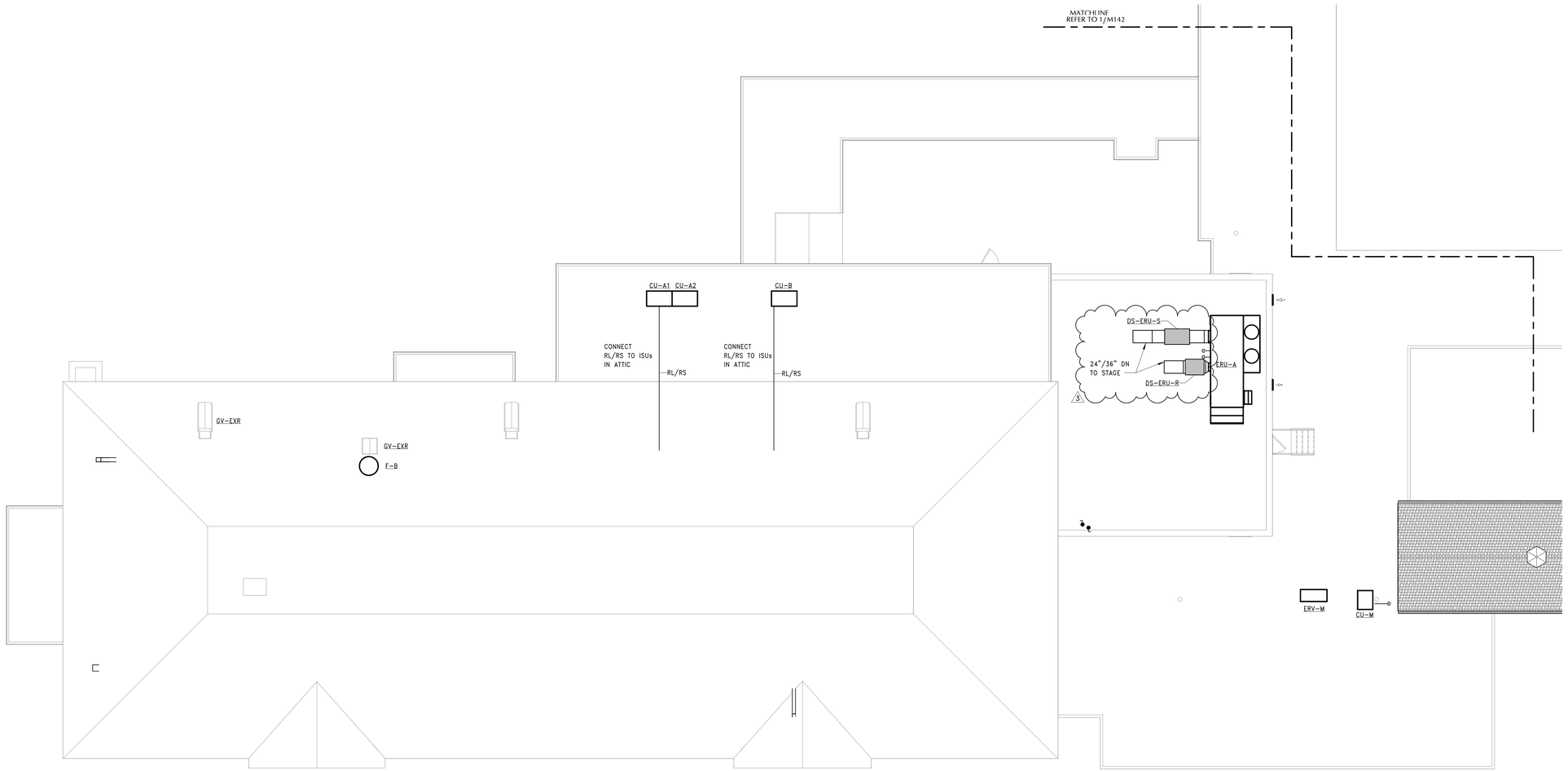
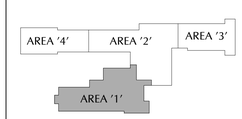


1 ROOF PLAN - AREA '1'
M141 1/8" = 1'-0"

KEY NOTES

KEY PLAN



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Sheet Title
ROOF PLAN - AREA '1'

Sheet No.
PES
M141

CONSTRUCTION DOCUMENTS

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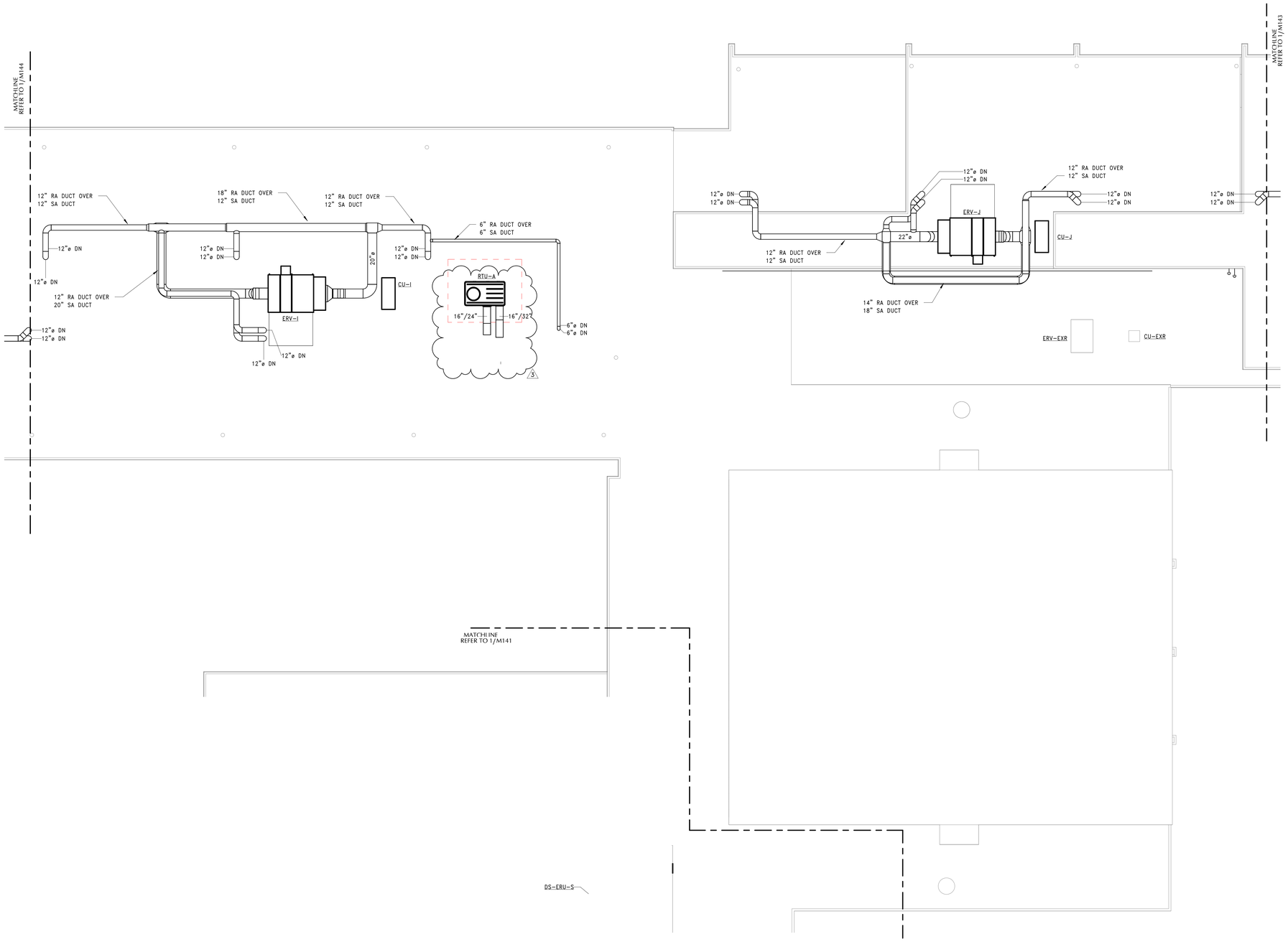

1 ROOF PLAN - AREA '2'
M142 1/8" = 1'-0"

KEY NOTES

KEY PLAN

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Sheet Title
ROOF PLAN - AREA '2'

Sheet No.
PES
M142

CONSTRUCTION DOCUMENTS

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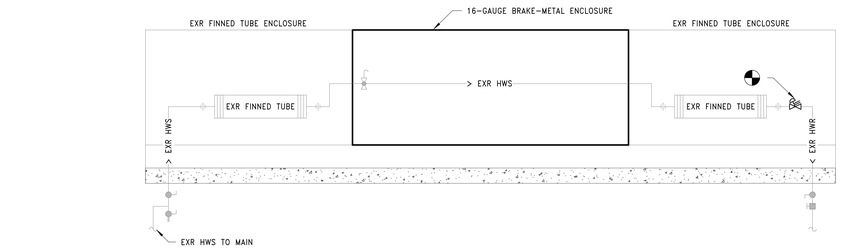
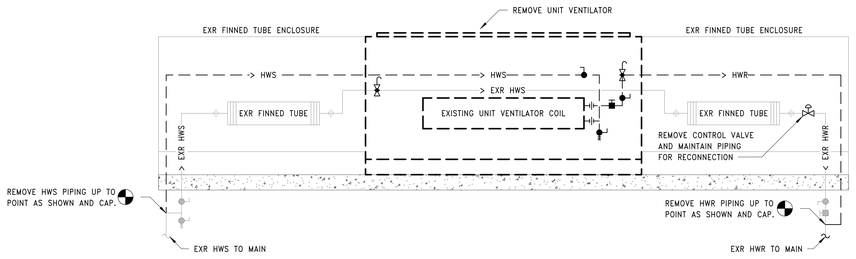
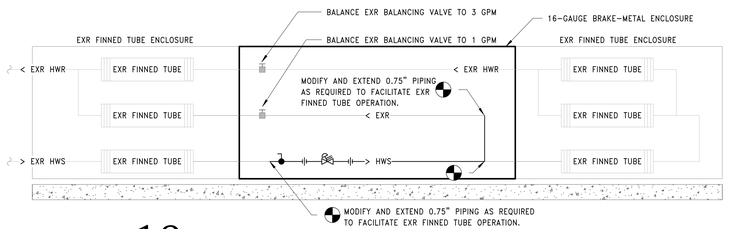


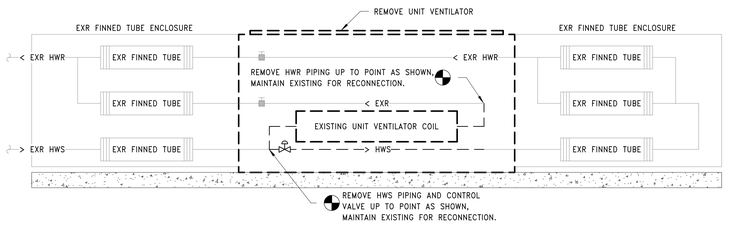
12 AREA '4' UNIT VENTILATOR AND FINNED TUBE PIPING
M601 NTS



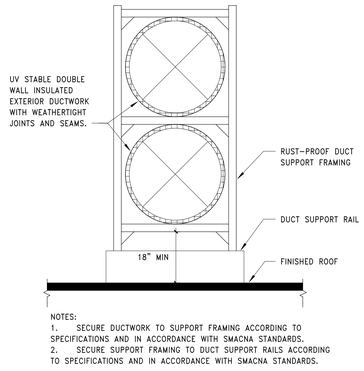
11 AREA '4' UNIT VENTILATOR AND FINNED TUBE DEMOLITION
M601 NTS



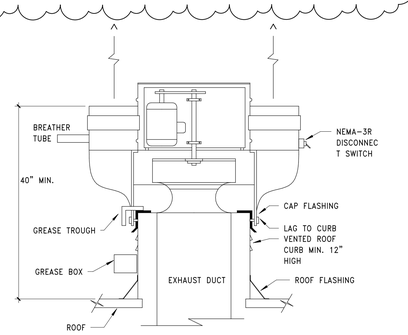
10 AREA '2' & '3' UNIT VENTILATOR AND FINNED TUBE PIPING
M601 NTS



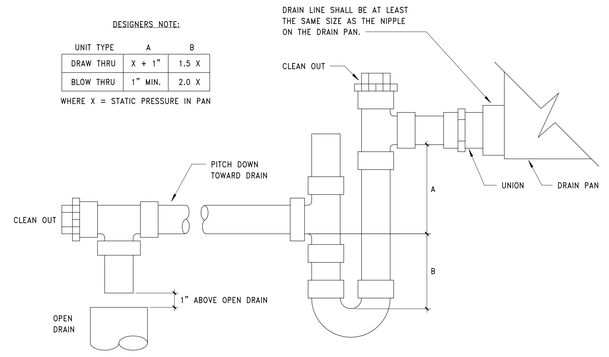
9 AREA '2' & '3' UNIT VENTILATOR AND FINNED TUBE DEMOLITION
M601 NTS



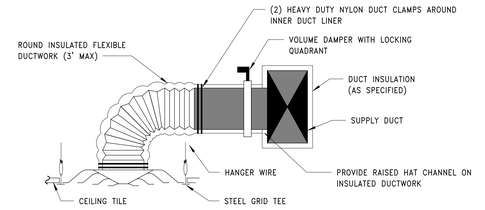
8 ROOFTOP DUCT SUPPORT DETAIL
M601 NTS



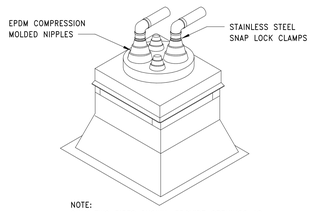
7 GREASE FAN
M601 1/4" = 1'-0"



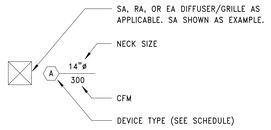
4 CONDENSATE PIPING
M601 NTS



3 DIFFUSER CONNECTION
M601 NTS

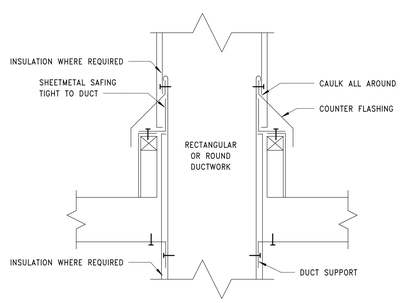


6 PIPE PORTAL
M601 NTS

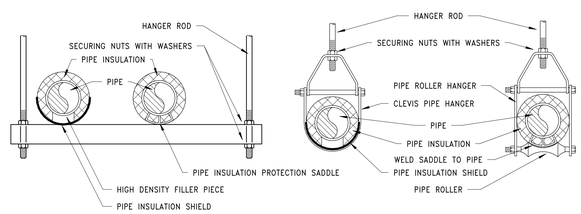


NOTES:
1. ALL INTERNAL PARTS WHICH MAY BE EXPOSED TO VIEW SHALL HAVE A FLAT BLACK FINISH.
2. DELETE OPPOSED-BLADE DAMPERS AT DEVICES MOUNTED AT FIRE DAMPERS.
3. TRANSITION FROM DUCT SIZE TO NECK SIZE AS REQUIRED.
4. ALL DIFFUSERS, REGISTERS AND GRILLES ARE POWDER COATED WHITE UNLESS OTHERWISE SPECIFIED.
5. PROVIDE BALANCING DAMPERS IN DUCT AT ALL DIFFUSERS/GRILLES REQUIRING BALANCED CFM VALUE. WHERE SPECIFIED AS SUCH, INTEGRAL DIFFUSER/GRILLE DAMPERS SHALL BE PROVIDED.

2 DIFFUSER/GRILLE TAG
M601 NTS



5 DUCT PENETRATION THROUGH ROOF
M601 NTS



1 PIPE HANGERS
M601 NTS

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Project Title

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ZACHARY ROBERT WESSON
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Sheet Title

DETAILS

Sheet No.

PES
M601

CONSTRUCTION DOCUMENTS

AIR SEPARATOR SCHEDULE

TAG	GPM	MANUFACTURER	MODEL
AS-A	110	SPIROTHERM	VDN300

EXPANSION TANK SCHEDULE

TAG	TYPE	ACCEPTANCE (GAL)	VOLUME (GAL)	DIAMETER / HEIGHT	SYSTEM FILL (PSIG)	RELIEF VALVE (PSIG)	MANUFACTURER	MODEL	NOTES
ET-A	DIAPHRAGM	53	53	24/38	50	75	AMTROL	200-L	1, 2

NOTES:
1. ASME PRESSURE VESSEL.
2. 40% GLYCOL SYSTEM.

GLYCOL MANAGEMENT SYSTEM SCHEDULE

TAG	LOCATION	VOLUME (GAL)	TYPE	SYSTEM FILL (PSIG)	RELIEF VALVE (PSIG)	MOTOR HP	VOLTAGE	PHASE	DISCONNECT SWITCH	MANUFACTURER	MODEL	NOTES
GMU-A	MAIL ROOM	50	40% PROPYLENE GLYCOL	50	75	1/2	120	1	FIELD PROVIDED	J.L. WINGERT CO.	GL50-E2-2-B-C-HC-HTM	1,2

NOTES:
1. PROVIDE WITH CONTACTS FOR REMOTE INDICATION OF HIGH/LOW LEVELS AND PUMP STATUS.
2. PROVIDE WITH HAND-OFF-AUTO SWITCHES.

PLATE & FRAME HEAT EXCHANGER SCHEDULE

			SOURCE SIDE						LOAD SIDE									
TAG	SERVICE	MBH	FLUID	GPM	EFT (F)	LFT (F)	FPD (FT)	FLUID	GPM	EFT (F)	LFT (F)	FPD (FT)	NOMINAL DIMENSIONS (IN)	NO. OF PLATES	DESIGN BASIS	MODEL	NOTES
PFHX-A	GHW	1650	WATER	104.7	160	130	11.0	40% PG	110	125	155	14.3	51.1x12.6x35.4	119	ALFA LAVAL	AQ2L-FG	

PUMP SCHEDULE

			PUMP DATA						ELECTRICAL DATA					
TAG	SERVICE	TYPE	GPM	PRESSURE (FT)	RPM	BHP	HP	MOTOR CONTROLLER	VOLTAGE	PHASE	FLA	DISCONNECT SWITCH	MANUFACTURER	MODEL
P-A-1	BUILDING HEATING GLYCOL	SPLIT-COUPLED INLINE	100	101	3500	4.02	7.5	FACTORY VFD	208	3	17.5	FIELD PROVIDED	TACO	SKS1506D
P-A-2	BUILDING HEATING GLYCOL	SPLIT-COUPLED INLINE	100	101	3500	4.02	7.5	FACTORY VFD	208	3	17.5	FIELD PROVIDED	TACO	SKS1506D

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CABINET UNIT HEATER SCHEDULE

	FAN DATA				HEATING COIL DATA							ELECTRICAL DATA						
TAG	CFM	ESP (In. Wg)	HP	MOTOR CONTROLLER	EAT (F)	LAT (F)	EFT (F)	LFT (F)	GPM	FPD (FT)	MBH	VOLTAGE	PHASE	MCA	MOCP	DISCONNECT SWITCH	MANUFACTURER	MODEL
CUH-B	600	0.05	0.089	INTEGRAL ECM	60	111.6	155	135	2.2	5.88	33.6	120	1	3.88	15	FIELD PROVIDED	TRANE	FFEB060

NOTES:
1. FINAL CONNECTIONS TO ALL CABINET UNIT HEATERS ARE 0.75" UNLESS NOTED OTHERWISE.

DIFFUSER & GRILLE SCHEDULE

TAG	SYSTEM TYPE	SHAPE	NOMINAL SIZE	MATERIAL	FINISH	MOUNTING	ACCESSORIES	MANUFACTURER	MODEL
A	SUPPLY GRILLE	RECTANGULAR	NECK SIZE + 2"	STEEL	WHITE POWDER COAT	SURFACE	–	TITUS	300RL
B	RETURN GRILLE	RECTANGULAR	NECK SIZE + 2"	STEEL	WHITE POWDER COAT	SURFACE	–	TITUS	350ZRL
D1	SUPPLY DIFFUSER	SQUARE	24"x24"	STEEL	WHITE POWDER COAT	CEILING	–	TITUS	OMNI
G1	RETURN GRILLE	SQUARE	24"x24"	STEEL	WHITE POWDER COAT	CEILING	–	TITUS	350ZRL
G2	RETURN GRILLE	SQUARE	24"x24"	STEEL	WHITE POWDER COAT	CEILING	–	TITUS	OMNI

DUCT SILENCER SCHEDULE

						DYNAMIC INSERTION LOSS (dB)								
TAG	CFM	SIZE (ENTERING-LEAVING)	LENGTH (FT)	FACE VELOCITY (FPM)	APD (in. WC)	63	125	250	500	1000	2000	4000	MANUFACTURER	MODEL
DS-ERU-R	7500	30"/36"-30"/36"	3	1350	0.13	4	4	9	18	27	28	23	VIBRO ACOUSTICS	EXRFL-MLV-F9
DS-ERU-S	7500	30"/36"-30"/36"	4	1350	0.18	5	6	11	22	33	34	29	VIBRO ACOUSTICS	EXRFL-MLV-F9

NOTES:
1. DUCT SILENCERS PROVIDED WITH 12" EXTENDED WIDTH.

5

FAN SCHEDULE

			FAN DATA						ELECTRICAL DATA					
TAG	SERVICE	TYPE	CFM	ESP (In. Wg)	RPM	BHP	HP	MOTOR CONTROLLER	VOLTAGE	PHASE	FLA	DISCONNECT SWITCH	MANUFACTURER	MODEL
F-B	KITCHEN HOOD	UPBLAST	2940	1	1119	0.86	2	INTEGRAL ECM	120	1	12.5	FIELD PROVIDED	GREENHECK	CUE-180-VG
F-C	VENTILATION EXHAUST	INLINE	500	0.5	1368	0.21	157W	INTEGRAL ECM	120	1	2.45	FIELD PROVIDED	GREENHECK	CSP-A510-VG

FIN TUBE SCHEDULE

	ELEMENT							ENCLOSURE				
TAG	PIPE DIAMETER (IN)	# OF ROWS	ELEMENT WIDTH (IN)	ELEMENT HEIGHT (IN)	EAT (F)	AVG. FLUID TEMP. (F)	BTU/FT	WIDTH (IN)	HEIGHT (IN)	DESCRIPTION	MANUFACTURER	MODEL
FT-B	0.75	2	4.25	4.25	70	145	1340	6	24	TOP OUTLET, STAMPED LOUVERS	STERLING	JVB-RD24

NOTES:
1. FINAL CONNECTIONS TO ALL FINNED TUBES ARE 0.75" UNLESS NOTED OTHERWISE.

AIR COOLED CONDENSING UNIT SCHEDULE

				ELECTRICAL DATA							
TAG	NOMINAL TONS	REFIGERANT	SEER/ IEER	VOLTAGE	PHASE	MCA	MOCP	DISCONNECT SWITCH	WEIGHT (LBS)	MANUFACTURER	MODEL	NOTES
CU-A1	10/20	R410A	24.2	208	3	40	60	FIELD PROVIDED	700	TRANE	TUHYE1203AN40A	1
CU-A2	10/20	R410A	24.2	208	3	40	60	FIELD PROVIDED	700	TRANE	TUHYE1203AN40A	1
CU-B	12	R410A	30.4	208	3	47	70	FIELD PROVIDED	700	TRANE	TUHYE1443AN40A	
CU-G	12	R410A	30.4	208	3	47	70	FIELD PROVIDED	700	TRANE	TUHYE1443AN40A	
CU-H	12	R410A	30.4	208	3	47	70	FIELD PROVIDED	700	TRANE	TUHYE1443AN40A	
CU-I	14	R410A	31.2	208	3	56	90	FIELD PROVIDED	800	TRANE	TUHYE1683AN40A	
CU-J	14	R410A	31.2	208	3	56	90	FIELD PROVIDED	800	TRANE	TUHYE1683AN40A	
CU-K	12	R410A	30.4	208	3	47	70	FIELD PROVIDED	700	TRANE	TUHYE1443AN40A	
CU-L1	8/16	R410A	32.6	208	3	31	45	FIELD PROVIDED	700	TRANE	TUHYE0963AN40A	2
CU-L2	8/16	R410A	32.6	208	3	31	45	FIELD PROVIDED	700	TRANE	TUHYE0963AN40A	2
CU-M	6	R410A	32.5	208	3	23	35	FIELD PROVIDED	600	TRANE	TUHYE0723AN40A	

NOTES:
1. CU-A COMBINATION UNIT (MODEL TUHYE2403BN40A) CONSISTS OF UNIT CU-A1 (MODEL TUHYE1203AN40A) AND UNIT CU-A2 (MODEL TUHYE1203AN40A).
2. CU-L COMBINATION UNIT (MODEL TUHYE1923BN40A) CONSISTS OF UNIT CU-L1 (MODEL TUHYE0963AN40A) AND UNIT CU-L2 (MODEL TUHYE0963AN40A).

INDOOR SPLIT UNITS

		FAN DATA			COOLING DATA						HEATING DATA			ELECTRICAL DATA							
TAG	TYPE	CFM	OA CFM	ESP (In. Wg)	EAT DB (F)	EAT WB (F)	LAT DB (F)	LAT WB (F)	REFRIGERANT	NOMINAL MBH	EAT (F)	LAT (F)	NOMINAL MBH	VOLTAGE	PHASE	MCA	MOCP	DISCONNECT SWITCH	WEIGHT (LBS)	MANUFACTURER	MODEL	NOTES
ISU-AHU-A	AIR HANDLING UNIT	500	75	0.5	77	65	57	55	R410A	18	70	89	20	208	1	3	15	FIELD PROVIDED	113	TRANE	TPVFYP018AM141A	1
ISU-AHU-B	AIR HANDLING UNIT	800	200	0.5	77	65	56	55	R410A	30	70	92	34	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP030AM141A	1
ISU-AHU-C	AIR HANDLING UNIT	800	300	0.5	77	65	56	55	R410A	30	70	92	34	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP030AM141A	1
ISU-AHU-D	AIR HANDLING UNIT	1000	350	0.5	77	65	57	55	R410A	36	70	91	40	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP036AM141A	1
ISU-AHU-E	AIR HANDLING UNIT	1000	400	0.5	77	65	56	55	R410A	36	70	89	40	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP036AM141A	1
ISU-AHU-F	AIR HANDLING UNIT	1000	425	0.5	77	65	56	55	R410A	36	70	92	40	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP036AM141A	1
ISU-AHU-G	AIR HANDLING UNIT	1000	450	0.5	77	65	55	55	R410A	36	70	91	40	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP036AM141A	1
ISU-AHU-H	AIR HANDLING UNIT	1000	475	0.5	77	65	55	55	R410A	36	70	91	40	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP036AM141A	1
ISU-AHU-I	AIR HANDLING UNIT	1000	500	0.5	77	65	55	55	R410A	36	70	89	40	208	1	4.1	15	FIELD PROVIDED	141	TRANE	TPVFYP036AM141A	1
ISU-AHU-J	AIR HANDLING UNIT	1200	550	0.5	77	65	55	55	R410A	48	70	89	54	208	1	5.6	15	FIELD PROVIDED	172	TRANE	TPVFYP048AM141A	1
ISU-AHU-K	AIR HANDLING UNIT	1500	725	0.5	77	65	54	54	R410A	54	70	95	60	208	1	5.6	15	FIELD PROVIDED	172	TRANE	TPVFYP054AM141A	1
ISU-C-A	CEILING RECESSED CASSETTE	300	25	0	77	65	59	58	R410A	8	70	85	9	208	1	0.28	15	FIELD PROVIDED	35	TRANE	TPLFYP008FM140A	1
ISU-C-B	CEILING RECESSED CASSETTE	300	50	0	77	65	59	58	R410A	8	70	90	9	208	1	0.28	15	FIELD PROVIDED	35	TRANE	TPLFYP008FM140A	1
ISU-C-C	CEILING RECESSED CASSETTE	300	50	0	77	65	55	54	R410A	12	70	94	13.5	208	1	0.29	15	FIELD PROVIDED	35	TRANE	TPLFYP012FM140A	1
ISU-C-D	CEILING RECESSED CASSETTE	450	25	0	77	65	55	54	R410A	18	70	95	20	208	1	0.5	15	FIELD PROVIDED	66	TRANE	TPLFYP018FM140A	1
ISU-C-E	CEILING RECESSED CASSETTE	450	50	0	77	65	53	52	R410A	18	70	99	20	208	1	0.5	15	FIELD PROVIDED	66	TRANE	TPLFYP018FM140A	1

NOTES:
1. BALANCE SUPPLY AIR DUCT FROM ERV TO EACH ISU. ERV SUPPLY AIR CFM IS TO BE THE OUTDOOR AIR CFM LISTED IN SCHEDULE. PROVIDE BALANCE DAMPERS AS REQUIRED.

DUCTED HEATING COIL SCHEDULE

TAG	FLUID	CFM	APD (in. WC)	EAT (F)	LAT (F)	EFT (F)	LFT (F)	GPM	MBH	FPD (FT)	WIDTH (IN)	HEIGHT (IN)	MANUFACTURER	MODEL
HC-ERV-A	40% PG	575	0.12	49	95	155	125	1.9	29.0	0.60	18	18	TRANE	DWPB18018
HC-ERV-B	40% PG	900	0.14	48	95	155	125	3.3	45.5	0.62	18	18	TRANE	DWPB18018
HC-ERV-C	40% PG	1250	0.12	52	95	155	125	4.2	58.0	0.89	18	18	TRANE	DWPB18018
HC-ERV-D	40% PG	1125	0.11	49	95	155	125	3.9	56.9	0.57	18	18	TRANE	DWPB18018
HC-ERV-M	WATER	300	0.24	46	95	155	125	1.2	16.1	0.09	12	12	TRANE	DWPB12012
HC-RTU-A	WATER	1600	0.23	45	95	155	125	6.3	86.8	6.46	24	18	TRANE	DTTB18024

ROOF TOP UNIT SCHEDULE

		SUPPY FAN DATA								COOLING DATA						ELECTRICAL DATA								
TAG	SERVICE	CFM	OA CFM	ESP (In. Wg)	RPM	BHP	HP	MOTOR CONTROLLER	POWER EXHAUST FAN HP	NOMINAL TONS	AMBIENT TEMPERATURE	EAT DB (F)	EAT WB (F)	LAT DB (F)	LAT WB (F)	VOLTAGE	PHASE	MCA	MOCP	DISCONNECT SWITCH	WEIGHT (LBS)	MANUFACTURER	MODEL	NOTES
RTU-A	119	1600	500	0.75	938	.55	1	FACTORY PROVIDED VFD	0.87	5	95	79	67	57.5	56	208	3	33	45	FACTORY PROVIDED	1000	TRANE	THC067E3R0A	1

NOTES:
1. SIDE SUPPLY AND RETURN DUCT CONNECTIONS.

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PACKAGED ENERGY RECOVERY UNIT SCHEDULE

		SUPPLY FAN DATA						EXHAUST FAN DATA						HOT WATER COIL DATA							DX COIL DATA					ENERGY RECOVERY WHEEL DATA												ELECTRICAL DATA									
																										WINTER					SUMMER																
TAG	SERVICE	CFM	OA CFM	ESP (In. Wg)	RPM	BHP	HP	CFM (EVENT MODE)	ESP (In. Wg)	RPM	BHP	HP	FLUID	EAT (F)	LAT (F)	EFT (F)	LFT (F)	GPM	MBH	FPD (FT)	EAT DB (F)	EAT WB (F)	LAT DB (F)	LAT WB (F)	MBH	OA TEMP DB (F)	RA TEMP DB (F)	LAT DB (F)	OA TEMP DB (F)	OA TEMP WB (F)	RA TEMP DB (F)	RA TEMP WB (F)	LAT DB (F)	LAT WB (F)	VOLTAGE	PHASE	FLA	MCA	MOCP	DISCONNECT SWITCH	MOTOR CONTROLLER	WEIGHT (LBS)	MANUFACTURER	MODEL	NOTES
ERU-A	160,161	7500	4500	1.00	2013	6.05	7.5	4500	1500	1.00	1553	5.35	7.5	40% PG	56	97	155	131	30.0	330	2.1	77	64	55	54	207.6	-10	70	47	89	73	74	62	78	66	208	3	94.7	113.6	125	FACTORY PROVIDED	FACTORY PROVIDED VFD	5000	TRANE	OADG017F1	

PACKAGED ENERGY RECOVERY VENTILATOR SCHEDULE

		SUPPLY FAN					EXHAUST FAN DATA						HEATING COIL DATA									ENERGY RECOVERY SECTION DATA												ELECTRICAL DATA								
																						WINTER					SUMMER																
TAG	SERVICE	CFM	ESP (In. Wg)	RPM	BHP	HP	CFM	ESP (In. Wg)	RPM	BHP	HP	MOTOR CONTROLLER	FLUID	APD (in. WC)	EAT (F)	LAT (F)	EFT (F)	LFT (F)	GPM	MBH	FPD (FT)	OA TEMP DB (F)	RA TEMP DB (F)	LAT DB (F)	OA TEMP DB (F)	OA TEMP WB (F)	RA TEMP DB (F)	RA TEMP WB (F)	LAT DB (F)	LAT WB (F)	VOLTAGE	PHASE	FLA	MCA	MOCP	DISCONNECT SWITCH	WEIGHT (LBS)	MANUFACTURER	MODEL
ERV-A	154, 254, 256	575	0.75	–	0.5	1	575	0.75	–	0.5	1	ECM, 0-10V	–							–	–	-10	70	49	89	73	74	62	78	67	120	1	8	18	20	FACTORY PROVIDED	600	RENEWAIRE LLC	HE1.5JINV-D11EE
ERV-B	155, 156D, 258, 259	900	0.75	–	0.5	1	900	0.75	–	0.5	1	ECM, 0-10V	–							–	–	-10	70	48	89	73	74	62	78	67	120	1	8	18	20	FACTORY PROVIDED	600	RENEWAIRE LLC	HE1.5JINV-D11EE
ERV-C	151, 158, 251, 253, 253A	1250	0.75	–	0.7	1	1250	0.75	–	0.7	1	ECM, 0-10V	–							–	–	-10	70	45	89	73	74	62	79	68	120	1	8	18	20	FACTORY PROVIDED	600	RENEWAIRE LLC	HE1.5JINV-D11EE
ERV-D	252, 255, 257	1125	0.75	–	0.7	1	1125	0.75	–	0.7	1	ECM, 0-10V	–							–	–	-10	70	49	89	73	74	62	78	67	120	1	8	18	20	FACTORY PROVIDED	600	RENEWAIRE LLC	HE1.5JINV-D11EE
ERV-G	101, 102, 103, 104	1850	0.5	1763	0.7	3.62	1850	0.5	1745	0.7	3.62	ECM, 0-10V	40% PG	0.04	43	95	155	125	7.9	112	17.72	-10	70	48	89	73	74	62	78	67	208	3	8.6	19.4	25	FACTORY PROVIDED	4400	RENEWAIRE LLC	DN-3-JRTBH133
ERV-H	113, 114, 115, 116	1800	0.5	1731	0.7	3.62	1800	0.5	1716	0.7	3.62	ECM, 0-10V	40% PG	0.04	49	101	155	125	7.4	103	15.3	-10	70	49	89	73	74	62	78	67	208	3	8.6	19.4	25	FACTORY PROVIDED	4400	RENEWAIRE LLC	DN-3-JRTBH133
ERV-I	117, 118, 119A, 120, 121, 122	1950	0.5	1828	0.7	3.62	1950	0.5	1814	0.7	3.62	ECM, 0-10V	40% PG	0.04	48	96	155	125	7.8	110	17.0	-10	70	48	89	73	74	62	78	67	208	3	8.6	19.4	25	FACTORY PROVIDED	4400	RENEWAIRE LLC	DN-3-JRTBH133
ERV-J	124, 126, 128	1500	0.5	1535	0.5	3.62	1500	0.5	1534	0.5	3.62	ECM, 0-10V	40% PG	0.04	50	96	155	125	7.7	76	17.7	-10	70	50	89	73	74	62	78	67	208	3	8.6	19.4	25	FACTORY PROVIDED	4400	RENEWAIRE LLC	DN-3-JRTBH133
ERV-K	123, 130, 132, 134	1950	0.5	1828	0.7	3.62	1950	0.5	1814	0.7	3.62	ECM, 0-10V	40% PG	0.04	48	96	155	125	7.8	101	17.0	-10	70	48	89	73	74	62	78	67	208	3	8.6	19.4	25	FACTORY PROVIDED	4400	RENEWAIRE LLC	DN-3-JRTBH133
ERV-L	125, 127, 129, 136, 138	2650	0.5	2333	1.6	3.62	2650	0.5	2306	1.6	3.62	ECM, 0-10V	40% PG	0.08	44	98	155	125	10.3	149	17.4	-10	70	44	89	73	74	62	79	68	208	3	8.6	19.4	25	FACTORY PROVIDED	4400	RENEWAIRE LLC	DN-3-JRTBH133
ERV-M	149, 149A, 149B, 149C, 149D, 149E, 149F	300	0.5	1523	0.1	0.5	300	0.5	1506	0.1	0.5	ECM, 0-10V	–	0.00						–	–	-10	70	55	89	73	74	62	77	66	208	1	4.8	3.9	15	FACTORY PROVIDED	500	RENEWAIRE LLC	HE10JRTV-D15EE
ERV-N	B21	500	0.5	1747	0.2	0.5	500	0.5	1720	0.2	0.5	ECM, 0-10V	–	0.00						–	–	-10	70	50	89	73	74	62	78	66	208	1	4.8	3.9	15	FACTORY PROVIDED	350	RENEWAIRE LLC	HE10JINV-D15EE

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Consultant

PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

Expires : 06/30/2025

#	DATE	DESCRIPTION
3	11/29/2023	BID ADDENDUM #3

Drawn By:
Checked By:
Proj. #: 13-12-01.04-0-001-024
CSArch Proj. #: 208-2101.03
Issued for Bid: 11/03/23

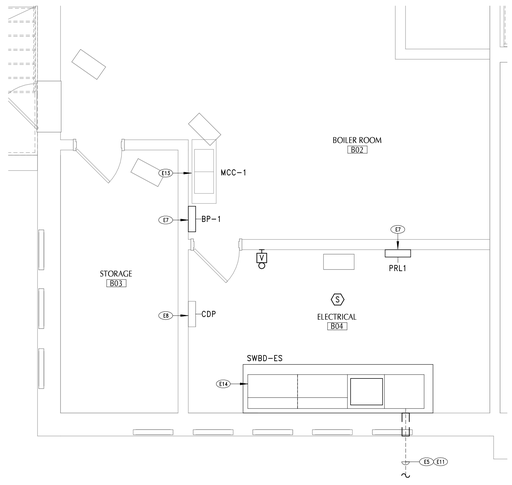
Sheet Title

SCHEDULES

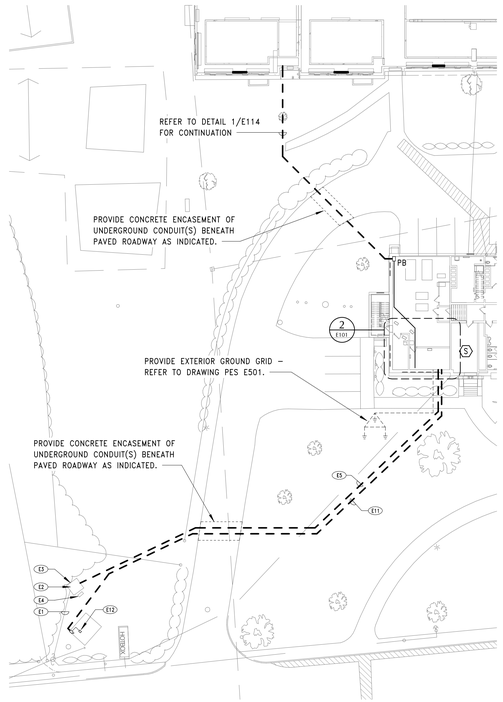
Sheet No.

PES
M901

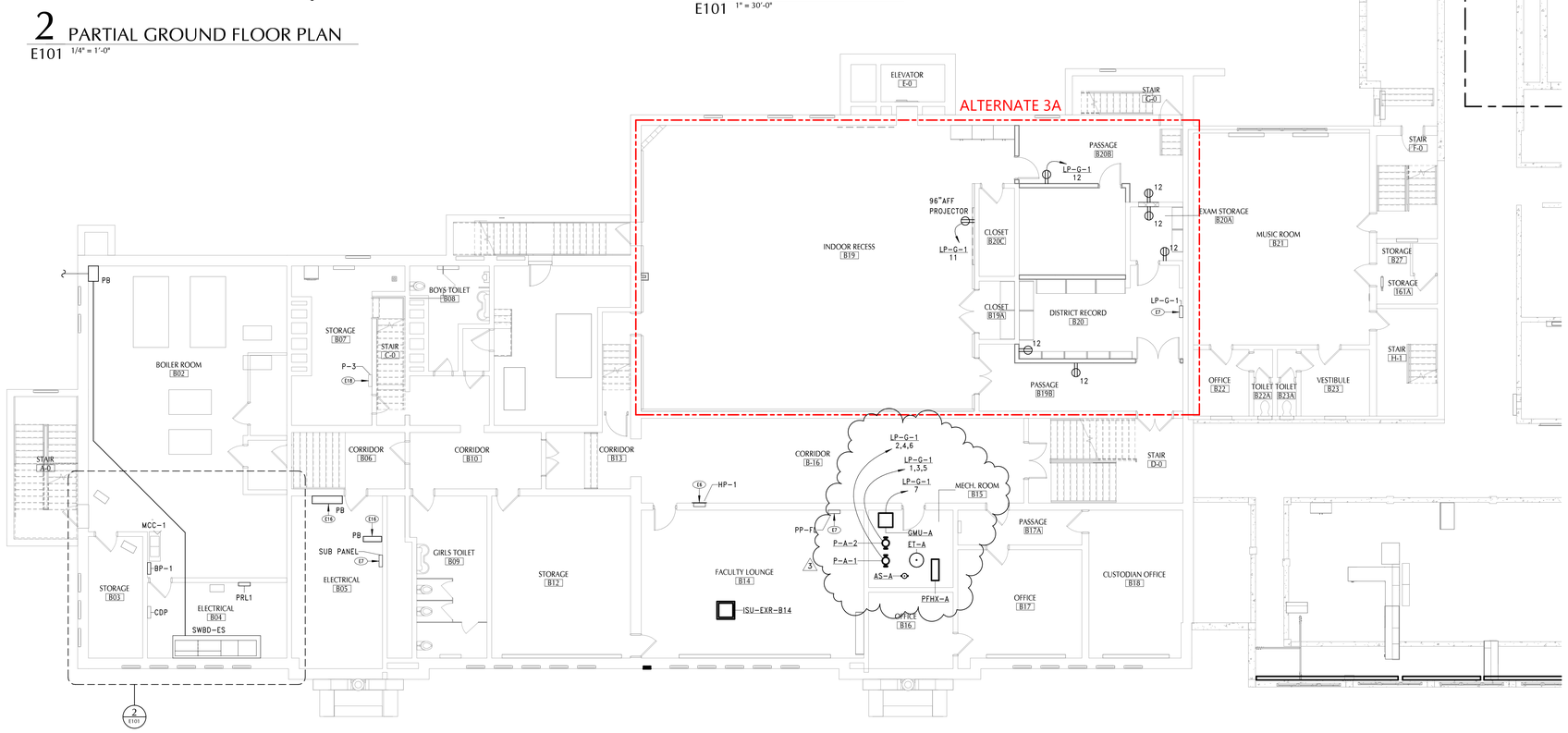
CONSTRUCTION DOCUMENTS



2 PARTIAL GROUND FLOOR PLAN
E101 1/4" = 1'-0"



3 PARTIAL SITE PLAN
E101 1" = 30'-0"



1 GROUND FLOOR PLAN - AREA '1'
E101 1/8" = 1'-0"

SHEET NOTES

A. FIELD COORDINATE ROUTING OF ALL FEEDERS AND BRANCH CIRCUITS.

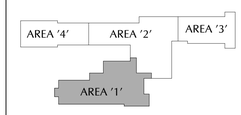
B. ALL PENETRATIONS THROUGH FIRE RATED WALLS AND FLOORS SHALL BE PROPERLY FIRE-STOPPED.

C. PROVIDE ALL REQUIRED EARTHWORK NECESSARY TO ACCOMMODATE NEW PAD MOUNTED TRANSFORMER INSTALLATION: PROVIDE ALL NECESSARY MODIFICATIONS TO EXISTING SLOPED GRADE FOR ESTABLISHING A LEVEL FOOTPRINT: GRADING RETENTION, TRENCHING, BACKFILL, COMPACTION AND SITE RESTORATION.

KEY NOTES

E1	COORDINATE WITH NEW YORK STATE ELECTRIC & GAS (NYSEG) FOR ALL WORK REQUIRED TO DISCONNECT AND REROUTE EXISTING UNDERGROUND 15KV, 3 PHASE PRIMARY ELECTRIC SERVICE FEEDER AS INDICATED ON THE PLAN. WORK TO BE PERFORMED DURING THE SUMMER OF 2024.
E2	REPLACEMENT NYSEG OWNED PAD MOUNTED TRANSFORMER. REFER TO DETAILS 1, 2 AND 3/E601. WORK TO BE PERFORMED DURING THE SUMMER OF 2024.
E3	PROVIDE UTILITY TRANSFORMER PAD AND CABLE VAULT BOX – REFER TO DETAILS 1, 2 AND 3/E601.
E4	PROVIDE ELECTRIC SERVICE SECONDARY METER SOCKET ENCLOSURE ATTACHED TO PAD MOUNTED TRANSFORMER. WORK TO BE PERFORMED DURING THE SUMMER OF 2024.
E5	PROVIDE UNDERGROUND 208/120V, 3 PHASE SECONDARY ELECTRIC SERVICE FEEDER. WORK TO BE PERFORMED DURING THE SUMMER OF 2024.
E6	PROVIDE REPLACEMENT PANELBOARD. REFER TO PANELBOARD REPLACEMENT SCHEDULE ON DWG. NO. E901 FOR SPECIFICATIONS. PROVIDE REPLACEMENT PANELBOARD FEEDER AS SPECIFIED ON DWG. NO. E501. PROVIDE RECONNECTION OF EXISTING PANELBOARD BRANCH CIRCUIT CONDUCTORS. PROVIDE ALL NECESSARY WALL MODIFICATIONS AS REQUIRED FOR PROPER PANEL INSTALLATION. PROVIDE COMPLETE INFILL OF EXISTING WALL OPENING AROUND THE PERIMETER OF REPLACEMENT PANELBOARD BACKBOX. PROVIDE WALL INFILL SURFACE TO MATCH SURFACE OF SURROUNDING WALL. PAINT TO MATCH.
E7	PROVIDE REPLACEMENT PANELBOARD. REFER TO REPLACEMENT PANELBOARD SCHEDULE ON DWG. NO. E901 FOR SPECIFICATIONS. PROVIDE REPLACEMENT PANELBOARD FEEDER AS SPECIFIED ON DWG. NO. E501. PROVIDE RECONNECTION OF EXISTING PANELBOARD BRANCH CIRCUIT CONDUCTORS.
E8	EXISTING PANELBOARD TO REMAIN. PROVIDE REPLACEMENT PANELBOARD FEEDER AS SPECIFIED ON DWG. NO. E501.
E11	PROVIDE UNDERGROUND 208/120, 3 PHASE, 4 WIRE FEEDER TO EXISTING SEWAGE PUMP STATION.
E12	PROVIDE RECONNECTION OF POWER TO EXISTING SEWAGE PUMP STATION. EXTEND AND CONNECT UNDERGROUND FEEDER TO A 3 POLE 60 AMP, NEMA 3R NON-FUSED DISCONNECT SWITCH. PROVIDE RECONNECTION OF EXISTING PUMP STATION CONTROL PANEL TO REPLACEMENT FEEDER WITH CONDUIT SEALING FITTING UL LISTED FOR CLASS 1, DIVISION 1 OR 2, GROUP D ENVIRONMENT BOUNDARY. PROVIDE RECONNECTION OF PUMP STATION GROUNDING SYSTEM. PROVIDE FOR COMPLETE PUMP STATION OPERATIONAL ACCEPTANCE TESTING.
E13	EXISTING MOTOR CONTROL CENTER TO REMAIN. PROVIDE RECONNECTION OF EXISTING FEEDER TO REPLACEMENT SWITCHBOARD AS SPECIFIED ON DWG. NO. E501.
E14	PROVIDE REPLACEMENT MAIN ELECTRIC SERVICE ENTRANCE SWITCHBOARD 'SWBD-ES'. REFER TO SWITCHBOARD REPLACEMENT SCHEDULE ON DWG. NO. E501 FOR SPECIFICATIONS. PROVIDE INCOMING ELECTRIC UTILITY AND LOAD FEEDER CONNECTIONS AS SPECIFIED ON DWG. NO. E501. PROVIDE RECONNECTION OF EXISTING PANELBOARD BRANCH CIRCUIT CONDUCTORS AS INDICATED.
E16	PROVIDE A WALL MOUNTED NEMA TYPE 1 SCREW COVER PULLBOX - SIZED TO ACCOMMODATE EXISTING FEEDER CONDUCTORS/CONDUITS TO REMAIN.
E18	EXISTING PANELBOARD TO REMAIN. PROVIDE RECONNECTION OF EXISTING SUPPLY FEEDER TO REPLACEMENT SWITCHBOARD.

KEY PLAN



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Project Title
PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

#	DATE	DESCRIPTION
3	11/29/2023	BID ADDENDUM #3

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Checked By:	JRB
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Sheet Title
GROUND FLOOR PLAN - AREA '1'

Sheet No.
PES
E101

CONSTRUCTION DOCUMENTS

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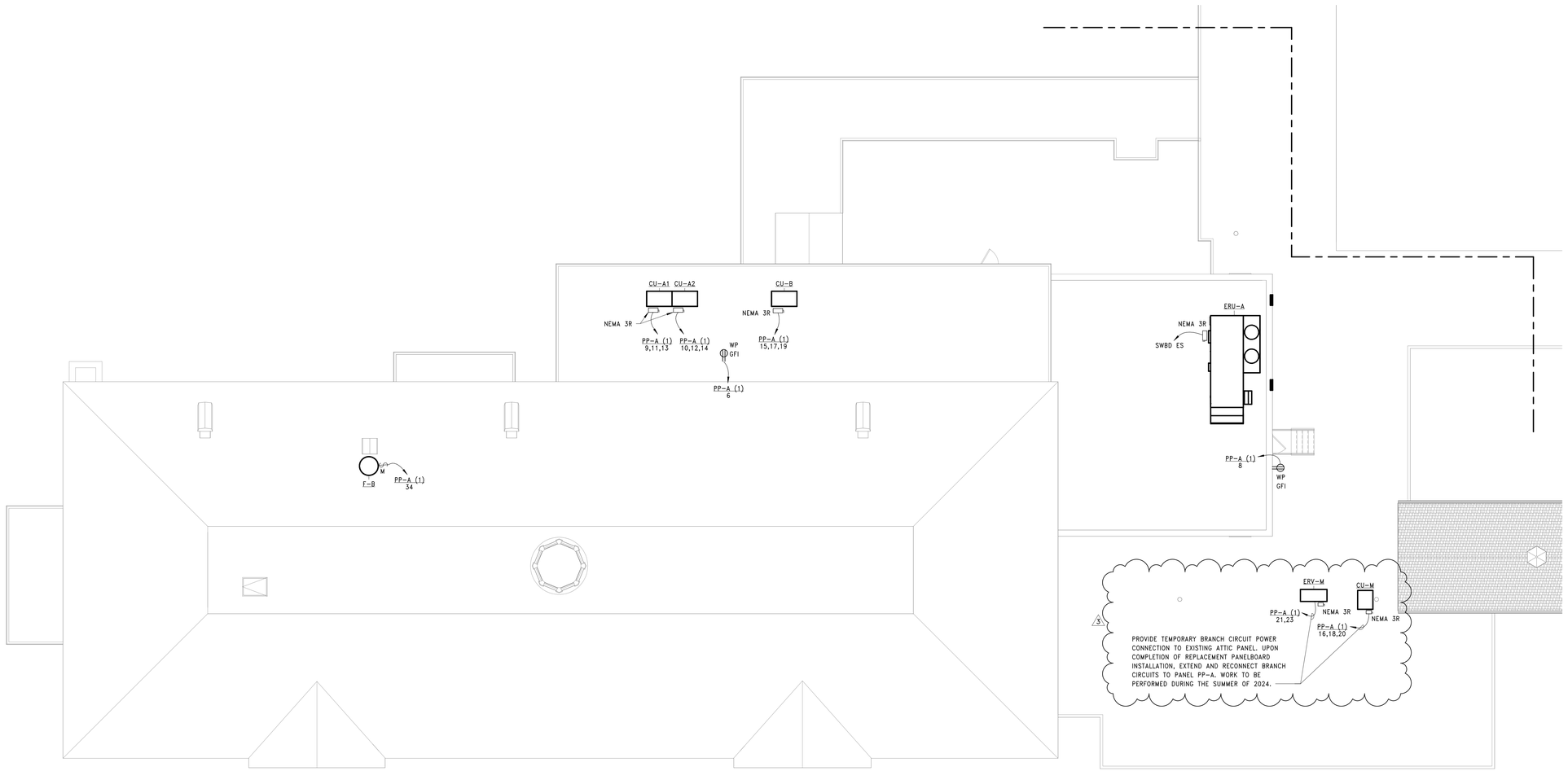

1 ROOF PLAN - AREA '1'
E141 1/8" = 1'-0"

SHEET NOTES

A. FIELD COORDINATE ROUTING OF ALL FEEDERS AND BRANCH CIRCUITS.

B. ALL PENETRATIONS THROUGH FIRE RATED WALLS AND FLOORS SHALL BE PROPERLY FIRE-STOPPED.

C. REFER TO EQUIPMENT CONNECTION SCHEDULE ON SHEET NO. E902 FOR BRANCH CIRCUIT DESIGNATION AND RATING.

KEY NOTES

KEY PLAN

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PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

STATE OF NEW YORK
JAMES R. BARRETT
073467
LICENSED PROFESSIONAL ENGINEER
EXPIRES 5/31/2026

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Sheet Title

ROOF PLAN - AREA '1'

Sheet No.

PES
E141

CONSTRUCTION DOCUMENTS

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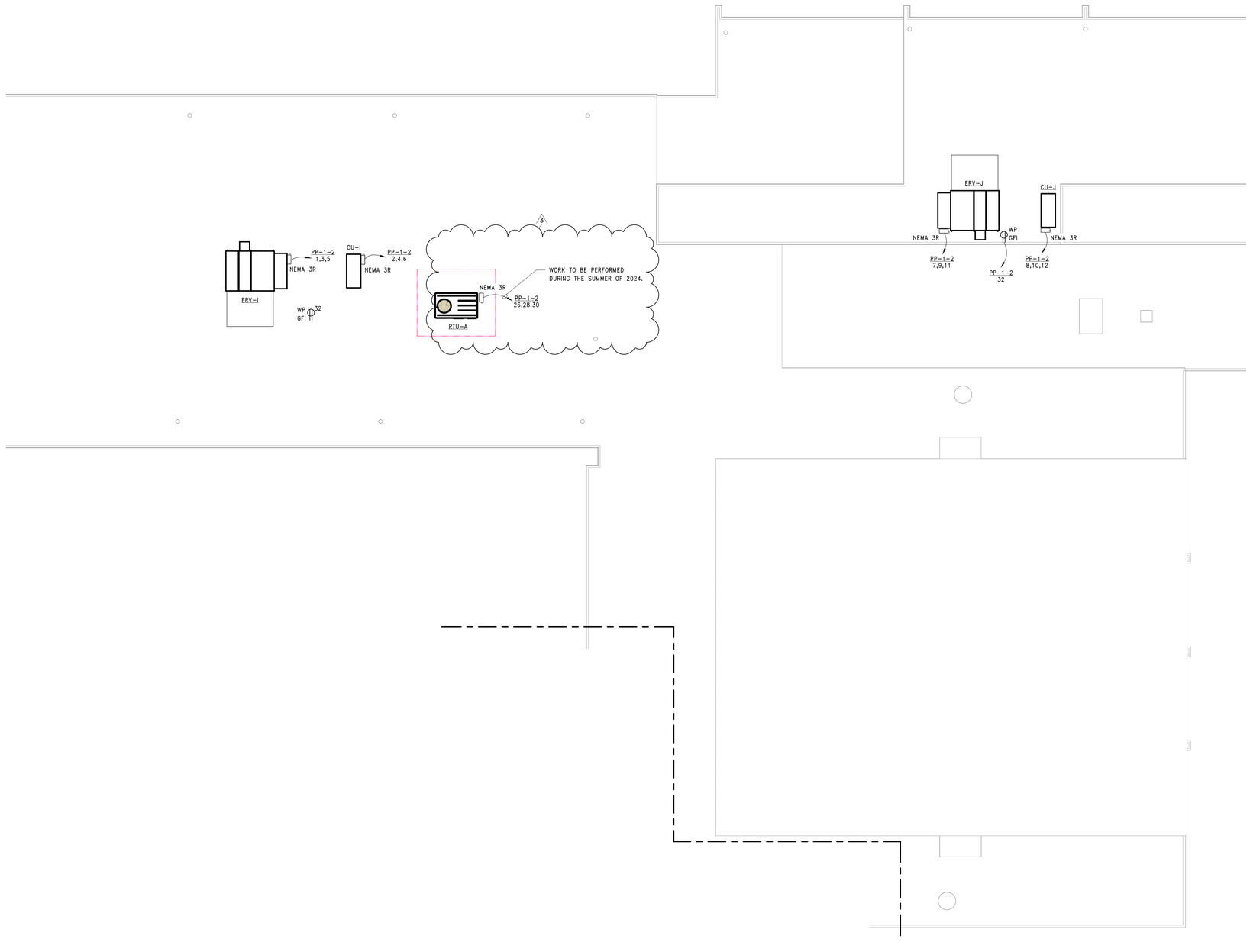


1 ROOF PLAN - AREA '2'
E142 1/8" = 1'-0"

SHEET NOTES

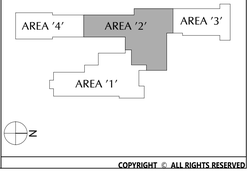
A. FIELD COORDINATE ROUTING OF ALL FEEDERS AND BRANCH CIRCUITS.

B. ALL PENETRATIONS THROUGH FIRE RATED WALLS AND FLOORS SHALL BE PROPERLY FIRE-STOPPED.

C. REFER TO EQUIPMENT CONNECTION SCHEDULE ON SHEET NO. E902 FOR BRANCH CIRCUIT DESIGNATION AND RATING.

KEY NOTES

KEY PLAN



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PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

JAMES R. BARRETT
LICENSED PROFESSIONAL ENGINEER
073467
STATE OF NEW YORK
EXPIRES 5/31/2026

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Sheet Title

ROOF PLAN - AREA '2'

Sheet No.

PES
E142

CONSTRUCTION DOCUMENTS

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SHEET NOTES

A. FIELD COORDINATE ROUTING OF ALL FEEDERS AND BRANCH CIRCUITS.

B. ALL PENETRATIONS THROUGH FIRE RATED WALLS SHALL BE PROPERLY FIRE-STOPPED.

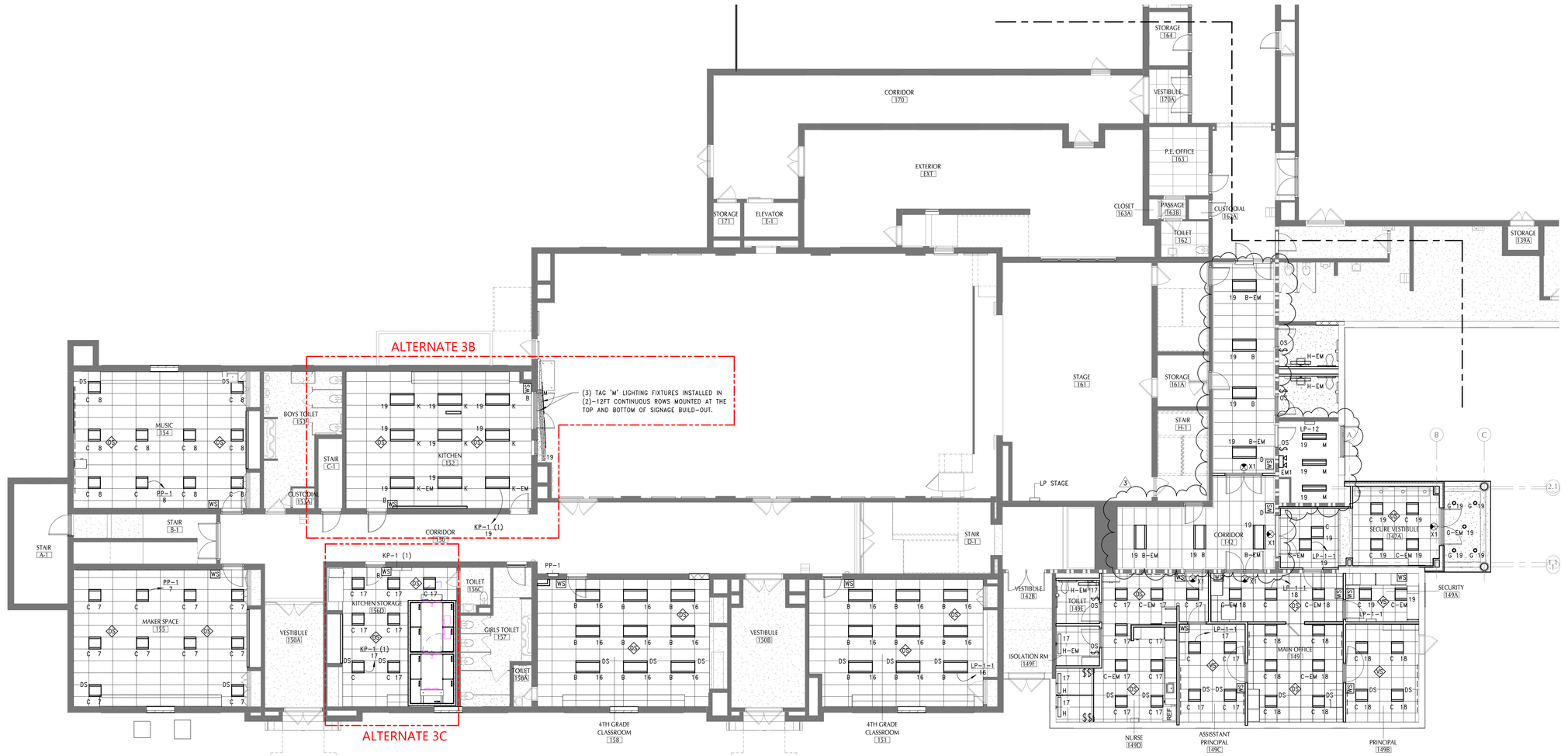
C. REFER TO LIGHTING FIXTURE SCHEDULE ON DWG E902.

D. REFER TO LIGHT FIXTURE SEQUENCE OF OPERATION ON DWG E902.

E. ALL EXIT SIGNS AND NIGHT LIGHT (NL) FIXTURES SHALL BE CONNECTED AHEAD OF ANY SWITCHING/CONTROL DEVICE (UN-SWITCHED).

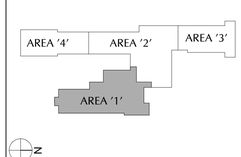
F. PROVIDE UN-SWITCHED HOT-LEG CONNECTION TO EM FIXTURES FOR VOLTAGE SENSING AND BATTERY CHARGING.

KEY NOTES



1 FIRST FLOOR LIGHTING PLAN - AREA '1'
E211 1/8" = 1'-0"

KEY PLAN



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Project Title

PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

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Sheet Title

FIRST FLOOR LIGHTING PLAN - AREA '1'

Sheet No.

PES
E211

CONSTRUCTION DOCUMENTS

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Distribution Sections: SWBD-ES

Location: ELECTRICAL B04
Mounting: FREESTANDING
Volts: 120/208 Wye
Phases: 3
Wires: 4
A.I.C. Rating: 65KA
Mains Type: MCB
Mains Rating: 2000

CKT	Circuit Description	# of Poles	Frame Size	Trip Rating	A	B	C	TOTAL	Remarks
1	EX. PANEL CDP	3	400	400	0 VA	0 VA	0 VA	--	
2	PANEL PRL1	3	100	100	0 VA	0 VA	0 VA	--	
3	PANEL BP-1	3	250	225	0 VA	0 VA	0 VA	--	
4	EX. MCC-1	3	250	200	0 VA	0 VA	0 VA	--	EXTEND & RECONNECT EXIST....
5	PANEL SUB-PANEL	3	100	100	0 VA	0 VA	0 VA	--	
6	EX. PANEL P-3	3	250	150	0 VA	0 VA	0 VA	--	EXTEND & RECONNECT EXIST....
7	PANEL HP-1	3	100	100	0 VA	0 VA	0 VA	--	
8	PANEL PP-FL	3	250	150	0 VA	0 VA	0 VA	--	
9	EX. ELEVATOR	3	250	200	0 VA	0 VA	0 VA	--	EXTEND & RECONNECT EXIST....
10	PANEL LP-G-1	3	250	225	0 VA	0 VA	0 VA	--	
11	PANEL PP-1-4	3	400	400	0 VA	0 VA	0 VA	--	
12	EX. PANEL KP-1A /PANEL KP-1 - ADD ALTERNATE #3	3	400	400	0 VA	0 VA	0 VA	--	
13	PANEL PP-1	3	100	100	0 VA	0 VA	0 VA	--	
14	PANEL LP-STAGE	3	250	225	0 VA	0 VA	0 VA	--	
15	PANEL LP-1-1	3	250	225	0 VA	0 VA	0 VA	--	
16	PANEL 12	3	100	100	0 VA	0 VA	0 VA	--	
17	PANEL 10	3	250	150	0 VA	0 VA	0 VA	--	
18	PANEL PP-1-2	3	600	600	0 VA	0 VA	0 VA	--	
19	PANEL PP-6	3	250	225	0 VA	0 VA	0 VA	--	
20	PANEL PP-A	3	400	400	0 VA	0 VA	0 VA	--	
21	ERU-A	3	250	125	0 VA	0 VA	0 VA	0 VA	
22	EXISTING SEWAGE PUMP STATION	3	100	60	0 VA	0 VA	0 VA	--	
23	EXISTING PUMP RM. COMPRESSOR	3	100	100	0 VA	0 VA	0 VA	--	
24	SPARE	3	250	225	0 VA	0 VA	0 VA	--	
25	SPARE	3	250	225	0 VA	0 VA	0 VA	--	
26	SPARE	3	100	100	0 VA	0 VA	0 VA	--	
27	SPARE	3	100	100	0 VA	0 VA	0 VA	--	
28	SPACE	3	--	--	--	--	--	--	PREPARED BUS SPACE
29	SPACE	3	--	--	--	--	--	--	PREPARED BUS SPACE
30	SPACE	3	--	--	--	--	--	--	PREPARED BUS SPACE

Total Conn. Load: 0 VA
Total Amps: 0

Notes: REFER TO SPECIFICATION SECTION NO. 262413

WIRING SCHEDULE
ONE PHASE CONDUCTOR
COPPER CONDUCTORS (0-600V)

CIRCUIT RATING	CONDUIT SIZE (INCHES)	CONDUCTOR SIZE	
	NG	PHASE/ NEUTRAL	GND
20	3/4	12	12
30	3/4	10	10
40	3/4	8	8
50	3/4	8	8
60	3/4	6	6
70	1	4	4
80	1	4	4
90	1	3	3
100	1	3	3
110	1	2	2
125	1-1/4	1	1
150	1-1/4	1/0	1/0

SUBSCRIPT KEY

SUBSCRIPT	CONDUCTORS PER CONDUIT
NG	1 PHASE CONDUCTOR, 1 NEUTRAL CONDUCTOR 1 EQUIPMENT GROUNDING CONDUCTOR

WIRING SCHEDULE
TWO PHASE CONDUCTORS
COPPER CONDUCTORS (0-600V)

CIRCUIT RATING	CONDUIT SIZE (INCHES)		CONDUCTOR SIZE	
	G	NG	PHASE/ NEUTRAL	GND
20	3/4	3/4	12	12
30	3/4	3/4	10	10
40	3/4	3/4	8	10
50	3/4	3/4	8	10
60	3/4	3/4	6	10
70	1	1	4	8
80	1	1	4	8
90	1	1-1/4	3	8
100	1	1-1/4	3	8
110	1	1-1/4	2	6
125	1-1/4	1-1/4	1	6
150	1-1/4	1-1/2	1/0	6
175	1-1/2	2	2/0	6
200	1-1/2	2	3/0	6

SUBSCRIPT KEY

SUBSCRIPT	CONDUCTORS PER CONDUIT
G	2 PHASE CONDUCTORS, 1 EQUIPMENT GROUNDING CONDUCTOR
NG	2 PHASE CONDUCTORS, 1 NEUTRAL CONDUCTOR, 1 EQUIPMENT GROUNDING CONDUCTOR

WIRING SCHEDULE
THREE PHASE CONDUCTORS
COPPER CONDUCTORS (0-600V)

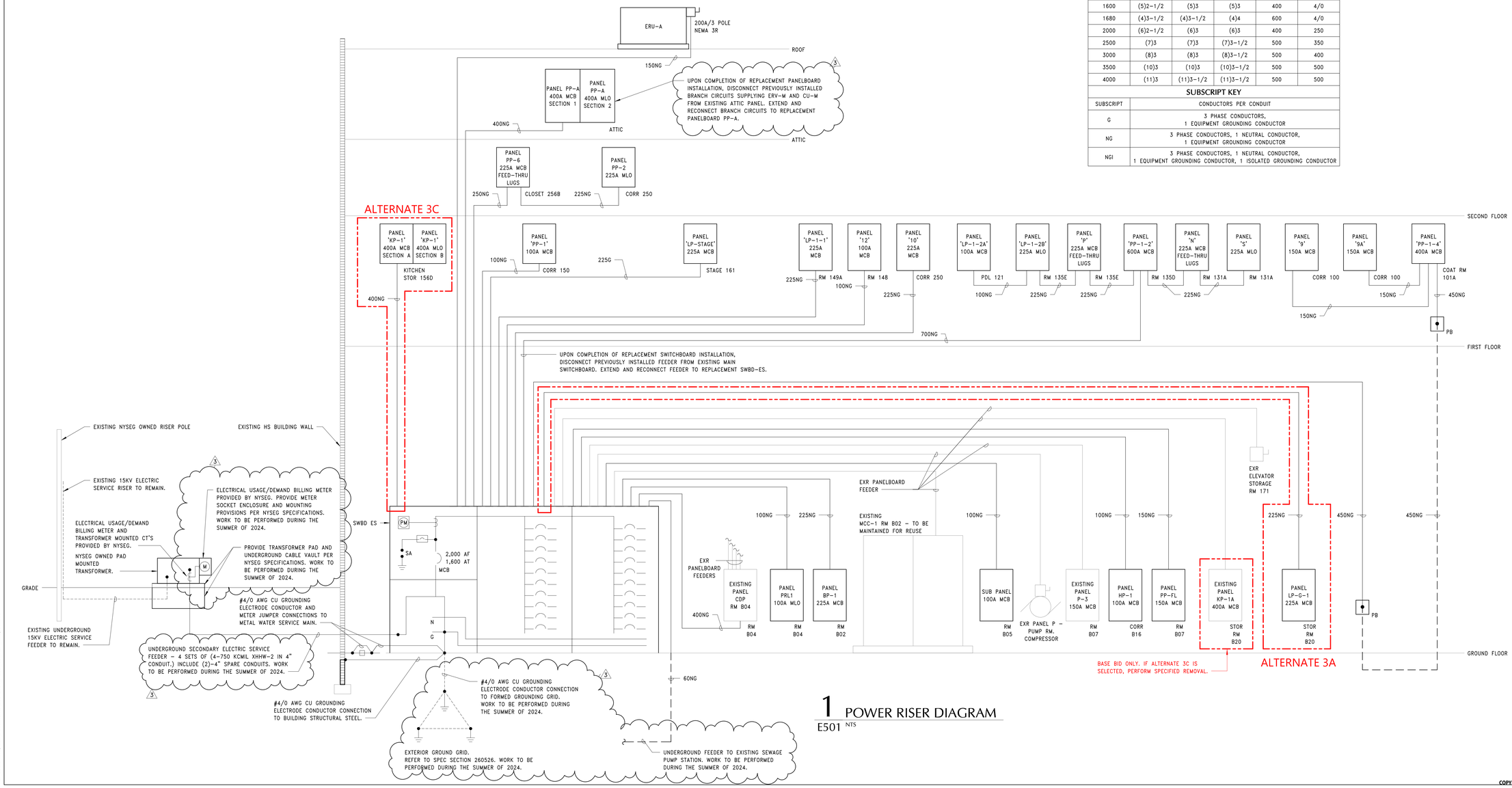
CIRCUIT RATING	CONDUIT SIZE (INCHES)			CONDUCTOR SIZE	
	G	NG	NGI	PHASE/ NEUTRAL	GND
20	3/4	3/4	3/4	12	12
30	3/4	3/4	3/4	10	10
40	3/4	3/4	3/4	8	10
50	3/4	3/4	3/4	8	10
60	3/4	1	1	6	10
70	1	1-1/4	1-1/4	4	8
80	1	1-1/4	1-1/4	4	8
90	1-1/4	1-1/4	1-1/4	3	8
100	1-1/4	1-1/4	1-1/4	3	8
110	1-1/4	1-1/4	1-1/2	2	6
125	1-1/4	1-1/2	2	1	6
150	1-1/2	2	2	1/0	6
175	2	2	2	2/0	6
200	2	2-1/2	2-1/2	3/0	6
225	2	2-1/2	2-1/2	4/0	4
250	2-1/2	2-1/2	2-1/2	250	4
300	2-1/2	2-1/2	3	350	4
350	3	3	3-1/2	500	3
400	(2)2	(2)2-1/2	(2)2-1/2	3/0	3
420	3-1/2	3-1/2	4	600	2
450	(2)2	(2)2-1/2	(2)2-1/2	4/0	2
500	(2)2-1/2	(2)2-1/2	(2)2-1/2	250	2
600	(2)2-1/2	(2)2-1/2	(2)3	350	1
700	(2)3	(2)3	(2)3-1/2	500	1/0
800	(3)2-1/2	(3)2-1/2	(3)3	300	1/0
840	(2)3-1/2	(2)3-1/2	(2)4	600	2/0
1000	(3)2-1/2	(3)3	(3)3	400	2/0
1200	(4)2-1/2	(4)2-1/2	(4)3	350	3/0
1600	(5)2-1/2	(5)3	(5)3	400	4/0
1680	(4)3-1/2	(4)3-1/2	(4)4	600	4/0
2000	(6)2-1/2	(6)3	(6)3	400	250
2500	(7)3	(7)3	(7)3-1/2	500	350
3000	(8)3	(8)3	(8)3-1/2	500	400
3500	(10)3	(10)3	(10)3-1/2	500	500
4000	(11)3	(11)3-1/2	(11)3-1/2	500	500

SUBSCRIPT KEY

SUBSCRIPT	CONDUCTORS PER CONDUIT
G	3 PHASE CONDUCTORS, 1 EQUIPMENT GROUNDING CONDUCTOR
NG	3 PHASE CONDUCTORS, 1 NEUTRAL CONDUCTOR, 1 EQUIPMENT GROUNDING CONDUCTOR
NGI	3 PHASE CONDUCTORS, 1 NEUTRAL CONDUCTOR, 1 EQUIPMENT GROUNDING CONDUCTOR, 1 ISOLATED GROUNDING CONDUCTOR

WIRING SCHEDULE NOTES:

1. CURRENT CARRYING CONDUCTOR AMPACITY BASED ON NEC TABLE 310.15(B)(16), COPPER WITH INSULATION TEMPERATURE RATING OF 75 DEGREES C.
2. RACEWAY FILL SCHEDULE IS BASED ON COPPER CONDUCTORS WITH THHN, THWN OR THWN-2 INSULATION.
3. MAXIMUM FILL FOR RACEWAY IS BASED ON CHAPTER 9 TABLE 1 AND TABLE C.1 FOR ELECTRICAL METALIC TUBING (EMT). ADJUST FILL AND RACEWAY SIZE FOR ANOTHER RACEWAY TYPE REQUIRED FOR THE APPLICATION IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
4. IN ACCORDANCE WITH CHAPTER 9 NOTES TO TABLES, NOTE 3 THE GROUND CONDUCTOR IS INCLUDED IN THE FILL CALCULATION.



1 POWER RISER DIAGRAM
E501 NTS

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Project Title

PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

STATE OF NEW YORK
JAMES R. BARNES
073467
LICENSED PROFESSIONAL ENGINEER
EXPIRES 5/31/2026

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Sheet Title

POWER RISER DIAGRAM

Sheet No.

PES
E501

CONSTRUCTION DOCUMENTS

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LIGHTING FIXTURE SCHEDULE

TAG	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	WATTAGE	VOLTAGE	REMARKS
A	LED 2X4 RECESSED STATIC TROFFER	MARK	WHSPRLCTR2X48OCRI40K6000LMMIN1120YBCZT	57W	120	
A-EM	LED 2X4 RECESSED STATIC TROFFER W/EMERGENCY BACKUP	MARK	WHSPRLCTR2X48OCRI40K6000LMMIN1120YBCZT E10WLCP	57W	120	
B	LED 2X4 RECESSED STATIC TROFFER	MARK	WHSPRLCTR2X48OCRI40K4000LMMIN1120SWCZT	34W	120	
B-EM	LED 2X4 RECESSED STATIC TROFFER W/EMERGENCY BACKUP	MARK	WHSPRLCTR2X48OCRI40K4000LMMIN1120SWCZT E10WLCP	34W	120	
C	LED 2X2 RECESSED STATIC TROFFER	MARK	WHSPRLCTR2X28OCRI40K4000LMMIN1120SWCZT	34W	120	
C-EM	LED 2X2 RECESSED STATIC TROFFER W/EMERGENCY BACKUP	MARK	WHSPRLCTR2X28OCRI40K4000LMMIN1120SWCZT E10WLCP	34W	120	
D	LED 4 FT STRIP LIGHT	LITHONIA	CLX LED LINEAR L48400LMSEFFDLWD120GZ1040K80CRIWH	28W	120	
EM1	COMMERCIAL LED EMERGENCY BATTERY LIGHTING UNIT	LITHONIA	ELM6LU1VOLTLTPSDRT - RTKIT	5W	120/277	PROVIDE REMOTE TEST KIT
F	LED 4 INCH ROUND RECESSED DOWNLIGHT	GOTHAM	EVO4440/20ARWWDLSS120GZ1	20W	120	
G	8 INCH ROUND RECESSED VANDAL RESISTANT DOWNLIGHT	GOTHAM	EVO840/30ARLSSMWDFOL120GZ1DWH	47W	120	
G-EM	8 INCH ROUND RECESSED VANDAL RESISTANT DOWNLIGHT W/EMERGENCY BACKUP	GOTHAM	EVO840/30ARLSSMWDFOL120GZ1DWH ELRSD	47W	120	
H	LED 36 INCH UP/DOWN DISTRIBUTION WALL BRACKET	KENALL	MPH36MW34/34L40K8DIM1DDV	71W	120	
H-EM	LED 36 INCH UP/DOWN DISTRIBUTION WALL BRACKET W/EMERGENCY BACKUP	KENALL	MPH36MW34/34L40K8DIM1SDV LEL	71W	120	
K	2X4 RECESSED FOOD SERVICE TROFFER	KENALL	CSEDO2467L40K8DIM11205F4HSYM	72W	120	
K-EM	2X4 RECESSED FOOD SERVICE TROFFER W/EMERGENCY BACKUP	KENALL	CSEDO2467L40K8DIM11205F4HSYM LEL	72W	120	
M	4FT LED SURFACE MOUNTED STRIP	LITHONIA	CSS L48 4000LM MVOLT 40K80CRI	35W	120	REFER TO DETAIL NO. 9/A305
N	SURFACE MOUNT, EDGE LIT 6 INCH ROUND DOWNLIGHT	PRESCOLITE	LBSE-6RD-35K8-WH	13W	120	
P	PENDANT MOUNT, 4 INCH ROUND CYLINDER	GOTHAM	EVO4CC-40/15-ARLSMWDMVOLT GZ1JBXCCCCANC120DWHAMF	14W	120	
X1	WALL MOUNTED EXIT SIGN W/EMERGENCY BACKUP	LITHONIA	LQC R EL N	30W	120	

EQUIPMENT CONNECTION SCHEDULE - SINGLE POINT CONNECTION

TAG	HP	VOLTAGE	PHASE	FLA	MCA	MOCP	POWER SOURCE	CIRCUIT BREAKER	WIRE SIZE	DISCONNECT SWITCH	DISCONNECT SIZE	FA SHUTDOWN	FA SUPPLY DUCT DETECTOR
CU-A1		208	3		40	60	PP-A (1)	9,11,13	1"C - 3#6, 1#10 G	FIELD PROVIDED	60A		
CU-A2		208	3		40	60	PP-A (1)	10,12,14	1"C - 3#6, 1#10 G	FIELD PROVIDED	60A		
CU-B		208	3		47	70	PP-A (1)	15,17,19	1.25"C - 3#4, 1#6 G	FIELD PROVIDED	100A		
CU-G		208	3		47	70	PP-1-4	11,13,15	1.25"C - 3#4, 1#6 G	FIELD PROVIDED	100A		
CU-H		208	3		47	70	PP-1-4	12,14,16	1.25"C - 3#4, 1#6 G	FIELD PROVIDED	100A		
CU-I		208	3		56	90	PP-1-2	2,4,6	1.25"C - 3#4, 1#6 G	FIELD PROVIDED	100A		
CU-J		208	3		56	90	PP-1-2	8,10,12	1.25"C - 3#4, 1#6 G	FIELD PROVIDED	100A		
CU-K		208	3		47	70	PP-1-2	13,15,17	1"C - 3#6, 1#10 G	FIELD PROVIDED	100A		
CU-L1		208	3		31	45	PP-1-2	19,21,23	1"C - 3#6, 1#10 G	FIELD PROVIDED	60A		
CU-L2		208	3		31	45	PP-1-2	20,22,24	1"C - 3#6, 1#10 G	FIELD PROVIDED	60A		
CU-M		208	3		23	35	PP-A (1)	16,18,20	1.25"C - 3#10, 1#12 G	FIELD PROVIDED	60A		
CUH-B-142A		120	1		3.88	15	LP-1-1	20	.75"C - 2#12, 1#12 G	FIELD PROVIDED	30A		
CUH-B-152		120	1		3.88	15	KP-1 (1)	40	.75"C - 2#12, 1#12 G	FIELD PROVIDED	30A		
ERU-A		208	3	94.7	113.6	125	SWBD ES		REFER TO DETAIL 1/E501	FACTORY PROVIDED		PROVIDE	PROVIDE
ERV-A		120	1	8	18	20	PP-A (1)	27	.75"C - 2#12, 1#12 G	FACTORY PROVIDED		PROVIDE	
ERV-B		120	1	8	18	20	PP-A (1)	22	.75"C - 2#12, 1#12 G	FACTORY PROVIDED		PROVIDE	
ERV-C		120	1	8	18	20	PP-A (1)	24	.75"C - 2#12, 1#12 G	FACTORY PROVIDED		PROVIDE	
ERV-D		120	1	8	18	20	PP-A (1)	29	.75"C - 2#12, 1#12 G	FACTORY PROVIDED		PROVIDE	
ERV-G		208	3	8.6	19.4	25	PP-1-4	5,7,9	.75"C - 3#10, 1#10 G	FACTORY PROVIDED		PROVIDE	PROVIDE
ERV-H		208	3	8.6	19.4	25	PP-1-4	6,8,10	.75"C - 3#10, 1#10 G	FACTORY PROVIDED		PROVIDE	PROVIDE
ERV-I		208	3	8.6	19.4	25	PP-1-2	1,3,5	.75"C - 3#10, 1#10 G	FACTORY PROVIDED		PROVIDE	PROVIDE
ERV-J		208	3	8.6	19.4	25	PP-1-2	7,9,11	.75"C - 3#10, 1#10 G	FACTORY PROVIDED		PROVIDE	PROVIDE
ERV-K		208	3	8.6	19.4	25	PP-1-2	14,16,18	.75"C - 3#10, 1#10 G	FACTORY PROVIDED		PROVIDE	PROVIDE
ERV-L		208	3	8.6	19.4	25	PP-1-2	26,27,29	.75"C - 3#10, 1#10 G	FACTORY PROVIDED		PROVIDE	PROVIDE
ERV-M		208	1	4.8	3.9	15	PP-A (1)	21,23	.75"C - 3#12, 1#12 G	FACTORY PROVIDED		PROVIDE	
ERV-N		208	1	4.8	3.9	15	PP-A (1)	28,30	.75"C - 3#12, 1#12 G	FACTORY PROVIDED		PROVIDE	
* F-B		120	1	12.5		3	PP-A (1)	34	.75"C - 2#12, 1#12 G	FIELD PROVIDED	30A	PROVIDE	
* F-C		120	1	2.45			KP-1 (1)	42	.75"C - 2#12, 1#12 G	FIELD PROVIDED	30A	PROVIDE	
GMU-A		120	1				LP-G-1	7	.75"C - 2#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-A-156D		208	1		3	15	PP-A (1)	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-B-254		208	1		4.1	15	PP-A (1)	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-C-252		208	1		4.1	15	PP-A (1)	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-D-154		208	1		4.1	15	PP-A (1)	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-E-151		208	1		4.1	15	PP-A (1)	5,7	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-E-155		208	1		4.1	15	PP-A (1)	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-E-158		208	1		4.1	15	PP-A (1)	5,7	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-E-251		208	1		4.1	15	PP-A (1)	5,7	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-E-255		208	1		4.1	15	PP-A (1)	5,7	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-E-259		208	1		4.1	15	PP-A (1)	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-F-129		208	1		4.1	15	LP-1-2B	17,19	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-F-257		208	1		4.1	15	PP-A (1)	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-103		208	1		4.1	15	PP-1-4	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-104		208	1		4.1	15	PP-1-4	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-113		208	1		4.1	15	PP-1-4	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-114		208	1		4.1	15	PP-1-4	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-115		208	1		4.1	15	PP-1-4	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-116		208	1		4.1	15	PP-1-4	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-118		208	1		4.1	15	LP-1-2A	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-120		208	1		4.1	15	LP-1-2A	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-122		208	1		4.1	15	LP-1-2A	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-G-123		208	1		4.1	15	LP-1-2B	17,19	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-H-101		208	1		4.1	15	PP-1-4	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-H-102		208	1		4.1	15	PP-1-4	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-124		208	1		4.1	15	LP-1-2B	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-125		208	1		4.1	15	LP-1-2B	17,19	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-126		208	1		4.1	15	LP-1-2B	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-127		208	1		4.1	15	LP-1-2B	17,19	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-128		208	1		4.1	15	LP-1-2B	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-130		208	1		4.1	15	LP-1-2B	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-132		208	1		4.1	15	LP-1-2B	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-134		208	1		4.1	15	LP-1-2B	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-I-136		208	1		4.1	15	LP-1-2B	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-J-117		208	1		5.6	15	LP-1-2A	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-AHU-K-138		208	1		5.6	15	LP-1-2B	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-A-119A		208	1		0.28	15	LP-1-2A	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-A-121		208	1		0.28	15	LP-1-2A	2,4	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-A-253		208	1		0.28	15	PP-6	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-A-253A		208	1		0.28	15	PP-6	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-B-149C		208	1		0.28	15	LP-1-1	11,13	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-B-149G		208	1		0.28	15	LP-1-1	11,13	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-B-149H		208	1		0.28	15	LP-1-1	11,13	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-C-149B		208	1		0.29	15	LP-1-1	11,13	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-D-256		208	1		0.5	15	PP-6	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-D-258		208	1		0.5	15	PP-6	1,3	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-E-149A		208	1		0.5	15	LP-1-1	11,13	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-C-E-149D		208	1		0.5	15	LP-1-1	11,13	.75"C - 3#12, 1#12 G	FIELD PROVIDED	30A		
ISU-EXR-135		0											
ISU-EXR-135B1		0											
ISU-EXR-135B2		0											
ISU-EXR-814		0											
P-A-1	7.5	208	3	17.5		40	LP-G-1	2,4,6	.75"C - 3#8, 1#10 G	FIELD PROVIDED	60A		
P-A-2	7.5	208	3	17.5		40	LP-G-1	1,3,5	.75"C - 3#8, 1#10 G	FIELD PROVIDED	60A		
RTU-A		208	3		33	45	PP-1-2	26,28,30	.75"C - 3#8, 1#10 G	FACTORY PROVIDED		PROVIDE	PROVIDE

* PROVIDE REQUIRED CONTROL INTERCONNECTION BETWEEN KITCHEN HOOD CONTROL PANEL AND: HOOD EXHAUST FAN CONTROLLER, KITCHEN AREA MAKE-UP AIR FAN CONTROLLER AND HOOD FIRE PROTECTION CONTROL PANEL. REFER TO FOOD SERVICE DRAWING NO. PES FS105.

LIGHTING SEQUENCE OF OPERATION (SOO)

SEQUENCE A - CLASSROOMS
- OCCUPANCY SENSOR(S) FOR AUTO ON/OFF OF ALL FIXTURES AFTER 15MIN. TIME DELAY.
- DAYLIGHT SENSOR(S) TO ACTUATE PRESET DIMMING LEVEL FOR 'DS' FIXTURES, BASED ON DAYLIGHT AVAILABLE IN SPACE, WITH DIM-TO-OFF FUNCTIONALITY.
- SCENE CONTROLLER FUNCTIONALITY:
  1. BUTTON 1: ON/OFF ALL FIXTURES
  2. BUTTON 2: DIM UP OF ALL FIXTURES
  3. BUTTON 3: DIM DOWN OF ALL FIXTURES

SEQUENCE B - GENERAL OFFICES
- OCCUPANCY SENSOR(S) FOR AUTO OFF OF ALL FIXTURES AFTER 15MIN. TIME DELAY.
- SCENE CONTROLLER FUNCTIONALITY:
  1. BUTTON 1: ON/OFF ALL FIXTURES
  2. BUTTON 2: DIM UP OF ALL FIXTURES
  3. BUTTON 3: DIM DOWN OF ALL FIXTURES

SEQUENCE C - BATHROOMS/TOILET ROOMS
- OCCUPANCY SENSOR(S) FOR AUTO ON/OFF OF ALL FIXTURES WITH 15MIN. TIME DELAY.
- KEY SWITCH FUNCTIONALITY:
  1. SWITCH 1: ON/OFF EM BATHROOM FIXTURES
  2. SWITCH 2: ON/OFF NON-EM BATHROOM FIXTURES

SEQUENCE D - VESTIBULES/CORRIDORS
- OCCUPANCY SENSOR(S) TO DIM FIXTURES TO 50% WHEN SPACE IS NOT OCCUPIED WITH 30MIN. TIME DELAY.
- KEY SWITCH FUNCTIONALITY:
  1. SWITCH 1: ON/OFF EM FIXTURES
  2. SWITCH 2: ON/OFF NON-EM FIXTURES

**REFER TO SECTION 260923 LIGHTING CONTROL DEVICES SPECIFICATION DOCUMENTS FOR SYSTEM REQUIREMENTS.

GENERAL NOTES:
LIGHTING CONTROL DEVICES ARE SHOWN ON LIGHTING PLANS FOR REFERENCE ONLY. PROVIDE POWER PACKS AND ROOM CONTROLLERS AS NEEDED TO SUPPORT SEQUENCING INDICATED FOR EACH SPACE.

THE CONTRACTOR SHALL PROVIDE SHOP DRAWINGS OF A COMPLETE LIGHTING CONTROL SYSTEM WITH ALL DEVICES SHOWN ON A REFLECTED CLINGS PLAN. SHOP DRAWINGS SHALL BE DRAWN TO SCALE AND SENT TO THE ENGINEER FOR APPROVAL PRIOR TO INSTALLATION.

NOTES:
- FIXTURES TAGGED 'NL' SHALL BE CONTINUOUS OPERATION NIGHT LIGHTING FIXTURES, AND SHALL BE CONNECTED TO LIGHTING POWER CIRCUIT AHEAD OF ALL SWITCHING AND CONTROLS.
- ALL EMERGENCY FIXTURES SHALL BE ENERGIZED TO 100% LIGHTING OUTPUT WITHIN 10 SECONDS OF LOSS OF POWER. ALL CONTROL SETTINGS SHALL BE OVERRIDDEN DURING A LOSS OF POWER EVENT.
- LIGHTING CONTROLS SHALL BE WIRELESS TYPE, USING WIRELESS, LITHIUM BATTERY POWERED WALL SWITCHES WITH CONFIGURATIONS AS REQUIRED BY SEQUENCES ABOVE.

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PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

STATE OF NEW YORK JAMES R. BARRETT 073467 LICENSED PROFESSIONAL ENGINEER
EXPIRES 5/31/2026

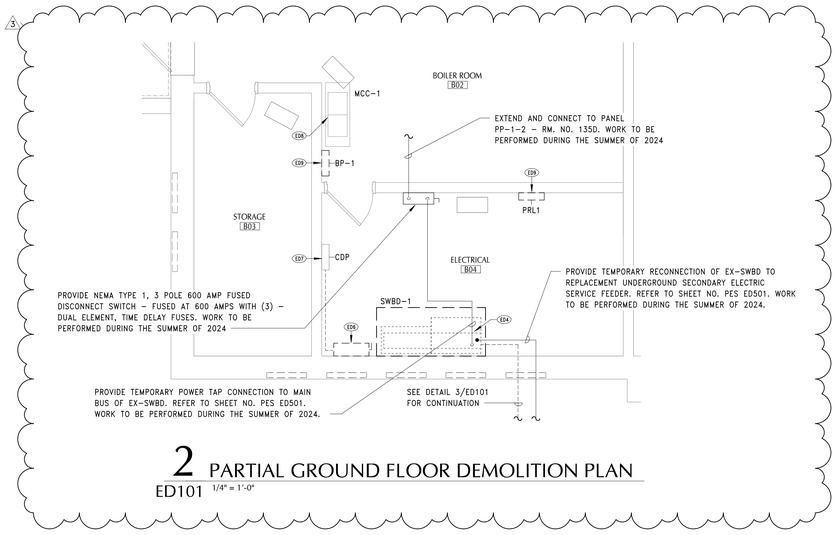
#	DATE	DESCRIPTION
3	11/29/2023	BID ADDENDUM #3

Drawn By: NDH
Checked By: JRB
Proj. #: 13-12-01-04-0-001-024
CSArch Proj. #: 208-2101.03
Issued for Bid: 11/03/23

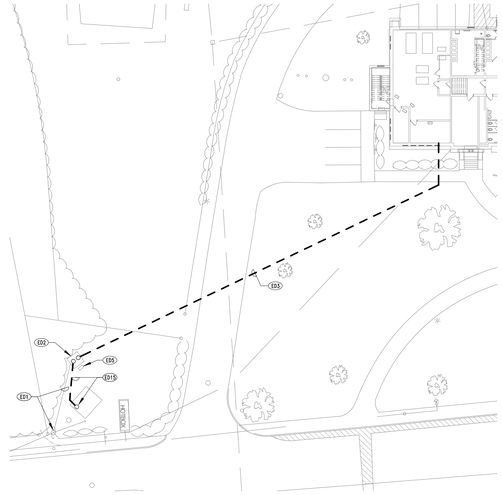
Sheet Title
SCHEDULES

Sheet No.
PES
E902

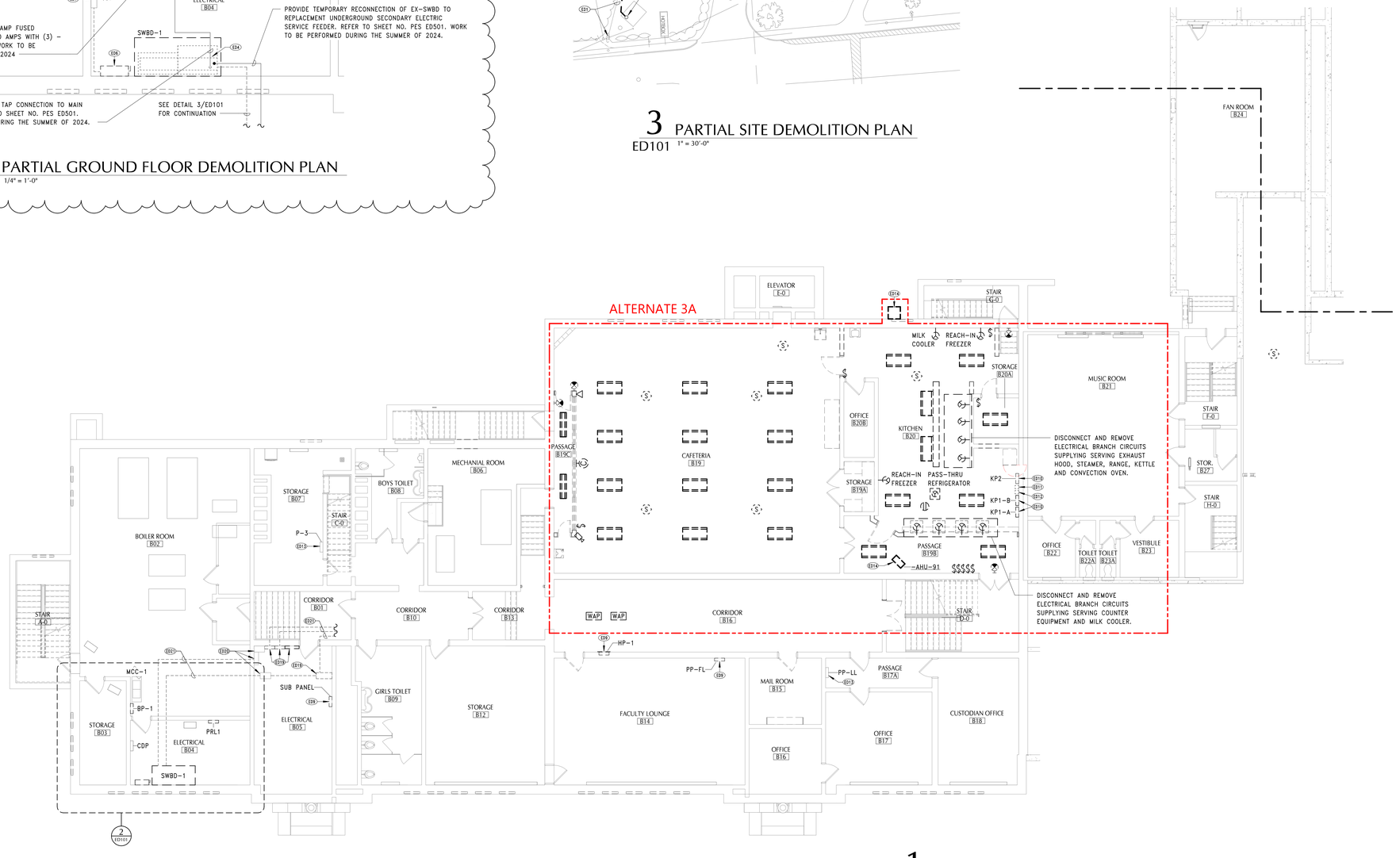
CONSTRUCTION DOCUMENTS



2 PARTIAL GROUND FLOOR DEMOLITION PLAN
ED101 1/4" = 1'-0"



3 PARTIAL SITE DEMOLITION PLAN
ED101 1" = 30'-0"



1 DEMOLITION GROUND FLOOR PLAN - AREA '1'
ED101 1/8" = 1'-0"

SHEET NOTES

A. BEFORE REMOVAL OR MODIFICATION OF ANY EXISTING CIRCUITS, FIELD VERIFY IF CIRCUITS FEED OTHER AREAS OF THE BUILDING REQUIRED TO REMAIN ENERGIZED DURING CONSTRUCTION.

B. ALL EXISTING WIRING AND CONDUIT TO ELECTRICAL ITEMS SHOWN AS DEMOLISHED-ON THIS DRAWING SHALL BE REMOVED IN IT'S ENTIRETY BACK TO SOURCE PANELBOARD. LABEL CIRCUIT BREAKER AS SPARE IN EXISTING PANELBOARD DIRECTORY.

C. WHERE REQUIRED TO DISCONNECT OR MODIFY PART OF AN EXISTING CIRCUIT SERVING AREAS OUTSIDE OF THE DEMOLITION SCOPE, THE CIRCUIT SHALL BE RECONNECTED AND MODIFIED TO MAINTAIN CONTINUITY.

D. MAINTAIN CONTINUITY OF ALL EXISTING TO REMAIN BRANCH CIRCUITS.

E ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR PROGRAMMING OF THE EXISTING FIRE ALARM SYSTEM TO ACCOUNT FOR THE REMOVAL OF DEVICES FROM THE EXISTING FIRE ALARM SYSTEM. PROVIDE ALL NECESSARY FIRE WATCHES IN AREAS WITHOUT COVERAGE WHEN FIRE ALARM SYSTEM IS OFF LINE.

F. DISCONNECT ELECTRICAL CONNECTIONS TO MECHANICAL AND OTHER EQUIPMENT BEING REMOVED BY OTHER TRADES.

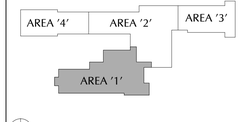
G. REMOVE ABANDONED RACEWAYS, BOXES, SUPPORTS, ETC. WHERE EXPOSED (INCLUDING THOSE LOCATED ABOVE EXISTING SUSPENDED CEILING) AND WHERE THEY INTERFERE WITH WORK OF ANY TRADE.

H. PROVIDE ALL BUILDING SURFACE RESTORATION OF EXISTING PENETRATIONS ASSOCIATED WITH REQUIRED ELECTRICAL DEMOLITION WORK. PATCH AND PAINT TO MATCH SURROUNDING EXISTING SURFACES AS NECESSARY. FOR PENETRATIONS LEFT IN FIRE RATED CONSTRUCTION, PROVIDE REQUIRED FIRESTOPPING PER SPECIFICATION SECTION 078413.

KEY NOTES

ED1	EXISTING UNDERGROUND 15KV, 3 PHASE PRIMARY ELECTRIC SERVICE FEEDER FROM EXISTING NEW YORK STATE ELECTRIC & GAS (NYSEG). OVERHEAD POWER DISTRIBUTION RISER POLE TO REMAIN.
ED2	EXISTING NYSEG OWNED PAD MOUNTED TRANSFORMER - 7.62/13.2Y KV:208Y/120V, 3 PHASE, 4 WIRE 150KVA. UPON TRANSITION OF BUILDING ELECTRIC SERVICE ENTRANCE CONNECTION FROM UTILITY TO REPLACEMENT ELECTRICAL EQUIPMENT AND EXISTING PAD MOUNTED TRANSFORMER HAS BEEN REMOVED BY THE UTILITY, REMOVE CONCRETE PAD, CURBING AND ASSOCIATED GROUNDING. PROVIDE COMPLETE SITE RESTORATION OF EXISTING PAD MOUNTED TRANSFORMER LOCATION.
ED3	DISCONNECT AND REMOVE EXISTING UNDERGROUND 208/120V, 3 PHASE SECONDARY ELECTRIC SERVICE FEEDER - (4) SETS OF (4-500 MCM IN 4" CONDUIT). CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING UNDERGROUND SERVICE LOCATOR SERVICES AS REQUIRED TO ACCURATELY IDENTIFY EXISTING ROUTE/BURIAL DEPTH. PROVIDE COMPLETE SITE RESTORATION OF EXISTING UNDERGROUND ELECTRIC SERVICE FEEDER TRENCHING. WORK TO BE PERFORMED DURING THE SUMMER OF 2024.
ED4	DISCONNECT AND REMOVE EXISTING MAIN ELECTRIC SERVICE ENTRANCE SWITCHBOARD. UNLESS INDICATED OTHERWISE MAINTAIN ALL EXISTING ACTIVE POWER DISTRIBUTION FEEDERS FOR REUSE AND RECONNECTION TO REPLACEMENT ELECTRIC SERVICE ENTRANCE SWITCHBOARD. WORK SHALL BE PERFORMED PER ESTABLISHED CONSTRUCTION SEQUENCE. REFER TO DEMO RISER DIAGRAM FOR FULL DETAIL. WORK TO BE PERFORMED DURING THE SUMMER OF 2024.
ED5	DISCONNECT AND REMOVE EXISTING ELECTRIC SERVICE METER SOCKET ENCLOSURES. REFER TO DEMOLITION RISER DIAGRAM - DRAWING PES ED501. TURN METER OVER TO NYSEG. WORK TO BE PERFORMED DURING THE SUMMER OF 2024.
ED8	DISCONNECT AND REMOVE EXISTING 3 POLE, 400 AMP, 208/120 VOLT DISCONNECT SWITCH WITH ASSOCIATED LINE AND LOAD SIDE POWER CONNECTIONS. TURN SWITCH OVER TO THE SCHOOL DISTRICT.
ED7	EXISTING PANEL "CDP" TO BE MAINTAINED FOR REUSE. DISCONNECT AND REMOVE POWER SUPPLY FEEDER. MAINTAIN ALL EXISTING BRANCH CIRCUIT WIRING.
ED8	EXISTING 600 AMP, 208/120 VOLT DOUBLE SECTION MOTOR CONTROL CENTER TO REMAIN. MAINTAIN SUPPLY FEEDER AND ALL EXISTING ACTIVE BRANCH CIRCUIT WIRING FOR REUSE.
ED9	DISCONNECT AND REMOVE EXISTING PANEL AND SUPPLY FEEDER BACK TO SOURCE. UNLESS INDICATED OTHERWISE, MAINTAIN ALL EXISTING BRANCH CIRCUIT WIRING FOR RECONNECTION TO REPLACEMENT PANEL.
ED10	DISCONNECT AND REMOVE EXISTING PANEL. DISCONNECT AND REMOVE PANEL SUPPLY FEEDER AND ALL EXISTING BRANCH CIRCUIT WIRING.
ED11	DISCONNECT AND REMOVE BANK OF (3)-EXISTING 2 KVA BOOST DRY TYPE TRANSFORMERS.
ED12	DISCONNECT AND REMOVE EXISTING MOTOR CONTROLLER ENCLOSURE WITH ALL LINE AND LOAD SIDE WIRING.
ED13	EXISTING PANEL, ASSOCIATED SUPPLY FEEDER AND ALL BRANCH CIRCUIT WIRING TO BE MAINTAINED FOR REUSE UNLESS OTHERWISE NOTED.
ED14	DISCONNECT POWER FROM EXISTING HVAC EQUIPMENT. REMOVE BRANCH CIRCUIT WIRE AND CONDUIT BACK TO POWER SOURCE PANELBOARD.
ED15	DISCONNECT AND REMOVE UNDERGROUND ELECTRIC SERVICE TO EXISTING SEWAGE PUMP STATION. REFER TO DEMOLITION RISER DIAGRAM - DRAWING PES ED501. DISCONNECT AND REMOVE EXISTING NYSEG METER SOCKET ENCLOSURE. TURN EXISTING METER OVER TO NYSEG.
ED19	DISCONNECT AND REMOVE EXISTING ELECTRICAL SPLICE/JUNCTION ENCLOSURES WITH ASSOCIATED LINE (TO MAIN ELECTRICAL SWITCHBOARD) AND LOAD SIDE (BRANCH PANELBOARDS) POWER CONNECTIONS INDICATED. REFER TO DEMOLITION RISER DIAGRAM - DRAWING PES ED501. MAINTAIN INDICATED EXISTING FEEDER CONDUCTORS TO REMAIN FOR RECONNECTION TO REPLACEMENT SWITCHBOARD.
ED20	EXISTING 12 INCH SQUARE FEEDER WIREWAY ASSEMBLIES TO REMAIN.
ED21	UNLES OTHERWISE NOTED, DISCONNECT AND REMOVE EXISTING FEEDER CONDUCTORS/CONDUITS. REFER TO DRAWING ED501 - DEMOLITION RISER DIAGRAM.

KEY PLAN



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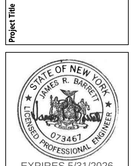
2020 CAPITAL PROJECT - PHASE 3

Project Title



EXPIRES 5/31/2026

#	DATE	DESCRIPTION
3	11/29/2023	BID ADDENDUM #3

Drawn By:	NDH
Checked By:	JRB
Proj. #:	13-12-01-04-0-001-024
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Issued for Bid:	11/03/23

Sheet Title
GROUND FLOOR DEMOLITION PLAN - AREA '1'

Sheet No.
PES ED101

CONSTRUCTION DOCUMENTS

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EXISTING MAIN ELECTRIC SERVICE ENTRANCE SWITCHBOARD EX-SWBD SCHEDULE			
SECTION NO. 1	SECTION NO. 2		
1,200 AMP, 3 POLE, FUSED BOLTED PRESSURE CONTACT SWITCH	400 AMP, 3 POLE FRAME/400 AMP TRIP: PANEL "KP-1" – (4)–500KCMIL, IN 3–1/2" CONDUIT.	250 AMP, 3 POLE FRAME/125 AMP TRIP: PANEL "11" (BUS OFFICE) – (4)–#2 AWG, IN 1–1/2" CONDUIT.	100 AMP, 2 POLE FRAME/100 AMP TRIP: PANEL "I" – (3)–#2 AWG, IN 1–1/2" CONDUIT.
	250 AMP, 3 POLE FRAME/225 AMP TRIP: PANELS "N" & "S" – (4)–#4/0 AWG, IN 2–1/2" CONDUIT.	250 AMP, 3 POLE FRAME/200 AMP TRIP: ELEVATOR – (4)–#2/0 AWG, IN 2–1/2" CONDUIT.	100 AMP, 2 POLE FRAME/100 AMP TRIP: PANEL "II" – (3)–#2 AWG, IN 1–1/2" CONDUIT.
	250 AMP, 3 POLE FRAME PREPARED SPACE.	250 AMP, 3 POLE FRAME/100 AMP TRIP: PANEL "FP-1" – (4)–#2 AWG, IN 1–1/2" CONDUIT.	100 AMP, 2 POLE FRAME/100 AMP TRIP: PANEL "III" – (3)–#2 AWG, IN 1–1/2" CONDUIT.
	250 AMP, 3 POLE FRAME/200 AMP TRIP: PANELS "MCC-1" – (4)–#3/0 AWG, IN 2–1/2" CONDUIT.	250 AMP, 3 POLE FRAME/100 AMP TRIP: PUMP ROOM COMPRESSOR – (4)–#2 AWG, IN 1–1/2" CONDUIT.	100 AMP, 2 POLE FRAME/100 AMP TRIP: PANEL "IV" – (3)–#2 AWG, IN 1–1/2" CONDUIT.
	250 AMP, 3 POLE FRAME/175 AMP TRIP: PANEL "8" (STAGE) – (4)–#2/0 AWG, IN 2–1/2" CONDUIT.	250 AMP, 3 POLE FRAME/100 AMP TRIP: PANEL "BP-1" (BOILER RM) – (4)–#2 AWG, IN 1–1/2" CONDUIT.	100 AMP, 2 POLE FRAME/100 AMP TRIP: PANEL "V" – (3)–#2 AWG, IN 1–1/2" CONDUIT.
	250 AMP, 3 POLE FRAME/175 AMP TRIP: PANEL "10" (GYM HALL) – (4)–#2/0 AWG, IN 2–1/2" CONDUIT.	250 AMP, 3 POLE FRAME/100 AMP TRIP: PANEL "12" (OLD COPY RM) – (4)–#2 AWG, IN 1–1/2" CONDUIT.	100 AMP, 2 POLE FRAME/100 AMP TRIP: PANEL "VI" – (3)–#2 AWG, IN 1–1/2" CONDUIT.
	250 AMP, 3 POLE FRAME/150 AMP TRIP: PANEL "9" (SOUTH CORR) – (4)–#1/0 AWG, IN 2" CONDUIT.		100 AMP, 2 POLE FRAME/100 AMP TRIP: PANEL "VII" – (3)–#2 AWG, IN 1–1/2" CONDUIT.
			100 AMP, 2 POLE FRAME/50 AMP TRIP: – (3)–#8 AWG, IN 1" CONDUIT.
			100 AMP, 2 POLE FRAME/60 AMP TRIP: – (3)–#8 AWG, IN 1" CONDUIT.
			100 AMP, 3 POLE FRAME/70 AMP TRIP: – (4)–#4 AWG, IN 1" CONDUIT.
			100 AMP, 3 POLE FRAME/70 AMP TRIP: – (4)–#4 AWG, IN 1" CONDUIT.
			100 AMP, 1 POLE FRAME/20 AMP TRIP: – (2)–#12 AWG, IN 3/4" CONDUIT.
			100 AMP, 1 POLE FRAME/20 AMP TRIP: – (2)–#12 AWG, IN 3/4" CONDUIT.
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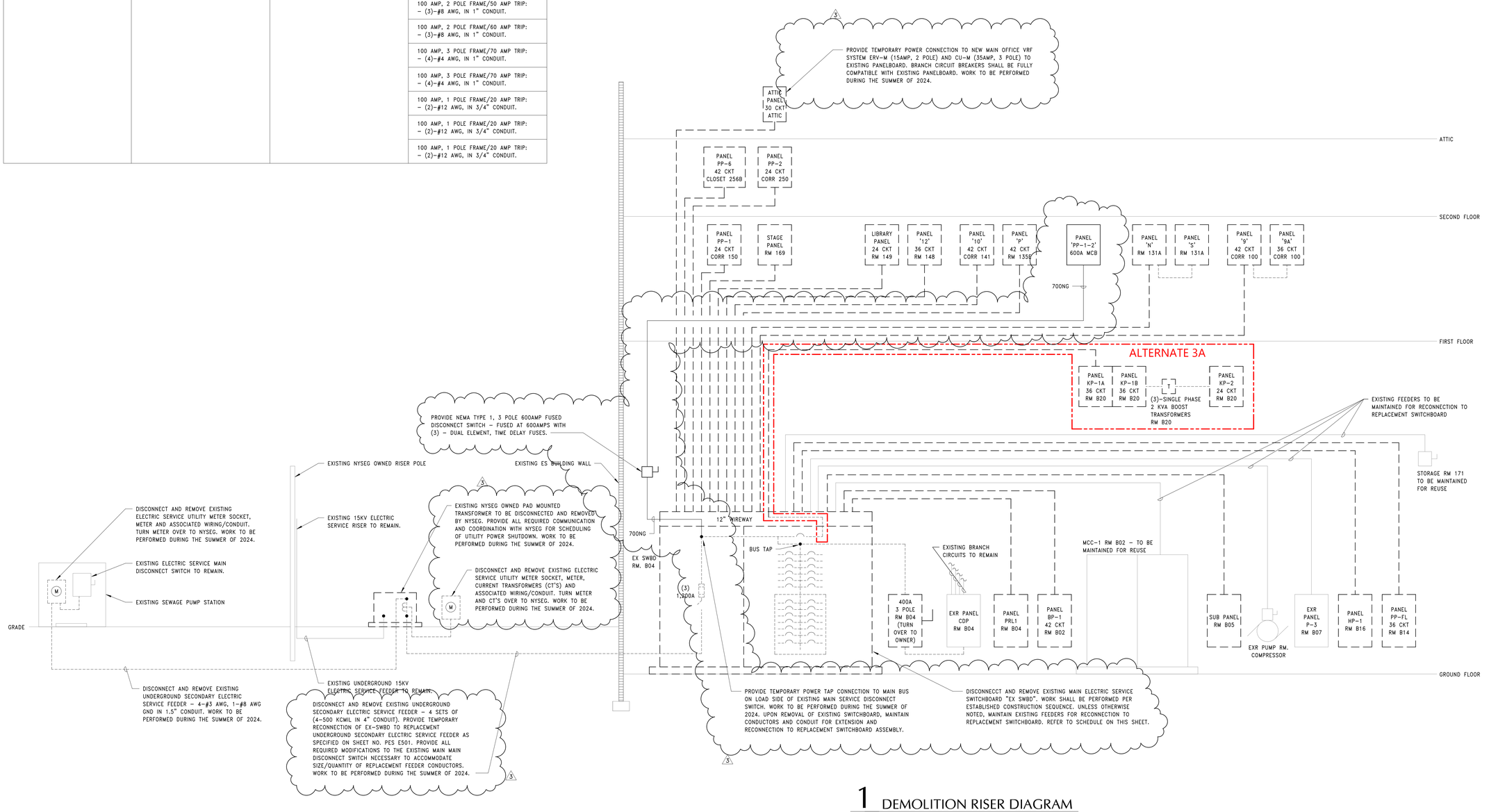

1 DEMOLITION RISER DIAGRAM
ED501 NTS

NOTE: ALL DEMO RISER DIAGRAM COMPONENTS SHOWN DASHED SHALL BE DISCONNECTED AND REMOVED.

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Consultant

PAWLING CENTRAL SCHOOL DISTRICT
PAWLING ELEMENTARY SCHOOL
2020 CAPITAL PROJECT - PHASE 3

Project Title

STATE OF NEW YORK JAMES R. BARRETT 073467 LICENSED PROFESSIONAL ENGINEER
EXPIRES 5/31/2026

#	DATE	DESCRIPTION
3	11/29/2023	BID ADDENDUM #3

Drawn By:	NDH
Checked By:	JRB
Proj. #:	13-12-01-04-0-001-024
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Issued for Bid:	11/03/23

Sheet Title
DEMOLITION RISER DIAGRAM

Sheet No.
PES ED501

CONSTRUCTION DOCUMENTS