

EXHIBIT F

**ADDENDUM 1                      November 9, 2016**

RE:                      UTHSC  
                             Switchgear Replacement

FROM:                 Shah Smith and Associates, Inc.  
                             2825 Wilcrest Dr., Ste. 350  
                             Houston, TX 77042

TO:                      UTHSC (Owner)

This Addendum forms a part of the Contract Documents and modifies the original Construction Documents dated September 30, 2016 as noted below:

This Addendum consists of the following updated plans and specifications.

**Drawings:**

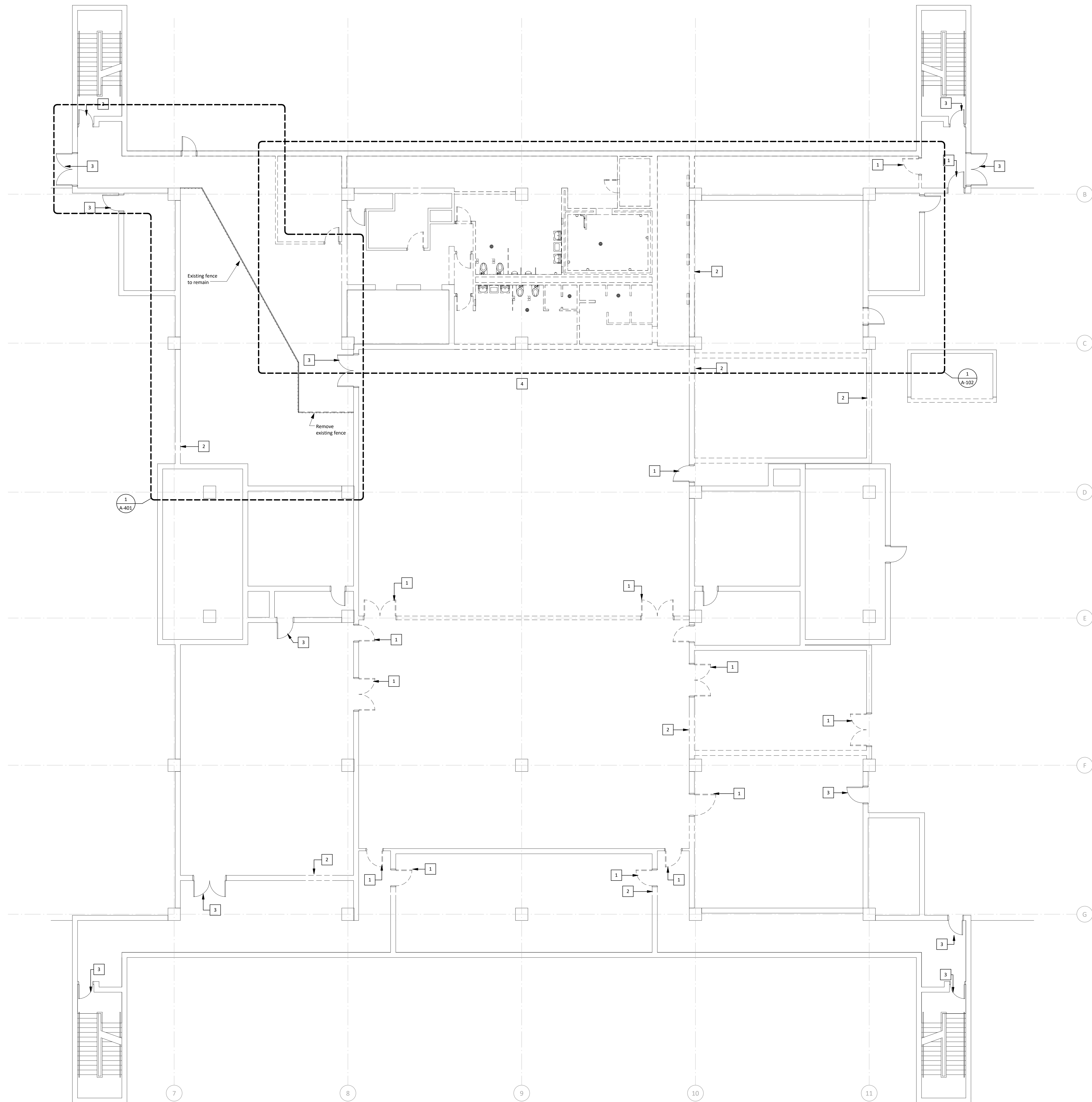
1. Sheet A-101 – Added Floor Note
2. Sheet A-111 – Updated Detail
3. Sheet A-400 – Added Notes
4. Sheet A-401 – Added Floor Note
5. Sheet A-540 – Updated door sizes.
6. Sheet E016 - Updated wiring requirements.

**Specifications:**

1. 26 12 16 – Dry type transformers – Above 600 Volt Primary and rated larger than 500 KVA – Issuing new specification in full.
2. 26 22 14 – Corrected spec number in footer. Changes are shown bold.

END OF ADDENDUM 1

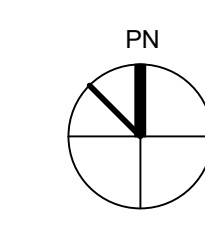
C:\Users\dsandoval\Documents\215-218R UTHSC MSB Switchgear (Central)\_dsandoval.rvt 11/9/2016 9:42:11 AM



- Keyed Notes**
- 1 Remove existing door, frame and hardware.
  - 2 Remove portion of existing wall for new door opening.
  - 3 Existing door, frame and hardware to remain.
  - 4 Remove existing basketball framing and items, above.

- General Notes - Demolition Plan**
1. Contractor to demolish and dispose of all items shown / noted to be removed, unless otherwise noted.
  2. Before starting the demolition work, confirm all dimensions and other existing conditions in the field. Report any discrepancies to the Engineer and Architect.
  3. See MEP drawings for removal of any utilities.
  4. Raised floor where the gym used to be will remain except where you have bearing for the stairs and lifts, those points should be cut to rest directly on the slab.

- Legend - Floor/Demo Plan**
- Existing to be removed
  - Existing to remain
  - New Partitions



First Floor - Architectural Plan

1/8" = 1'-0"

6

Demolition Notes

2

**Demolition Notes:**

1. The Contractor shall be responsible for the protection against vandalism/unauthorized entry, etc. during the removal and replacement of the interior envelope. Do not leave building components unprotected or uncovered after hours.
2. Contractor to provide protection, as required during construction, at all remaining utilities (clean outs, gas valves, etc.).
3. Coordinate with Owner proper access and location for waste disposal and location of dumpsters.
4. Contractor to demolish and dispose of all items shown/noted to be removed, verify with owner items to be recycled. Items noted to be reused or returned to Owner shall be cleaned thoroughly by Contractor prior to storage or re-installation.
5. Contractor to remove all electrical outlets, voice/data outlets, light switches, and thermostats affected by demolition work. Contractor shall cap all involved wiring and revise any necessary changes on respective electrical panels.
6. The building will remain occupied during demolition/renovation. Contractor to coordinate shut-downs and tie-ins to all mechanical, electrical, plumbing, communications, fire alarms, and sprinkler systems to minimize disruptions to building occupants.
7. Contractor to protect existing smoke detectors from dust/debris during demolition/renovation to prevent accidental trigger of the alarm system.
8. Contractor will be responsible for the protection of existing furniture, equipment, finishes, etc. during demolition/renovation. Items damaged will be repaired or replaced with new at Contractor's expense.
9. Contractor to provide and maintain corridor access and fire egress requirements during all demolition/renovation construction phases.
10. Contractor to protect existing doors, frames, or hardware remaining during demolition/renovation. Contractor to paint any existing frames remaining after construction to match existing. Clean and refurbish any salvaged door hardware for re-installation. Replace any non-code compliant hardware with new to match existing building standards.
11. Contractor to remove all existing floor and ceiling finishes in demolition area, unless noted otherwise.
12. Coordinate with Owner for removal of all cameras/readers/ etc.
13. Contractor shall adhere to all Life Safety and Indoor Air Quality Control standards at all times. Non-compliance may result in the shut-down of activities, in which no time extension or additional costs to the Owner will be allowed.
14. Maintenance of indoor air quality is critical in areas of all facilities. Construction causing disturbance or existing dust, or creating new dust, odors, etc. must be conducted in tight enclosures that prohibit the flow of particles into sensitive areas. The contractor is required to provide dust barriers as determined by the project manager, Environmental Health and Safety and/or Infection Control.
15. Contractor shall protect all column/composite deck with existing fireproofing. Contractor will be responsible to ensure that any damaged fire proofing is replaced for approved required rating.
16. Contractor to make best effort to salvage doors, frames, hardware, etc. and conform with O&M if they want to warehouse salvaged items.
17. Contractor responsible to inspect existing conditions for all window frames and sills for damage including but not limited to scratches, cracks and dents.

**SHAH SMITH & ASSOCIATES, INC.**  
 2825 Wilcrest, Suite #350 Houston, Texas 77042  
 Ph. 713.780.7563 Fax. 713.780.9209  
 Texas Registered Engineering Firm F-2113

**Philo Wilke Partnership**  
 11275 S. Sam Houston Parkway W. Suite 200  
 Houston, Texas 77031  
 (832) 554-1130  
 www.pwarch.com

**Pinnacle Structural Engineers**  
 3120 Southwest Freeway, Suite 410  
 Houston, TX 77098  
 713.807.8911

**UTHealth**  
 The University of Texas  
 Health Science Center at Houston

5	Addendum 1	11/09/2016
4	Issued for Construction	09/30/2016
3	100% CD Review	06/24/2016
2	90% CD Review	05/13/2016
1	50% Construction Documents	02/10/2016

No.	Description	Date
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Keyplan

*Carlynn J. Hanna*  
 REGISTERED ARCHITECT  
 STATE OF TEXAS  
 11/09/2016

The University of Texas  
 Health Science Center at  
 Houston

**MSB SWITCHGEAR REPLACEMENT**  
 Demolition Plan

PWP Project Number	215-218R
Date	11/09/2016
Designed By	DS
Checked By	BL
Drawing No.	<b>A-101</b>
Scale	As indicated

No.	Description	Date
5	Addendum 1	11/09/2016
4	Issued for Construction	09/30/2016
3	100% CD Review	06/24/2016
2	90% CD Review	05/13/2016
1	50% Construction Documents	02/10/2016

Keyplan

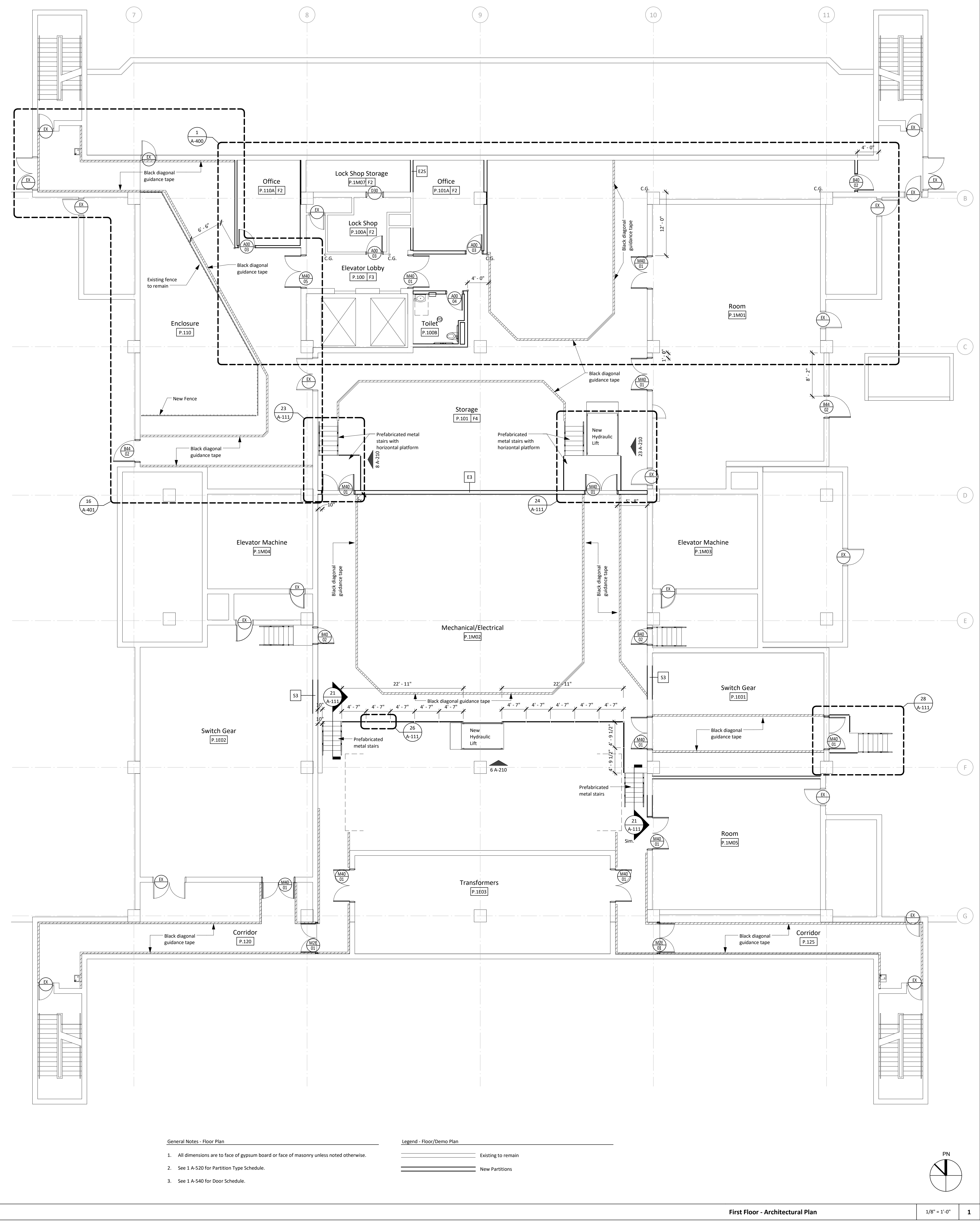


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Houston

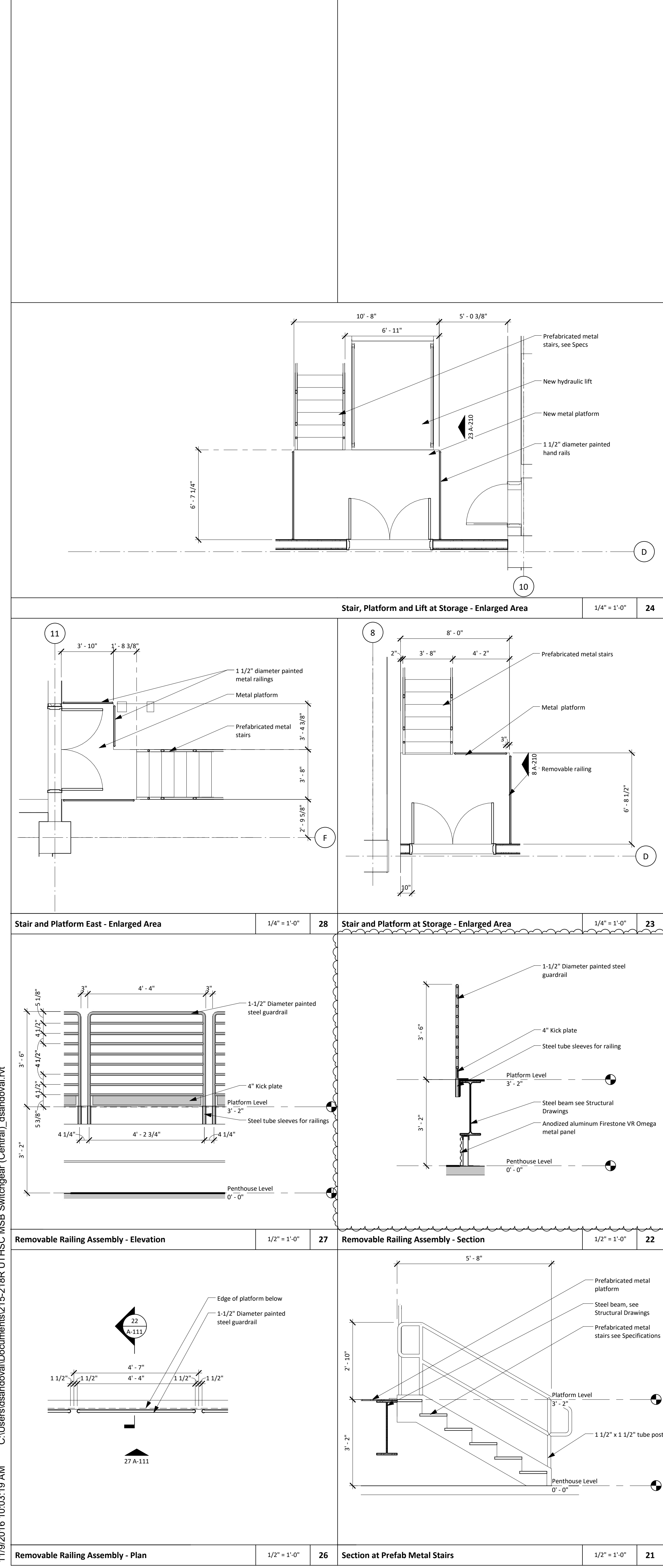
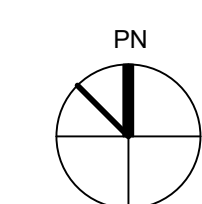
**MSB SWITCHGEAR  
REPLACEMENT  
Floor Plan**

PWP Project Number	215-218R
Date	11/09/2016
Designed By	DS
Checked By	BL
Drawing No.	A-111

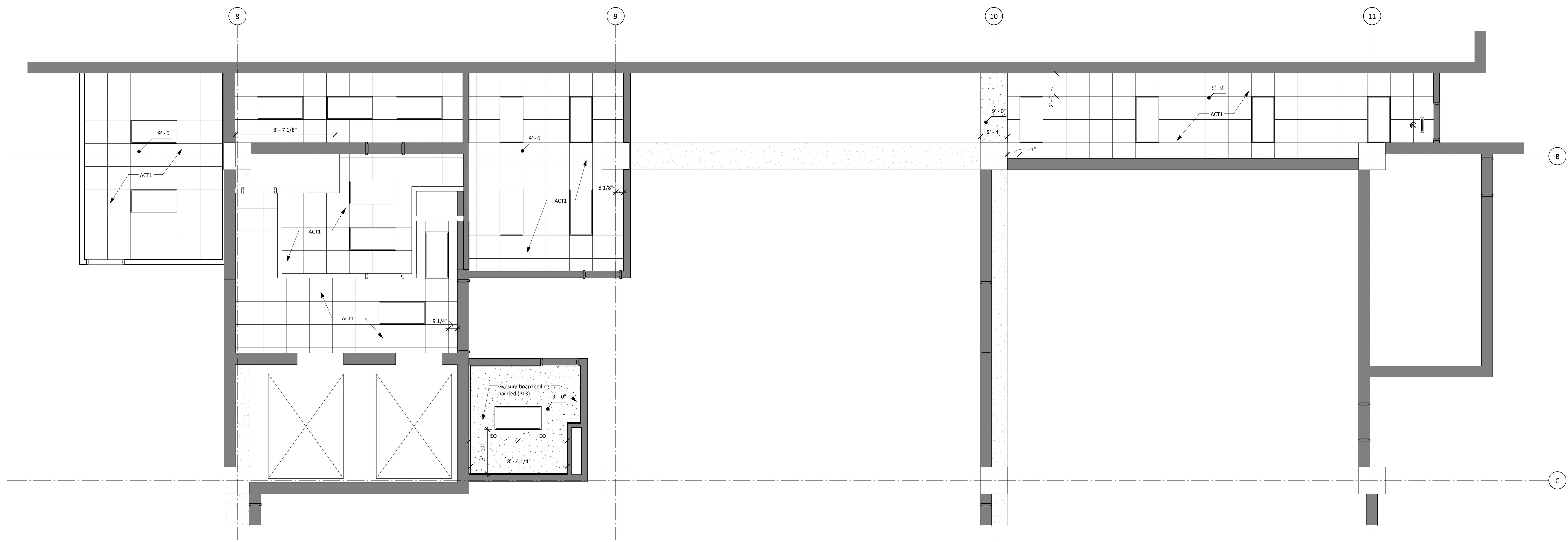
Scale As indicated



- General Notes - Floor Plan**
- All dimensions are to face of gypsum board or face of masonry unless noted otherwise.
  - See 1 A-520 for Partition Type Schedule.
  - See 1 A-540 for Door Schedule.
- Legend - Floor/Demo Plan**
- Existing to remain
  - New Partitions



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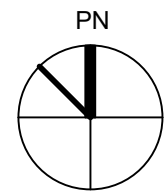


**General Notes - Reflected Ceiling Plan**

- All new ceilings to be 2' x 2' lay-in acoustical ceiling tile at 9'-0" a.f.f., unless noted otherwise. See Finish Schedule for types.
- See Interior Elevations for furr down heights and dimensions.
- Center all down-lights, sprinkler heads, and wall washers in center of ceiling tile, unless noted otherwise.

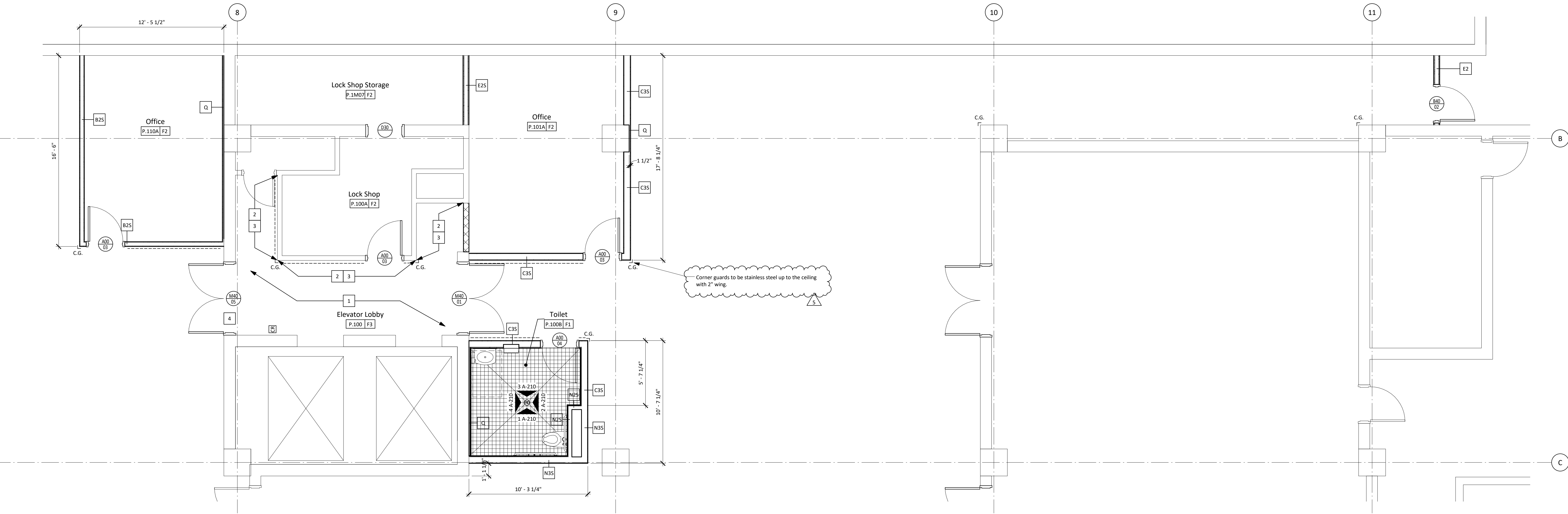
**Legend - Reflected Ceiling Plan**

— New partition to structure. See 1 A-520 for partition schedule.



Penthouse Level - Office, Restroom and Corridor

1/4" = 1'-0" 3



**Keyed Notes**

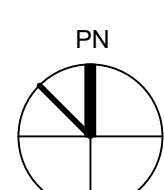
- Patch and repair wall as needed. Paint to match existing (Worldly Grey).
- Remove gypsum, replace with impact resistant gypsum. Existing stud framing to remain.
- Replace stud framing damaged by demolition activities.
- Remove existing mechanical duct opening above door. Infill opening to match adjacent partition rating.

**General Notes - Floor Plan**

- All dimensions are to face of gypsum board or face of masonry unless noted otherwise.
- See 1 A-520 for Partition Type Schedule.
- See 1 A-540 for Door Schedule.

**Legend - Floor/Demo Plan**

— Existing to remain  
 — New Partitions  
 — CG Corner Guard, surface mounted  
 — PWSW-18 Stainless steel wall protection to cover up to 4'-0" a.f.f. To be standard drilled.

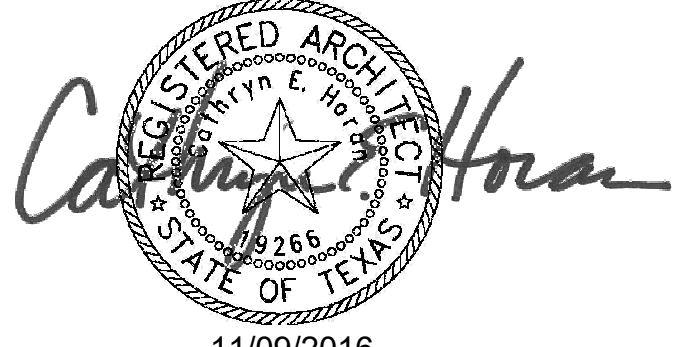


Penthouse Level - Office, Restroom and Corridor

1/4" = 1'-0" 1

No.	Description	Date
5	Addendum 1	11/09/2016
4	Issued for Construction	09/30/2016
3	100% CD Review	06/24/2016
2	90% CD Review	05/13/2016
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**Keyplan**



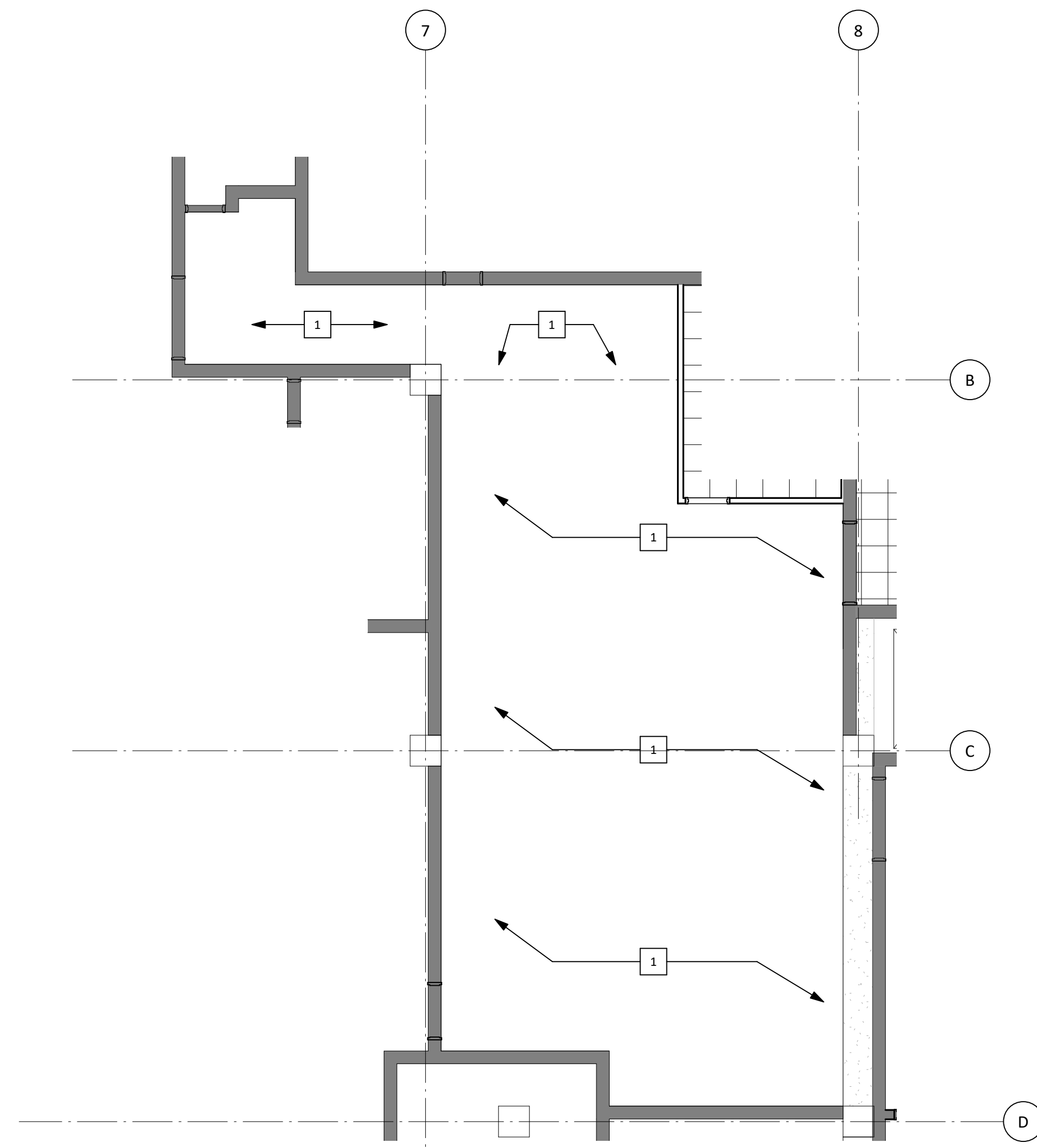
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 Health Science Center at  
 Houston

**MSB SWITCHGEAR  
 REPLACEMENT**

Enlarged Plans - Restrooms

PWP Project Number	215-218R
Date	11/09/2016
Designed By	DS
Checked By	BL
Drawing No.	A-400

Scale 1/4" = 1'-0"



**Keyed Notes**

1 New light fixtures see MEP Drawings for additional information

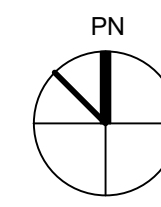
**General Notes - Reflected Ceiling Plan**

- All new ceilings to be 2' x 2' lay-in acoustical ceiling tile at 9'-0" a.f.f., unless noted otherwise. See Finish Schedule for types.
- See Interior Elevations for furr down heights and dimensions.
- Center all down-lights, sprinkler heads, and wall washers in center of ceiling tile, unless noted otherwise.

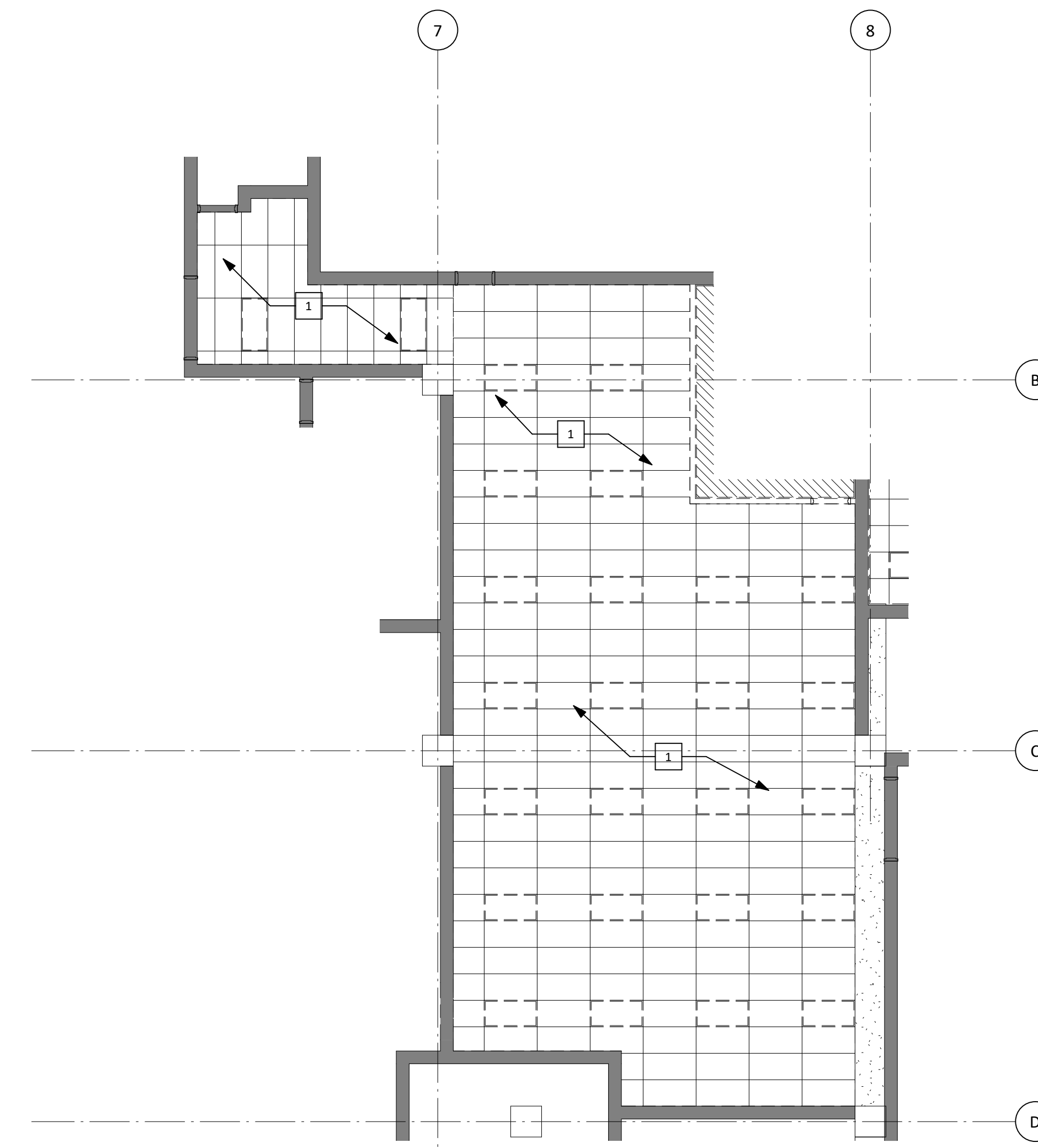
**Legend - Reflected Ceiling Plan**

Existing to remain

New Partitions to structure. See 1 A-520 for partition schedule.



Penthouse Level RCP - Storage Plan Alternate 1/8" = 1'-0" 18



**Keyed Notes**

1 Remove existing ceiling grid. Light fixtures to be replaced using existing electrical lines.

**General Notes - Demolition Plan**

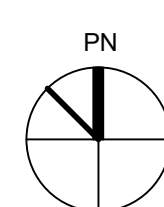
- Contractor to demolish and dispose of all items shown / noted to be removed, unless otherwise noted.
- Before starting the demolition work, confirm all dimensions and other existing conditions in the field. Report any discrepancies to the Engineer and Architect.
- See MEP drawings for removal of any utilities.

**Legend - Floor/Demo Plan**

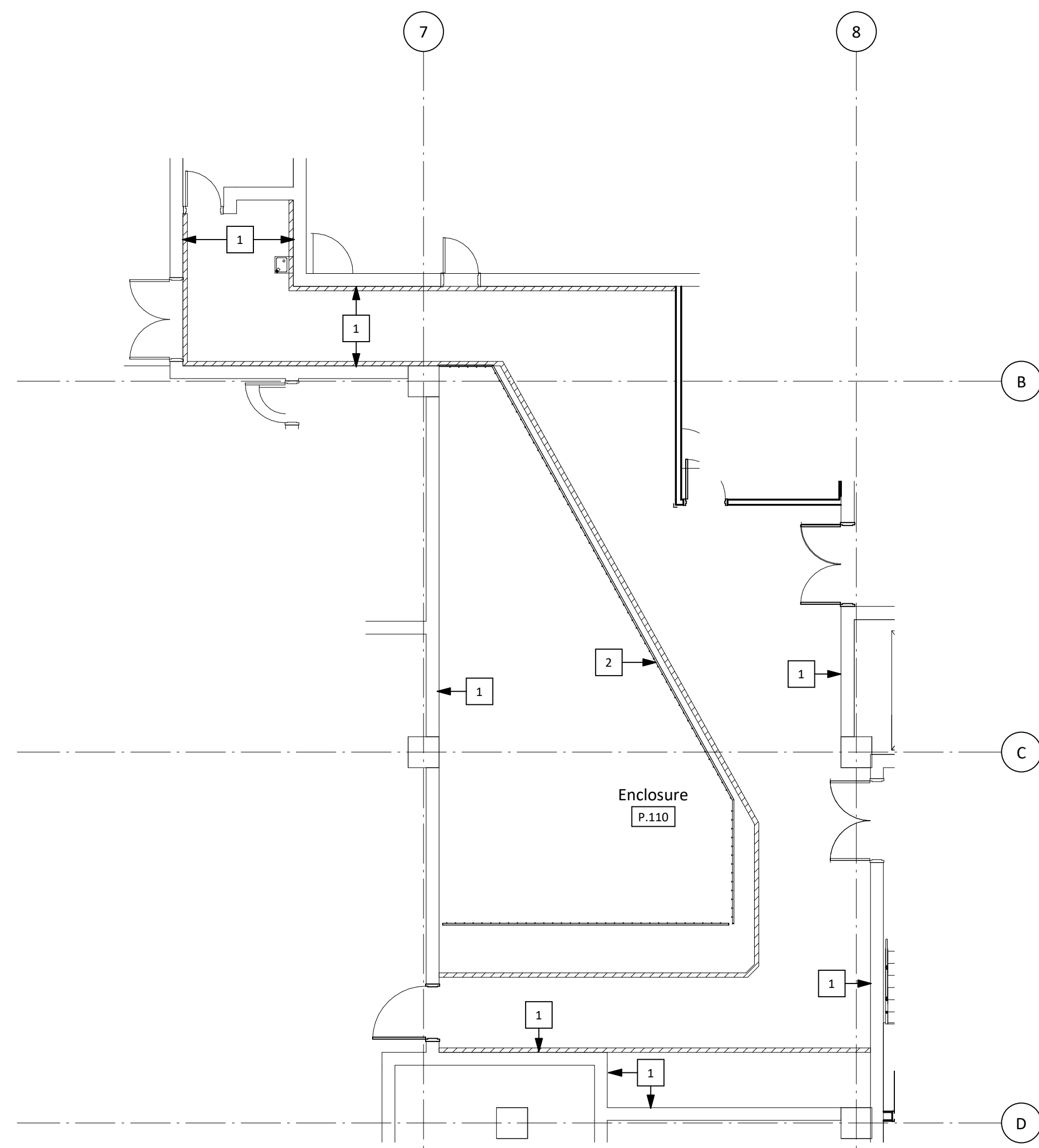
Existing to be removed

Existing to remain

New Partitions



Penthouse Level Demolition RCP - Storage Plan Alternate 1/8" = 1'-0" 3



**Keyed Notes**

1 Patch and repair wall as needed. Paint to match existing (Worldly Gray).

2 Fencing to be replaced to original location.

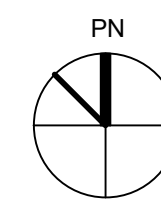
**General Notes - Floor Plan**

- All dimensions are to face of gypsum board or face of masonry unless noted otherwise.
- See 1 A-520 for Partition Type Schedule.
- See 1 A-540 for Door Schedule.

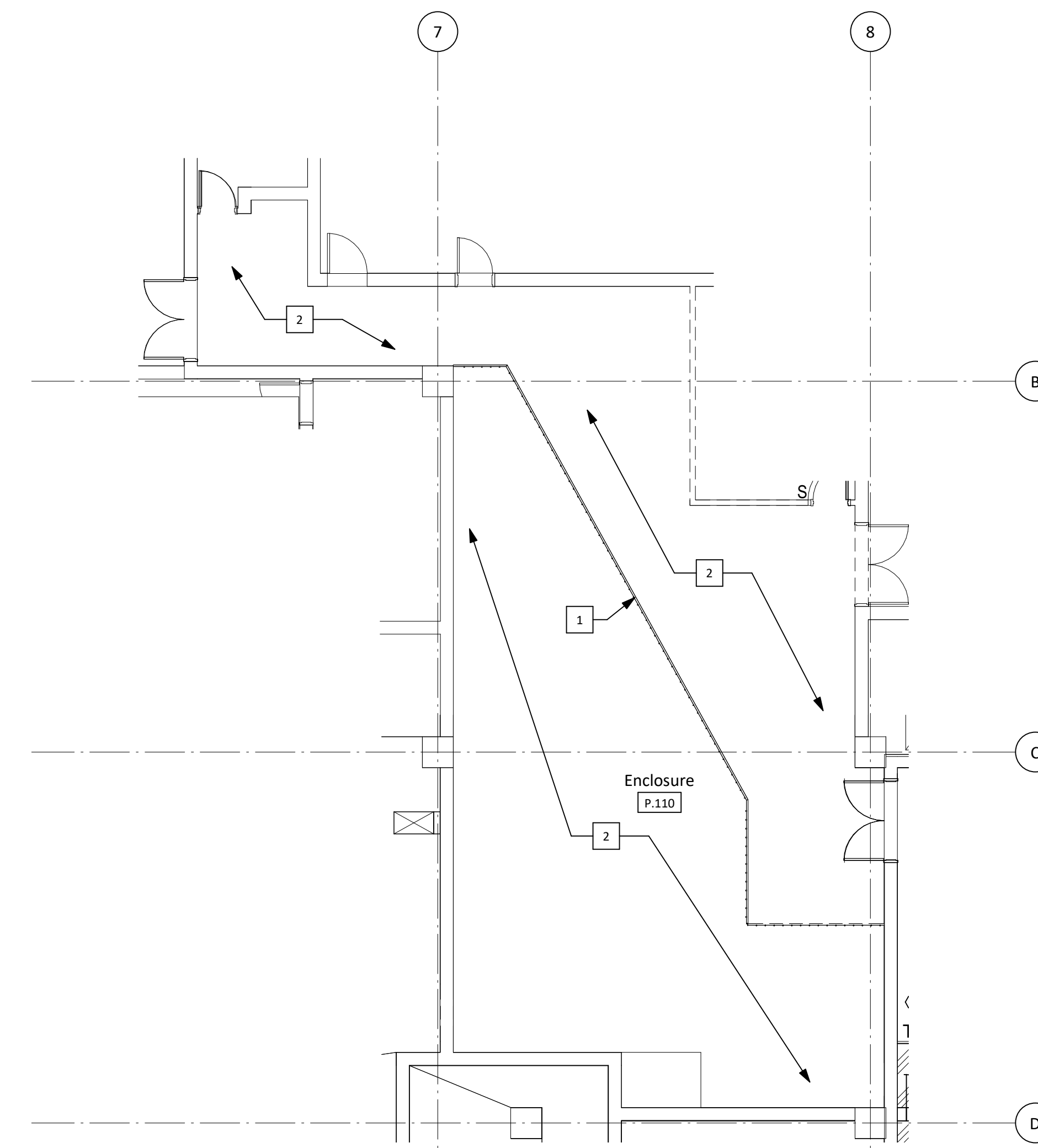
**Legend - Floor/Demo Plan**

Existing to remain

New Partitions



Penthouse Level Floor Plan - Storage Plan Alternate 1/8" = 1'-0" 16



**Keyed Notes**

1 Remove existing fencing and store for future use.

2 Strip and seal concrete floor.

**General Notes - Demolition Plan**

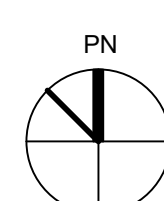
- Contractor to demolish and dispose of all items shown / noted to be removed, unless otherwise noted.
- Before starting the demolition work, confirm all dimensions and other existing conditions in the field. Report any discrepancies to the Engineer and Architect.
- See MEP drawings for removal of any utilities.
- Floor removal in this area to be done by UT-Health.

**Legend - Floor/Demo Plan**

Existing to be removed

Existing to remain

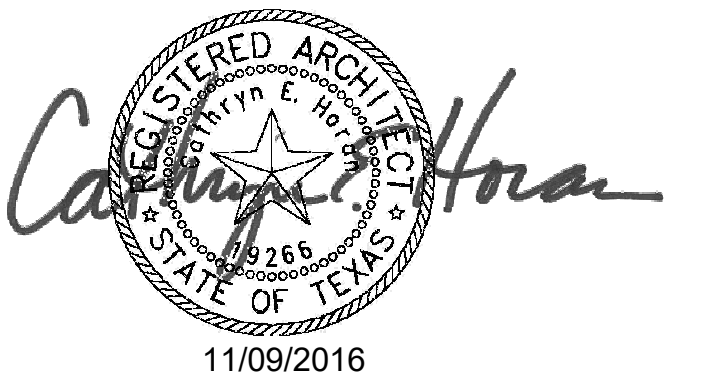
New Partitions



Penthouse Level Demolition Plan - Storage Plan Alternate 1/8" = 1'-0" 1

No.	Description	Date
5	Addendum 1	11/09/2016
4	Issued for Construction	09/30/2016

Keyplan



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 Houston

**MSB SWITCHGEAR  
 REPLACEMENT**

Enlarged Plans - Alternates

PWP Project Number	215-218R
Date	11/09/2016
Designed By	DS
Checked By	BL
Drawing No.	<b>A-401</b>

Scale 1/8" = 1'-0"



**Pinnacle Structural Engineers**  
 3120 Southwest Freeway, Suite 410  
 Houston, TX 77098  
 713.807.8911



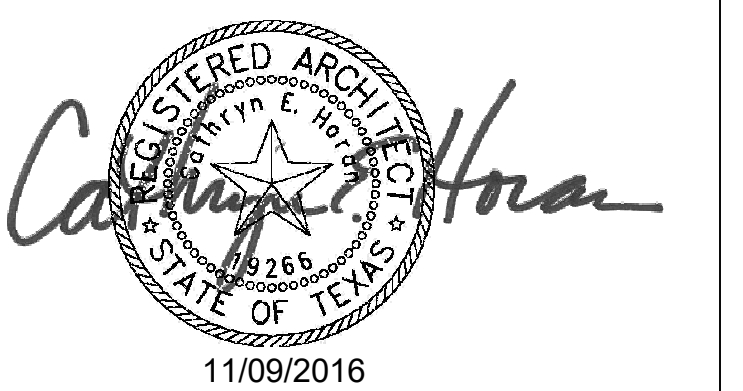
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4	Issued for Construction	09/30/2016
3	100% CD Review	06/24/2016
2	90% CD Review	05/13/2016
1	50% Construction Documents	02/10/2016

**No. Description Date**

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**Keyplan**

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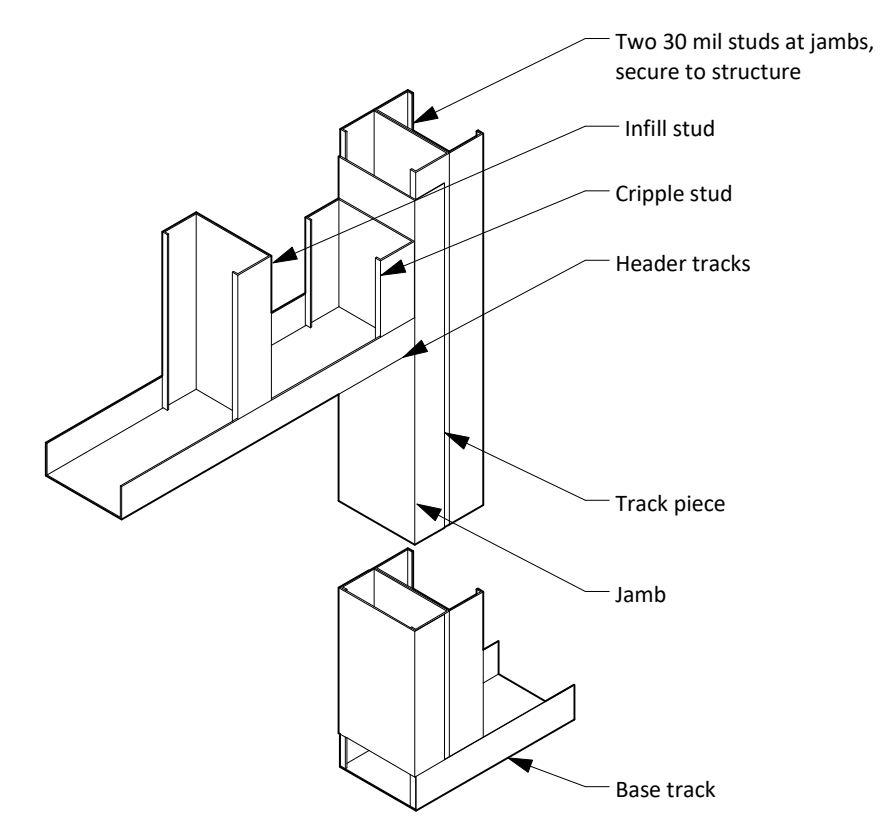


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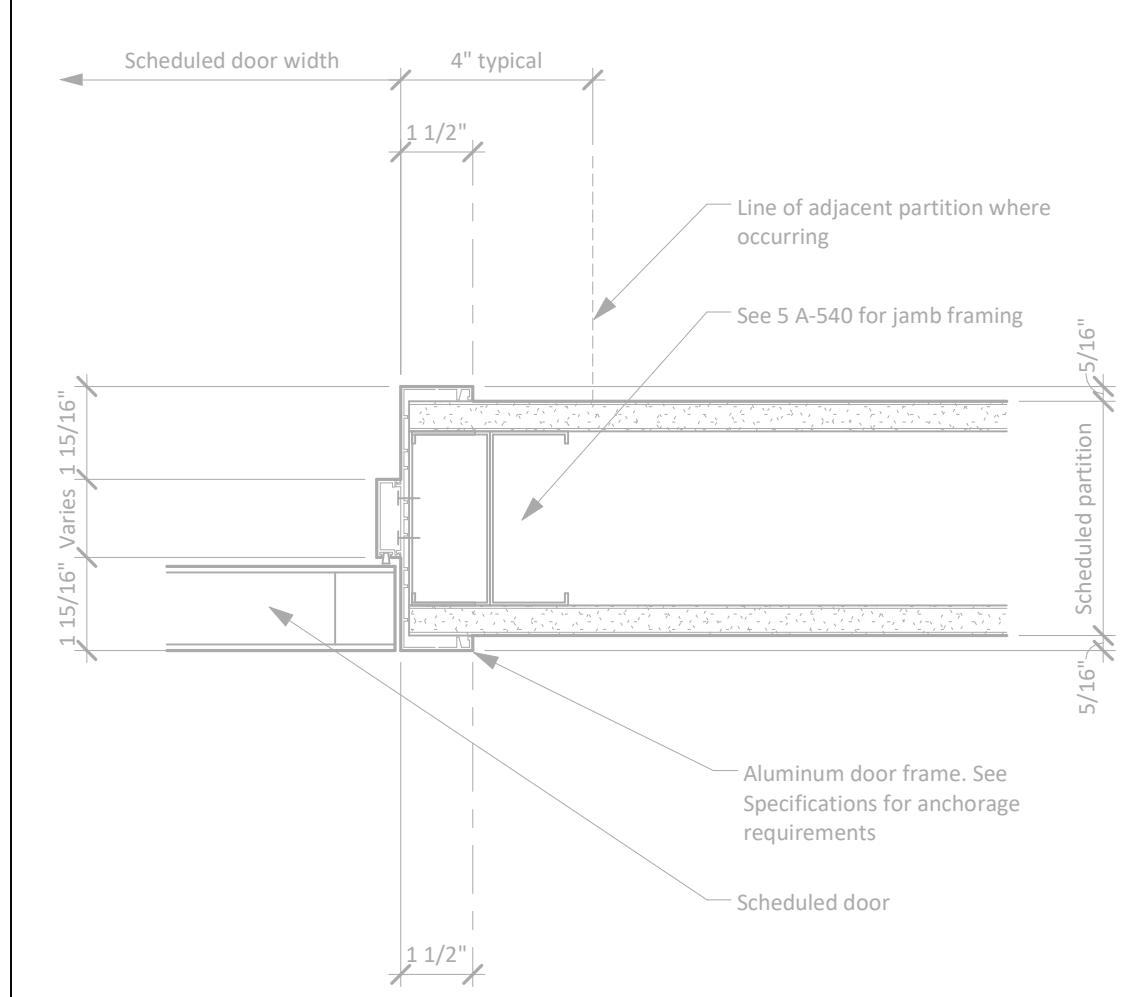
**MSB SWITCHGEAR REPLACEMENT**  
 Door and Window Details

PWP Project Number	215-218R
Date	11/09/2016
Designed By	DS
Checked By	BL
Drawing No.	A-540

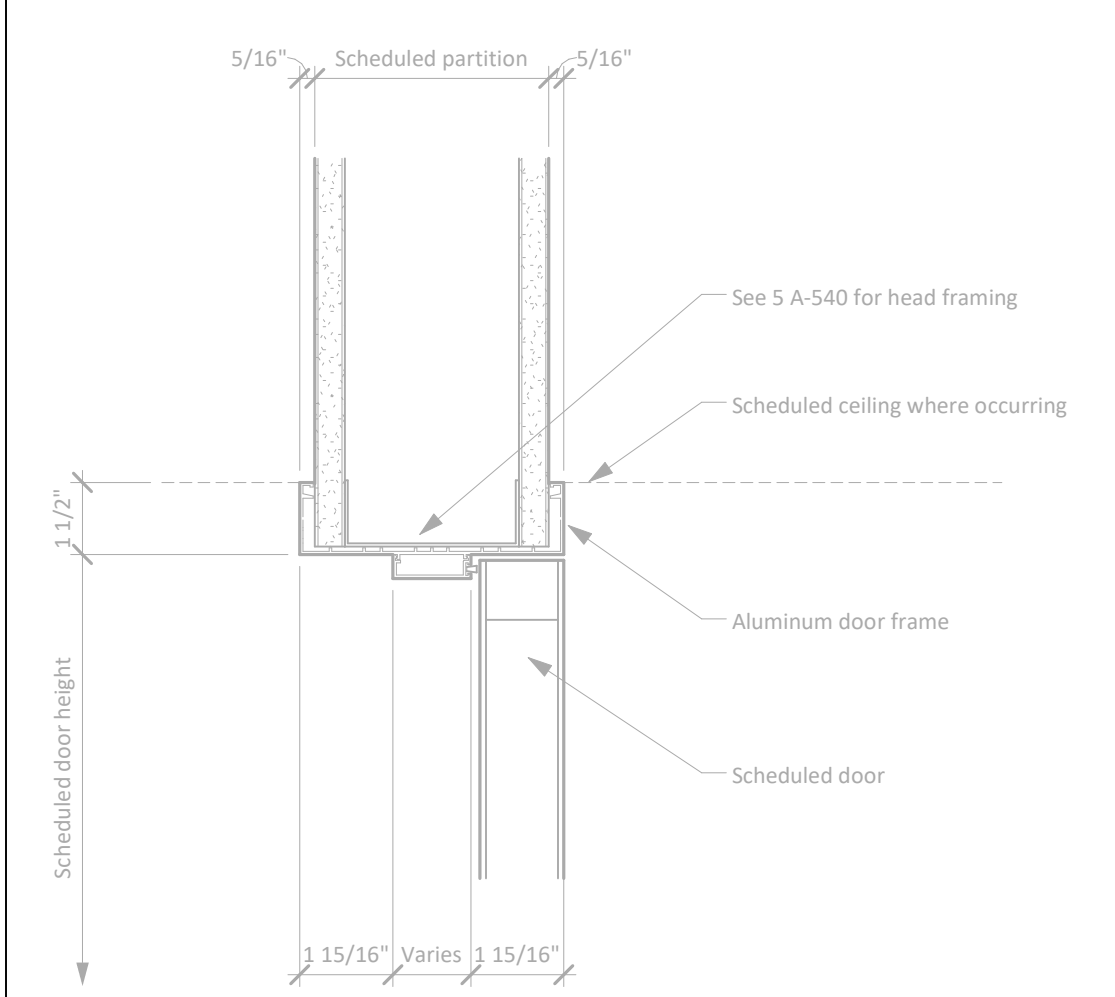
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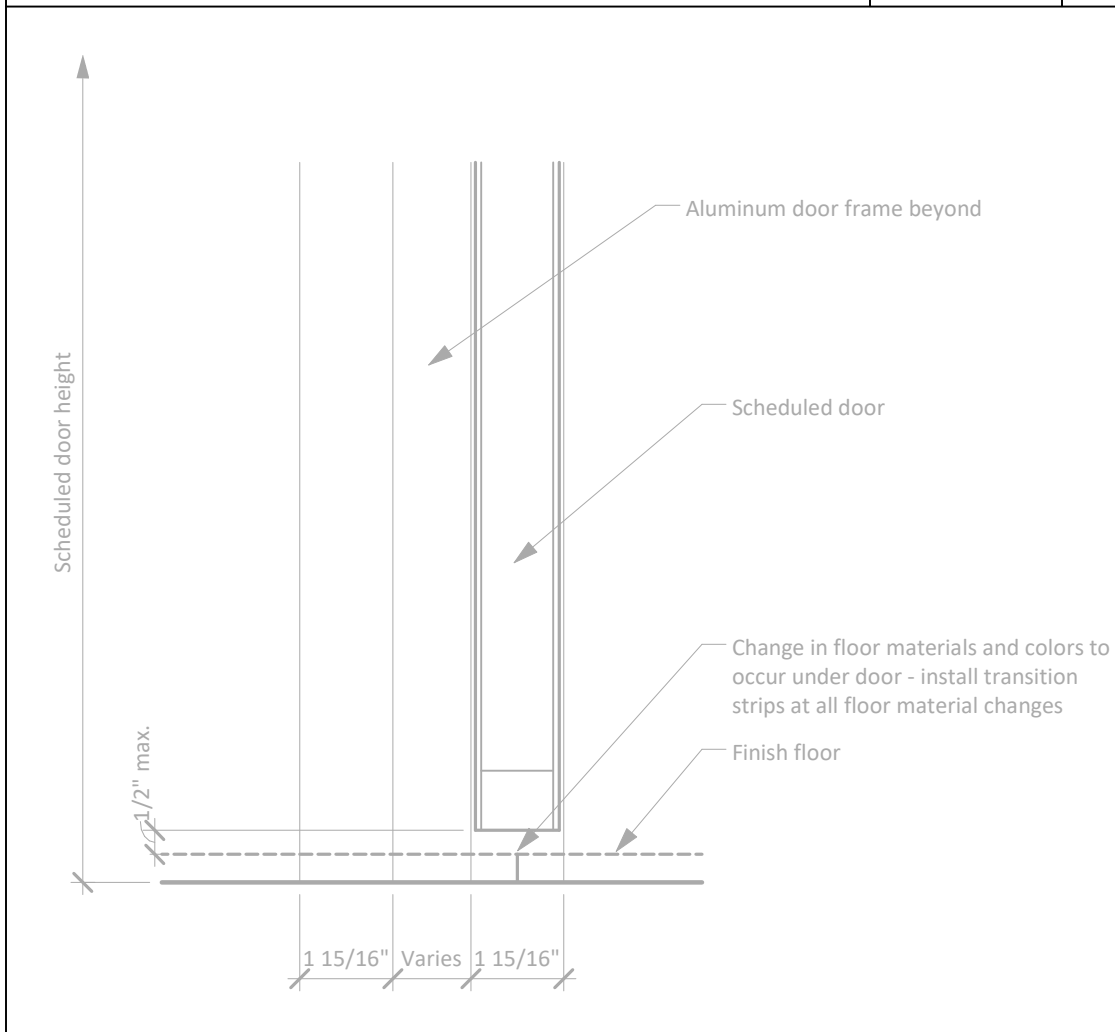
**Typical Framing at Opening** 3" = 1'-0" 10 N.T.S. 5



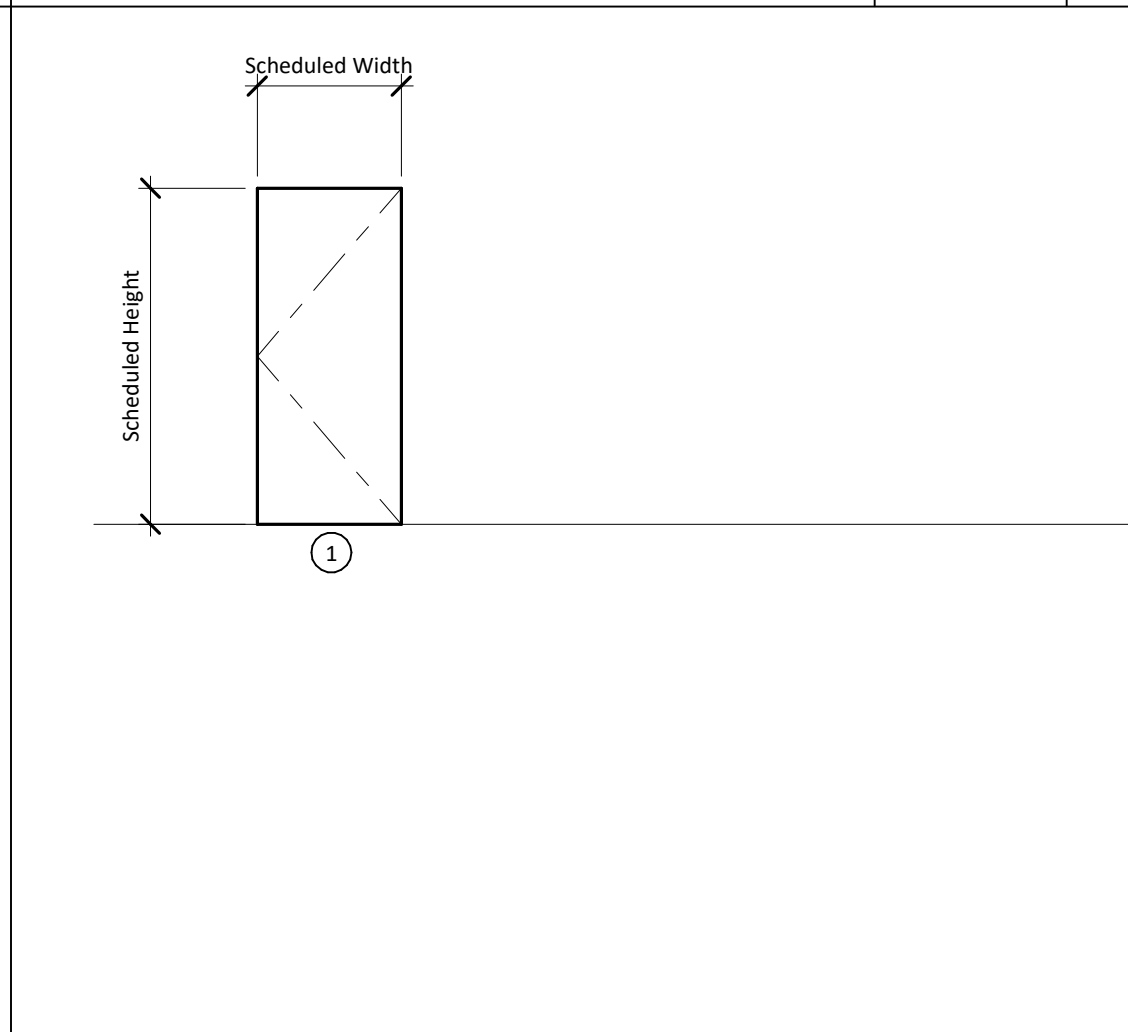
**Jamb at Interior Aluminum Door Frame** 3" = 1'-0" 10



**Head at Interior Aluminum Door Frame** 3" = 1'-0" 15



**Sill at Interior Aluminum Door Frame** 3" = 1'-0" 14



**Door Panel Elevations** 1/4" = 1'-0" 2

Type	Description	Width	Height	Thick.	No.	Mat'l	Finish	Mat'l	Finish	Sill Detail	Jamb Detail(s)	Head Detail	Fire Rating (min.)	Notes
A00	Interior flush door	3'-0"	8'-0"	1 3/4"	1	Wood	DPL1	Steel	FPT1	11 A-540	13 A-540	12 A-540	-	
B40	Interior fire-rated flush door - 90m	3'-0"	8'-0"	1 3/4"	1	Steel	DPT1	Steel	FPT1	16 A-540	18 A-540	17 A-540	90	
B44	Interior fire-rated flush door - 90m	4'-0"	8'-0"	1 3/4"	1	Steel	DPT1	Steel	FPT1	16 A-540	18 A-540	17 A-540	90	
D30	Metal Frame - no door	3'-0"	8'-0"	0"	-	-	-	-	-	FPT1	11 A-540	13 A-540	-	
M2E	Interior pair of fire-rated flush doors - 90m	5'-6"	8'-6"	1 3/4"	11	Steel	DPL1	Steel	FPT1	16 A-540	18 A-540	17 A-540	90	
M40	Interior pair of fire-rated flush doors - 90m	6'-0"	8'-6"	1 3/4"	11	Steel	DPL1	Steel	FPT1	16 A-540	18 A-540	17 A-540	90	

**Door Type Schedule** 1/4" = 1'-0" 2

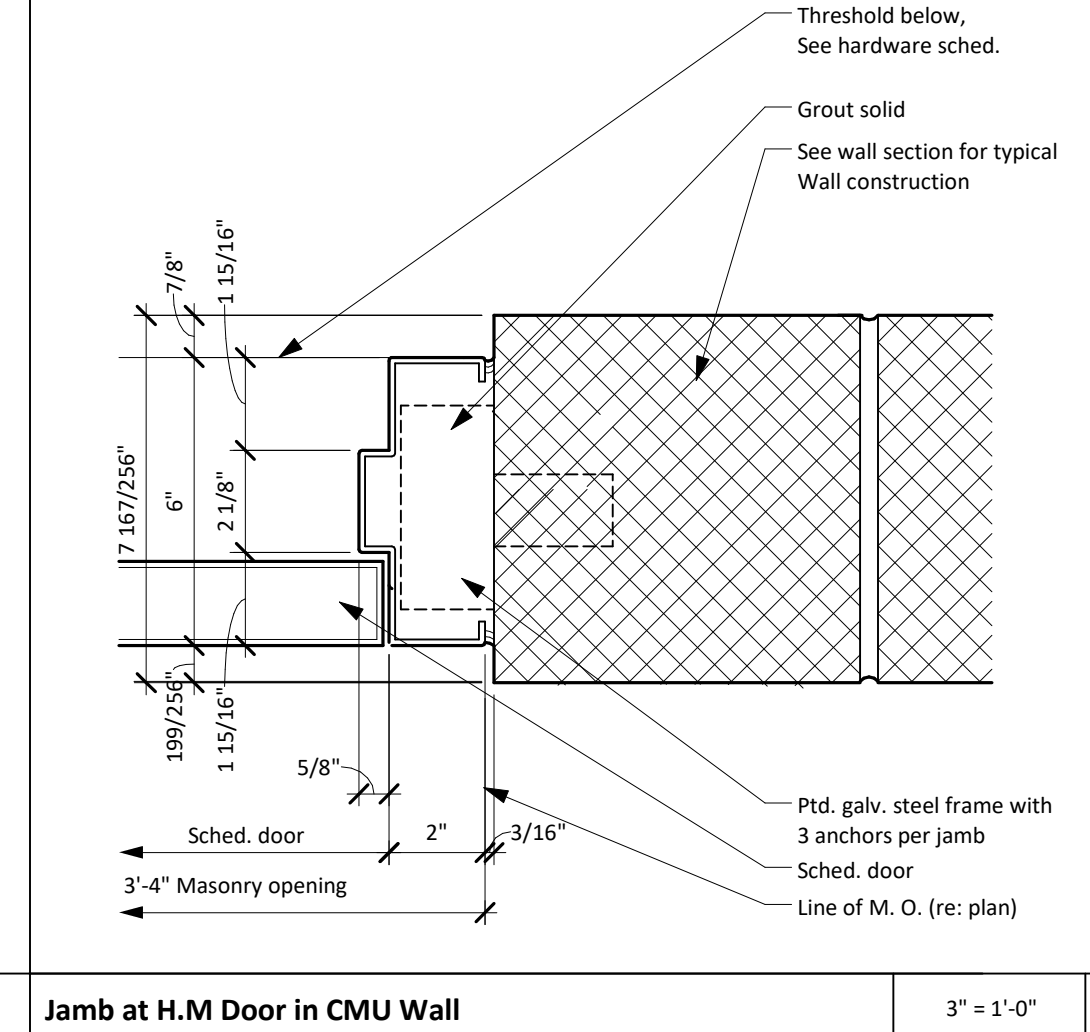
HW SET: 01	Each to have:	Part	Description	Qty	Unit	Notes
HW SET: 01	Each to have:	8	EA HINGE	5B81HW 4.5 X 4.5 NRP	630	IVE
		1	EA PANIC HARDWARE	9947DT-F	626	VON
		1	EA FIRE EXIT HARDWARE	9947NL-F	626	VON
		1	EA RIM CYLINDER	951 6 PIN	626	FAL
		1	SET ASTRAGAL	115NA	CL	NGP
		2	EA SURFACE CLOSER	4040XP SCUSH	689	LEN
		2	EA CUSH SHOE SUPPORT	4046-30 AS REGD	689	LEN
		2	EA KICK PLATE	8400 10" X 1" LOW	630	IVE
		1	SET SEALS	5050B	8RN	NGP
		1	EA DOOR SWEEP	1031VA	CL	NGP
1	EA THRESHOLD	425	AL	NGP		

HW SET: 02	Each to have:	Part	Description	Qty	Unit	Notes
HW SET: 02	Each to have:	4	EA HINGE	5B81HW 4.5 X 4.5 NRP	630	IVE
		1	EA PANIC HARDWARE	9947DT-F	626	VON
		1	EA RIM CYLINDER	951 6 PIN	626	FAL
		1	EA SURFACE CLOSER	4040XP SCUSH	689	LEN
		1	EA CUSH SHOE SUPPORT	4046-30 AS REGD	689	LEN
		1	EA KICK PLATE	8400 10" X 2" LOW	630	IVE
		1	SET SEALS	5050B	8RN	NGP
		1	EA DOOR SWEEP	1031VA	CL	NGP
		1	EA THRESHOLD	425	AL	NGP

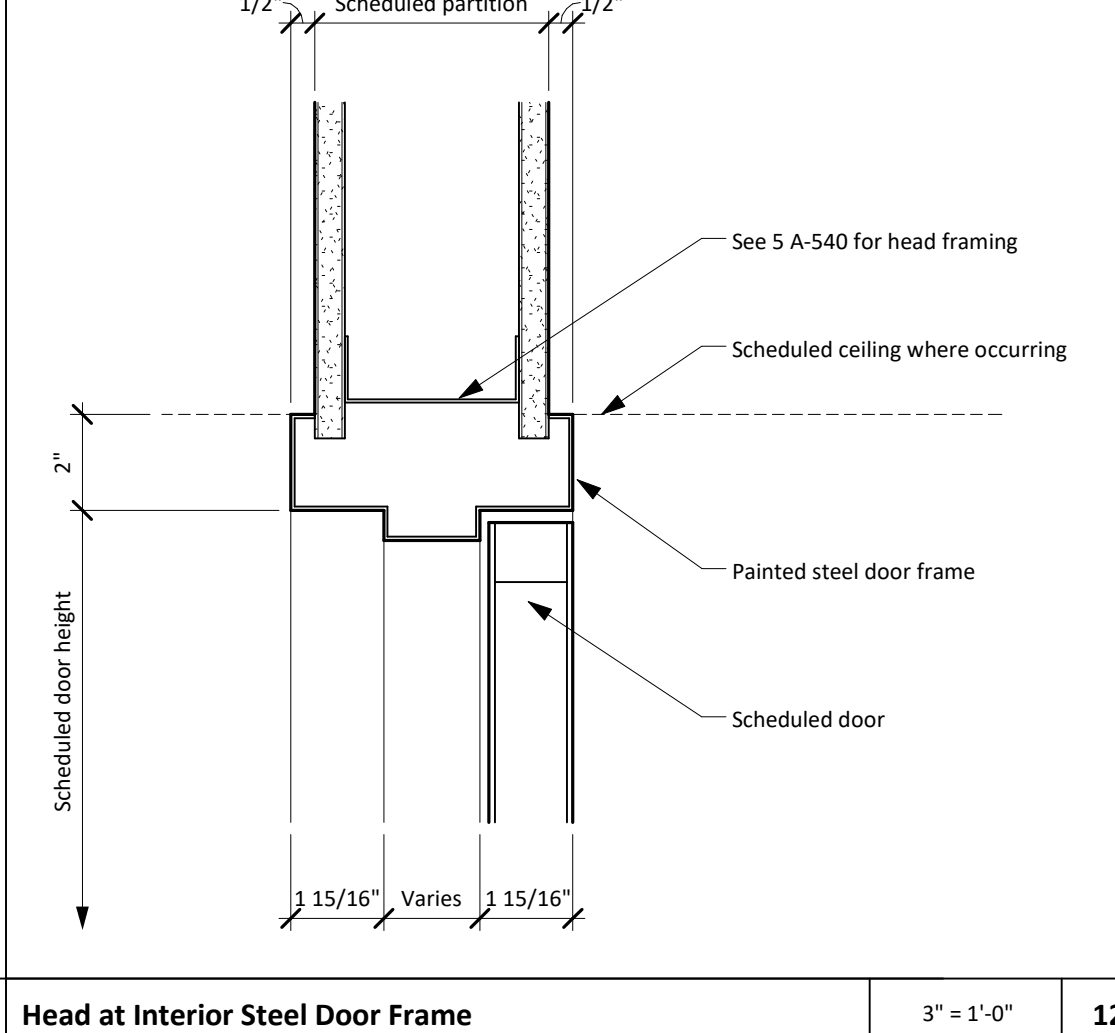
HW SET: 03	Each to have:	Part	Description	Qty	Unit	Notes
HW SET: 03	Each to have:	4	EA HINGE	5B81 4.5 X 4.5	652	IVE
		1	EA ENTRY/OFFICE LOCK	MA521P6 AG	626	FAL
		1	EA DOOR STOP	WS407CCV/PS436	626	IVE
		AS REQD	AS REQD			
		1	SET SEALS	BY FRAME SUPPLIER	8/O	

HW SET: 04	Each to have:	Part	Description	Qty	Unit	Notes
HW SET: 04	Each to have:	4	EA HINGE	5B81 4.5 X 4.5	652	IVE
		1	EA PUSH PLATE	8200 6" X 16"	630	IVE
		1	EA PULL PLATE	8303 EZ 6" X 16"	630	IVE
		1	EA SURFACE CLOSER	1463 FC	689	LEN
		1	EA DOOR STOP	WS407CCV/PS436	626	IVE
1	SET SEALS	AS REQD BY FRAME SUPPLIER	8/O			

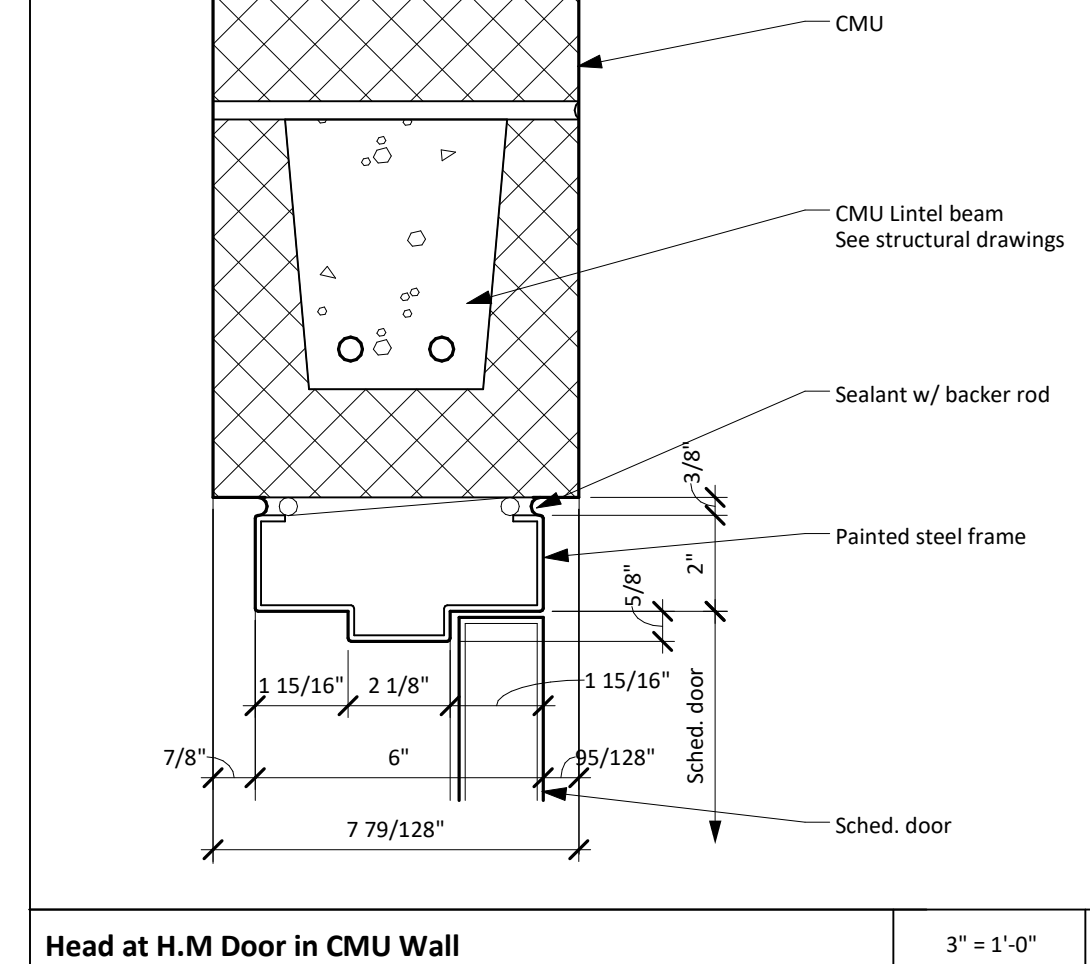
**Door Type Schedule** 1



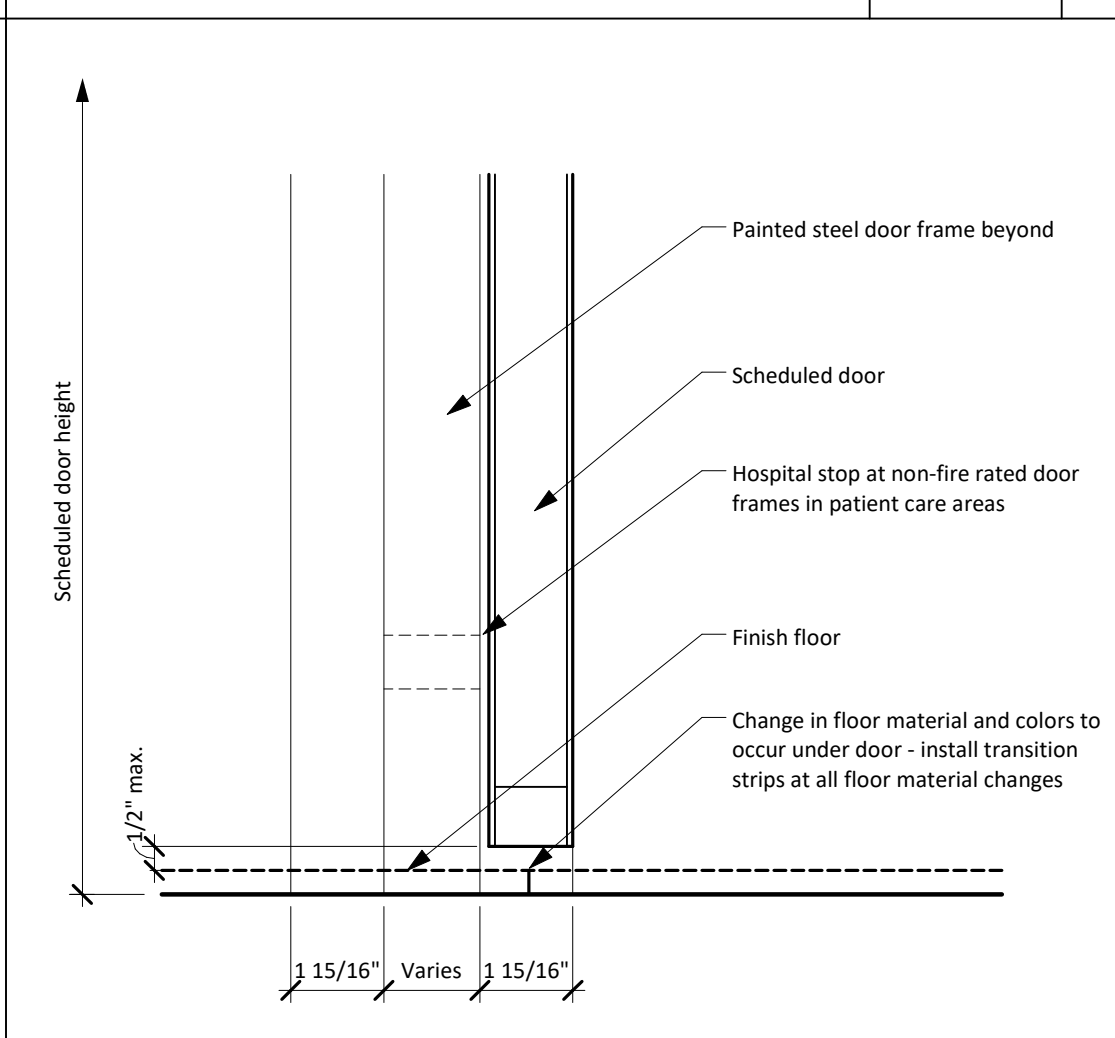
**Jamb at H.M Door in CMU Wall** 3" = 1'-0" 18



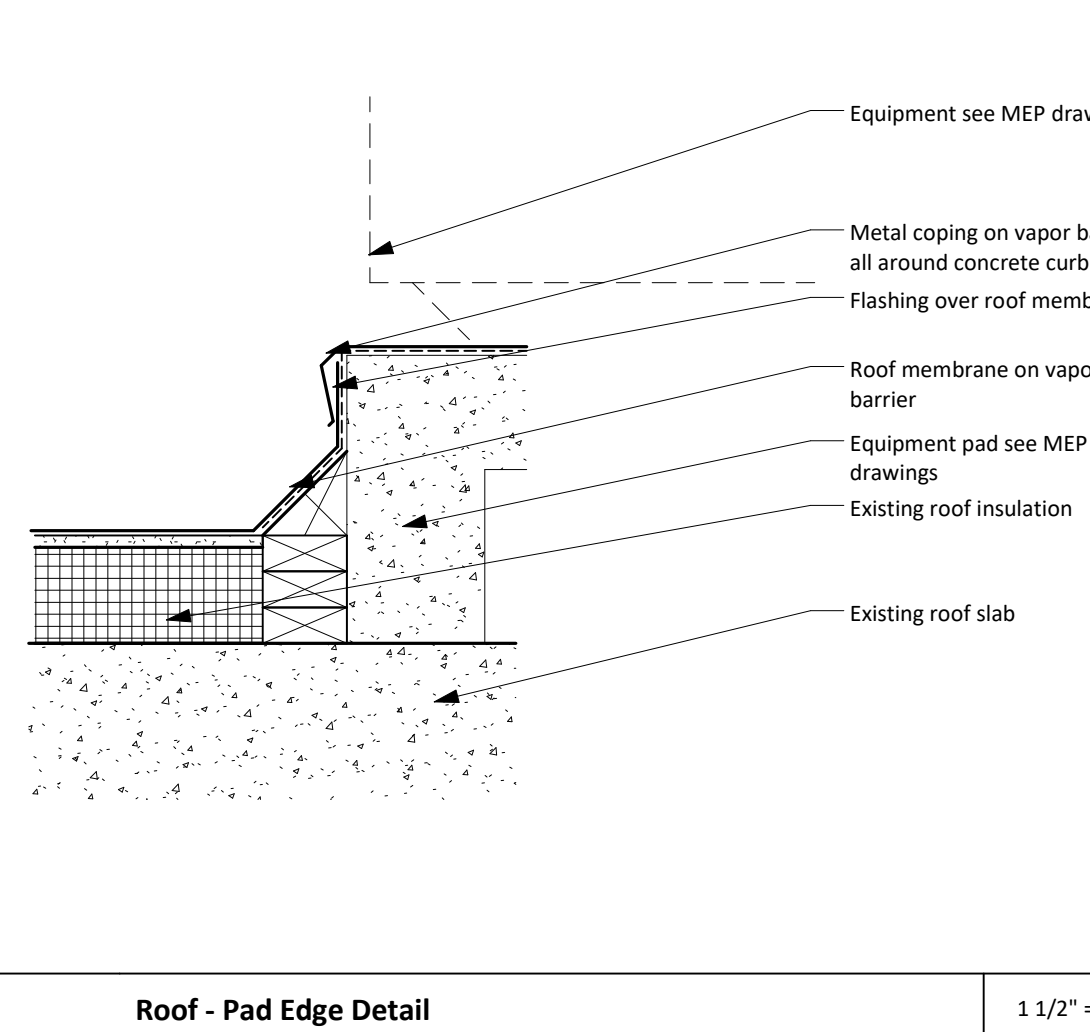
**Head at Interior Steel Door Frame** 3" = 1'-0" 12



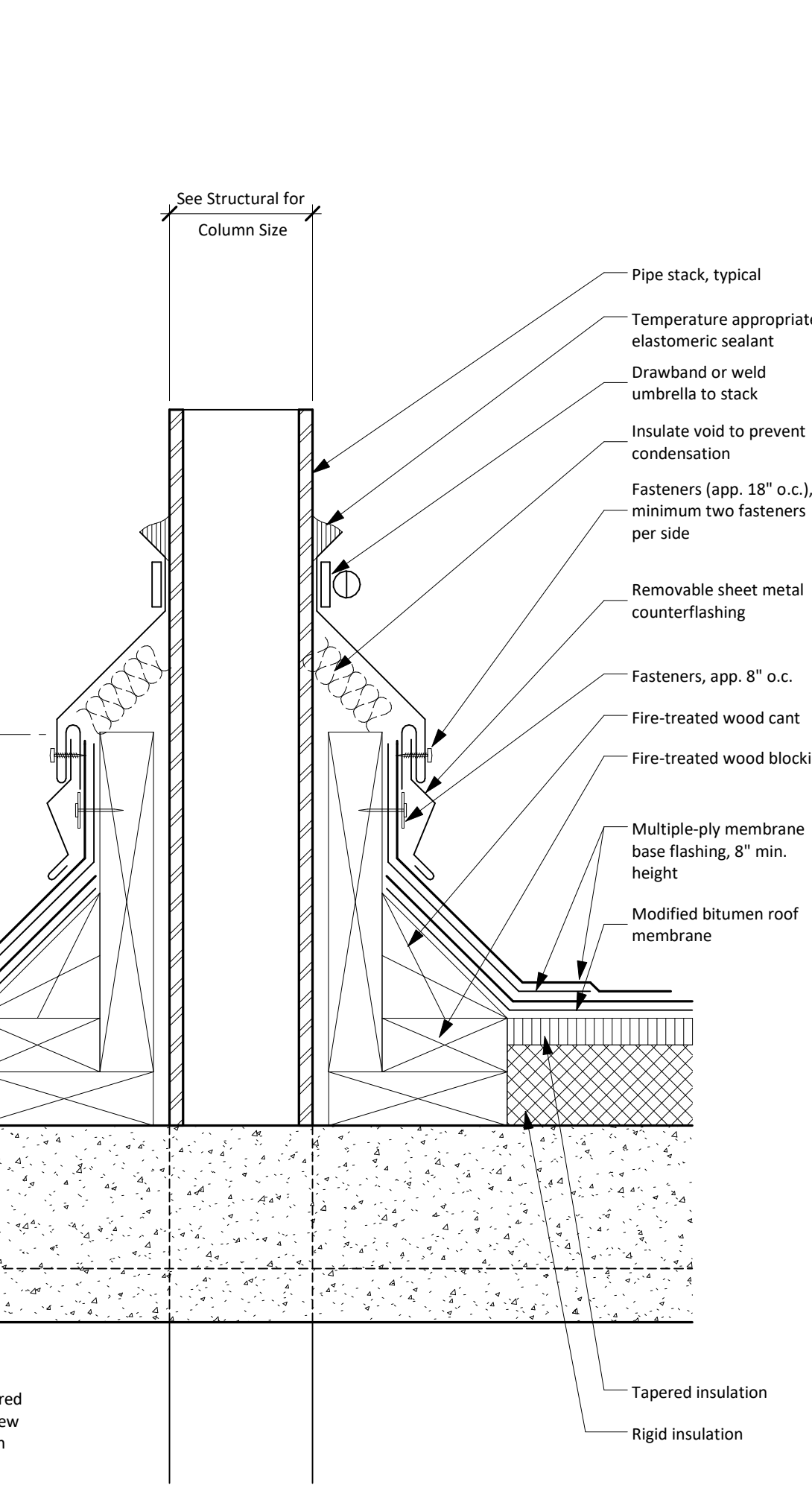
**Sill at H.M Door in CMU Wall** 3" = 1'-0" 17



**Sill at Interior Steel Door Frame** 3" = 1'-0" 11



**Roof - Pad Edge Detail** 1 1/2" = 1'-0" 1

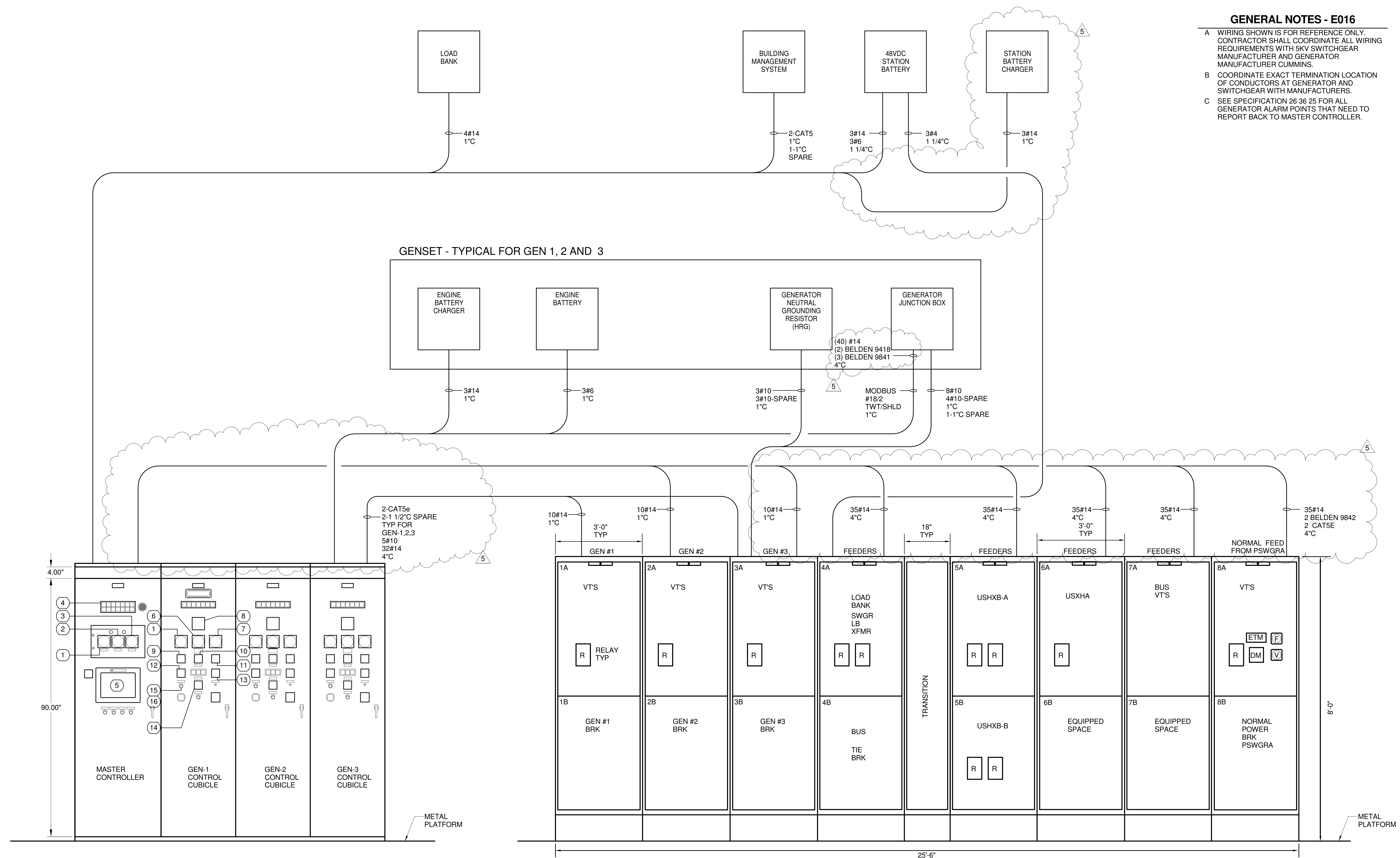


**Typical Pipe Roof Penetration Detail** 3" = 1'-0" 21

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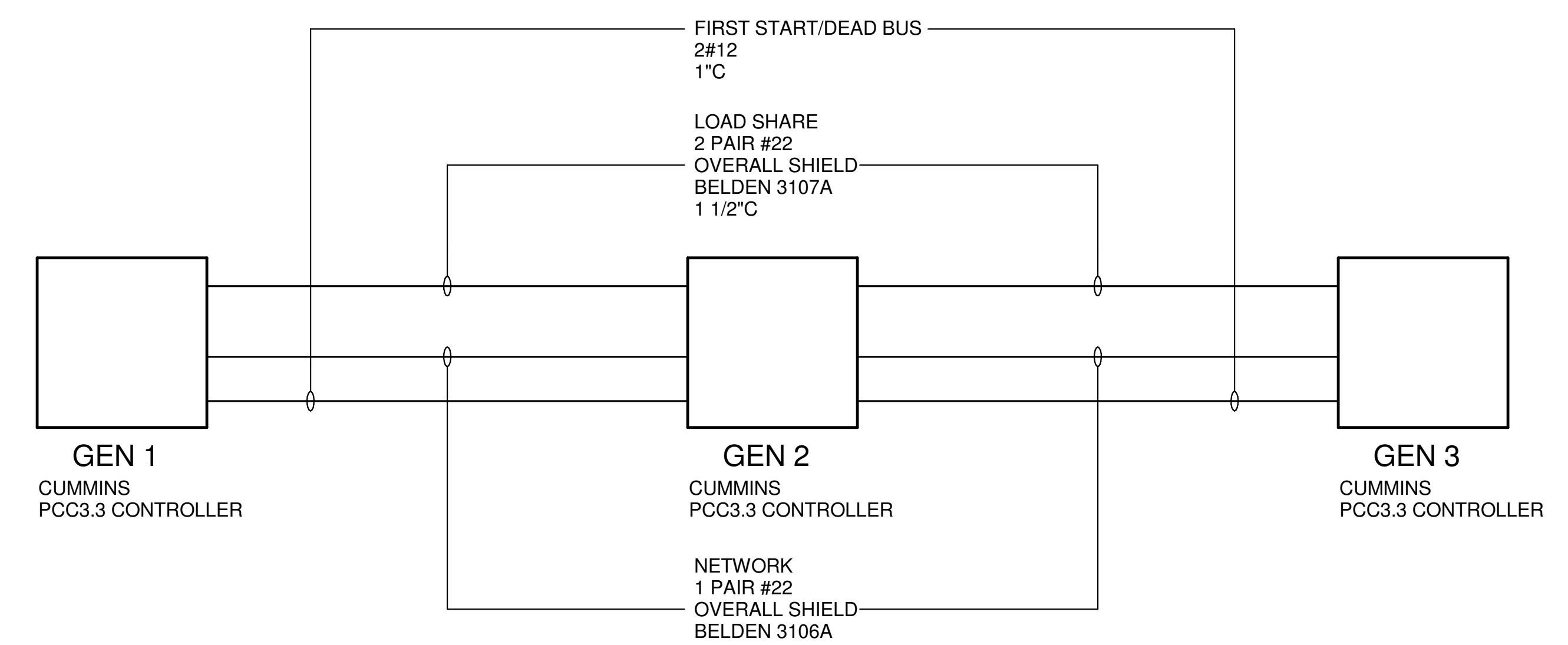
Note: Remove existing roof membrane and insulation as required for new pipe penetration. Install new membrane and insulation to match existing as required.

- GENERAL NOTES - E016**
- A WIRING SHOWN IS FOR REFERENCE ONLY. CONTRACTOR SHALL COORDINATE ALL WIRING REQUIREMENTS WITH SKV SWITCHGEAR MANUFACTURER AND GENERATOR MANUFACTURER CUMMINS.
  - B COORDINATE EXACT TERMINATION LOCATION OF CONDUCTORS AT GENERATOR AND SWITCHGEAR WITH MANUFACTURERS.
  - C SEE SPECIFICATION 26 36 25 FOR ALL GENERATOR ALARM POINTS THAT NEED TO REPORT BACK TO MASTER CONTROLLER.



**NEW 5KV PARALLELING SWITCHGEAR PSE & PARALLELING MASTER/GENSET CONTROLLERS - FRONT ELEVATION**  
1 NOT TO SCALE

- |  |                          |
|--|--------------------------|
| ① 0-5KV SCALE VOLTMETER -150V MOVEMENT | ⑩ ENGINE SELECTOR SWITCH |
| ② SYNCHROSCOPE                         | ⑪ AMMETER SWITCH         |
| ③ 55-65 HZ FREQUENCY METER             | ⑫ SYNCHRONIZING SWITCH   |
| ④ MASTER LIGHT ASSEMBLY                | ⑬ FREQUENCY METER SWITCH |
| ⑤ 17" OPERATOR INTERFACE               | ⑭ CIRCUIT BREAKER SWITCH |
| ⑥ ANALOG WATTMETER                     | ⑮ VOLTAGE ADJUST         |
| ⑦ ANALOG AMMETER                       | ⑯ SPEED ADJUST           |
| ⑧ POWER METER                          | ⑰ MANUAL SYNCH           |
| ⑨ VOLTMETER SWITCH                     |                          |



**WIRING REQUIREMENTS BETWEEN GENERATORS 1, 2 AND 3 (VERIFY WITH CUMMINS)**  
2 NOT TO SCALE

No.	Description	Date
5	ADDENDUM #1	11/09/2016
4	ISSUED FOR CONSTRUCTION	09/30/2016
3	100% CD REVIEW	06/24/2016
2	90% PKG 1/2 REVIEW	05/13/2016
1	50% CD	02/10/2016

Keyplan




The University of Texas  
Health Science Center at  
Houston

**MSB SWITCHGEAR REPLACEMENT**

**NEW 5KV PARALLELING SWITCHGEAR PSE - FRONT ELEVATION**

SSA Project Number	1095-023-02
Date	09/30/2016
Designed By	KTM
Checked By	DBB
Drawing No.	E016

Scale NOT TO SCALE

SECTION 26 12 16

DRY-TYPE TRANSFORMERS - ABOVE 600 VOLT PRIMARY AND  
RATED LARGER THAN 500 kVA (US DOE 2016)

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. This Section specifies the furnishing and installation of 3-phase dry-type transformers with above 600 volt primary and rated 500 kva and above.. See plans for ratings and quantity. All transformers are part of a substation lineup consisting of high voltage terminal compartment, transformer and 480V or 208V switchgear. All transformers shall meet DOE 2016 energy efficiency standards.

1.2 REFERENCE STANDARDS

- A. NEMA TR-27 - Commercial, Institutional and Industrial Dry-Type Transformers.
- B. DOE 2016 Transformer Efficiency Standards

1.3 APPLICABLE PROVISION

- A. Refer to Section 26 05 00, Electrical General Provisions.

1.4 SHOP DRAWINGS

- A. Brochures. Submit brochures on the transformer.
- B. Dimensional Drawings. Submit dimensional drawings of the transformer, including top and bottom views showing entry and exit space for conduits. Drawings shall include 15kV switch and switchgear as part of lineup.

PART 2 – PRODUCTS

2.1 RATINGS

- A. Required kva, voltages, phases and winding configurations are indicated on the drawings. Transformers must be rated for 60 hertz operation.

2.2 COILS

- A. Windings. Use copper wire (bar stock) for coil windings. Aluminum foil windings are not acceptable.
- B. Taps. Provide two 2-1/2 percent taps above and two 2-1/2 percent taps below rated primary voltage.



- C. The completed coils shall be preheated, vacuum-impregnated with non-hydroscopic, thermosetting insulating varnish, and then thoroughly baked. This process shall completely seal the coils against moisture, and eliminate any voids which could create hot spots or cause corona formation.

## 2.3 INSULATION

- A. All transformers shall have a maximum temperature rise of 115°C above a 40°C ambient. All insulating materials used, to be in accordance with NEMA ST20 or NEMA TR27 Standards for a 220°C insulation system. The temperature rise shall be designated on the transformer nameplate.

## 2.4 CORES

- A. The transformer cores are to be constructed of high grade, non-aging silicon steel laminations with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with heavy, structural steel bars or angles.

## 2.5 BASIC IMPULSE LEVEL

- A. The basic impulse levels (BIL) shall be a minimum of 30kV for the 5kV class.

## 2.6 SOUND REQUIREMENTS

- A. Average sound levels must not exceed the following values as measured in accordance with NEMA TR-27.

## 2.7 CONSTRUCTION

- A. Enclosure. Provide a self-supporting steel enclosure with removable panels for access to the taps and for core and coil inspection. Construct enclosure so that it may be dismantled to reduce size and weight for rigging.
- B. High Voltage Terminal Compartment. Make this compartment integral with the transformer case for cable entrance and provide ample space for fanning and stress cone terminating of incoming cables from below. Provide barriers between this compartment and the transformer to prevent temperature surrounding the cables from exceeding NEMA standards.
- C. Surge Arresters. Metal-oxide, gapless type lightning arresters shall be installed by the manufacturer on the high voltage side of the transformer to provide additional protection against abnormally high voltage transients. See plans for ratings.
- D. Low Voltage Terminal Compartment. Make this compartment integral with the transformer case. Provide for top entrance of cables, number and size as indicated on drawings. Transformer will connect to low voltage switchgear via flexible connection.
- E. Accessories. Provide jack pads, ground pad, diagrammatic nameplate, provisions for rolling and protected ventilation grilles.
- F. Painting. Grind steel surfaces smooth, with burrs, sharp edges, welding splatters, loose rust, scale and the like totally removed after fabrication. Following this, chemically clean and treat

steel work to allow a good bond between the steel surfaces and apply a rust-preventive primer paint. After priming, thoroughly paint the inside and outside with a suitable finish paint. Provide a small quantity of finish paint for touch-up after field installation.

2.8 INFRARED VIEWING PORT

- A. Provide an infrared viewing port to allow for viewing of the cable terminations at the primary of the transformer.

2.9 CURRENT TRANSFORMERS

- A. Phase current transformers shall be located around secondary conductors/busbars as shown on one line diagrams. If possible, this shall be done without the use of a transition section between the transformer and switchgear main breaker compartment. If a transition section is required, it shall be a maximum of 18" wide.

2.10 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers are Square D, General Electric, Cutler-Hammer.

PART 3 – EXECUTION

3.1 TAP SETTING

- A. Select the appropriate tap setting on transformer so that the actual secondary voltage is  $\pm 1/2$  of a tap span. Record the transformer serial number, kva rating, selected tap setting and secondary voltage readings. Submit three copies of the record to the Engineer.

3.2 FOUNDATION PAD

- A. None required in gym AHU area for double ended lineups. Provide a 3 1/2" thick pad for Load Bank Transformer. For all other transformers, mount on new metal platform/pad. Level as required.

3.3 TOUCH-UP PAINTING

- A. Restore marred surfaces to factory finish.

END OF SECTION

SECTION 26 22 13

HIGH EFFICIENCY K-7 TRANSFORMERS (US DOE 2016)

PART 1 - GENERAL

1.1 SUMMARY

- A. Copper-wound transformers meeting US Department of Energy 2016 mandated minimum efficiency. These transformers shall be UL listed to feed a K-7 electronic equipment load profile and be optimized to minimize operating cost under light loading.
- B. Compliance with full specification is required
- C. Transformers shall meet the following requirements:
  - 1. Efficiencies must meet or exceed the US DOE 2016 minimum requirement
  - 2. No load losses must comply with those defined in this specification
  - 3. Efficiency at low load and under nonlinear load must meet the minimum requirements of this specification
  - 4. K-7 listing per UL 1561 is required, see plans.
  - 5. Comprehensive testing under linear and nonlinear loading is required to verify specified performance . Performance submittals are required
- D. The Work under this Section is subject to requirements of the Contract Documents including the Uniform General Conditions, Supplementary General Conditions, and Division One Sections.
- E. All work covered by this Section shall be accomplished in accordance with all applicable provisions of the Contract Documents and any addenda or directives which may be issued herewith, or otherwise.
- F. Drawings and general provisions of the Contract, including Terms and Conditions, Supplementary Conditions, Special Conditions, and other Division One Sections, apply to this Section.

1.2 REFERENCES

- A. US Department of Energy, 10 CFR Part 431, April 18, 2013. Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule
- B. DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431.
- C. ANSI/NEMA ST 20 - Dry Type Transformers for General Applications.
- D. NEMA Premium Efficiency Transformers Program
- E. Consortium for Energy Efficiency (CEE): Specification for Low-Voltage, Dry- Type Distribution Transformers

- F. EPACT 2005 - United States Energy Policy Act 2005 / NEMA TP1 - Guide for Determining Energy Efficiency for Distribution Transformers
- G. ANSI/NEMA TP-2 – Standard Test Method for Measuring Energy Consumption of Distribution Transformers
- H. IEEE C57.110-1998 – IEEE Recommended Practice for establishing transformer capability when feeding nonsinusoidal load currents
  - 1. IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers
- I. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- J. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.
- K. ISO 9001:2008 – International Standards Organization - Quality Management System
- L. ISO 14001:2004 – International Standards Organization - Environmental Management System
- M. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories

### 1.3 RELATED SECTIONS

- A. Section 26 05 26, Grounding and Bonding.
- B. Section 26 05 33, Raceways.
- C. Section 26 05 29, Metal Framing and Supports.
- D. Section 26 05 73, Overcurrent Protective Device Coordination Study.

### 1.4 SUBMITTALS

Submit product data including the following:

- A. Test Reports per US DOE 10 CFR Part 431, NEMA TP2, of previously manufactured units – representative of the kVA range on the project, tested in ISO 17025 Certified Efficiency Test Lab, signed by test engineer, documenting history of production capability to comply with performance requirements of this specification.
- B. Test Reports per factory ISO Nonlinear Load Test Program, signed by factory test engineer of previously manufactured units – representative of the kVA range on the project, tested in ISO 17025 Certified Efficiency Test Lab, documenting history of production capability to comply with performance requirement of this specification.
- C. Construction details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight
- D. Basic Performance characteristics including insulation class, temperature rise, core and

- coil materials, impedances & audible noise level, unit weight
- E. Documentation of UL listing of 1/2" clearance from ventilated surfaces
- F. Inrush Current (typical 3 cycle recovery)
- G. Short Circuit Current data: Primary & Secondary
- H. Efficiency, Loss & Heat output Data
- I. No load and full load losses per NEMA ST20
- J. Linear load data @ 1/6 load
- K. Linear load data @ 1/4, 1/2, 3/4 & full load
- L. Linear Load efficiency @ 35% loading tested per NEMA TP-2.
- M. Efficiency under K7 load profile at 16.7%, 25%, 50%, 75%, 100% of nameplate rating.
- N. Factory ISO 9001 procedure describing nonlinear load test program
  1. Meter and CT details including model, accuracy, serial numbers and calibration information.
- O. Copy of ISO 14001:2015 Certification
- P. Copy of ISO 9001:2008 Certification or manufacturer's own certification showing compliance with the ISO certification.
- Q. Documentation that materials used for shipment packaging meet the environmental requirements of this specification.

#### 1.5 NONLINEAR LOAD TEST PROGRAM

- A. Nonlinear Load Testing shall be carried out by an ISO 17025 Certified Efficiency Test Lab, and follow a defined protocol, independently audited within the ISO system.
- B. Efficiency shall be determined purely by measurements following IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers. Other methods are not acceptable.
- C. The nonlinear load bank shall consist of phase-neutral equipment with a K-7 profile, representative of a mix of typical office receptacle loads.
- D. Meters and CTs shall both be revenue class accurate and carry current calibration certificates. CTs shall be operated within their approved accuracy loading range. Dual meters shall gather simultaneous primary and secondary energy and harmonic data. Meter and CT details including model, accuracy, serial numbers and calibration information.
- E. Efficiency: Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency curve.

- F. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Store and protect products
- B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
- C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

#### 1.7 WARRANTY

- A. In addition to the requirements of Division One and Section 26 00 00, provide 18 month pro-rated warranty against defects in materials and workmanship, with limited liability.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

- A. Square D, Cutler Hammer, General Electric, Powersmiths International Corp.
- B. Manufacturers wishing to have products evaluated for acceptability and conformance with the performance requirements of this specification, shall provide detailed compliance and/or exception statements, along with the documentation required in the submittal section, including test documentation, signed by an engineer, that confirms that the transformer(s) meets the specified performance.
- C. Failure to provide the required documentation no less than 7 days prior to the bid date will disqualify products from consideration for this project.

#### 2.2 RATINGS

- A. Compatibility: This product must facilitate the ability of the electrical system to supply a sinusoidal voltage in order to improve the long-term compatibility of the electrical system with all types of linear and nonlinear connected loads today and in the future. All national and international standards on harmonics and power quality set limits on levels of voltage distortion to maintain compatibility.
- B. Copper-wound, 3-phase, common core, ventilated, dry-type, isolation transformer built to UL1561, NEMA ST20 and other relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers 750 kVA and less, 600 volt primary and less, shall be UL Listed and CSA Approved. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.
- C. Insulation System:

1. Shall be NOMEX-based impregnant for lowest environmental impact, long term reliability and long life expectancy.
  2. Class: 220 degrees C
  3. Impregnant Properties for low emissions during manufacturing, highest reliability and life expectancy
  4. Epoxy co-polymer
  5. VOC: less than 1.65 lbs/gal (low emissions during manufacturing)
  6. Water absorption (24hrs @25C): less than 0.05% (superior insulation, longer life)
  7. Chemical Resistance: Must have documented excellent performance rating by supplier
  8. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance)
  9. Dissipation Factor: max. 0.02 @25C to reduce aging of insulation, extending useful life
- D. Operating Temperature Rise: 115 degree C in a 40 degree C maximum ambient
- E. UL Listed & Labeled K-Rating: K-7 or higher
- F. Enclosure type: Indoor Ventilated NEMA 1, drip-proof [or select other: sprinklerproof, outdoor padmount, secure, outdoor public, totally enclosed, stainless steel]
- G. Rear Clearance: UL Listed for 6" clearance minimum from the wall. This capability shall be explicitly described on the nameplate of each unit.
- H. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule which takes effect January 1, 2016, and comply with the table of Maximum No Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load per 10 CFR Part 431, and efficiency at 35% load under a K-7 load profile. THIS NEEDS UPDATING. WAITING FOR INFO FROM OTHER MANUFACTURERS

kVA	No load losses (Watts)	Efficiency @ 1/6 load (%)	Efficiency @ 35% load (%)	Efficiency at 25% load under K-4,K7 nonlinear load
15	47	97.85%	98.28	98.00%
20	60	98.05%	98.34	98.10%
25	66	98.15%	98.41	98.15%
30	71	98.27%	98.50	98.30%
45	97	98.40%	98.66	98.40%
50	112	98.45%	98.67	98.42%
63	120	98.50%	98.75	98.48%
75	135	98.63%	98.82	98.60%
100	180	98.65%	98.88	98.65%
112.5	195	98.70%	98.92	98.70%
125	215	98.73%	98.94	98.72%
150	235	98.80%	98.99	98.80%
175	270	98.82%	99.02	98.82%
200	310	98.84%	99.05	98.84%

225	330	98.90%	99.09	98.90%
250	365	98.91%	99.10	98.92%
300	400	98.95%	99.15	99.00%
400	530	98.96%	99.20	99.02%
450	600	98.97%	99.22	99.03%
500	650	99.00%	99.25	99.05%
600	800	99.01%	99.28	99.07%
750	875	99.10%	99.32	99.10%
850	950	99.11%	99.34	99.11%
1000	1200	99.12%	99.36	99.12%

- I. Voltage Taps: For transformers 15kVA-300kVA, provide two 2-1/2% full capacity taps above and four 2-1/2% taps below nominal primary voltage. For transformers 500 and 750KVA, provide two 2-1/2% full capacity taps above and two 2-1/2% taps below nominal primary voltage.
- J. Impedance: Between 3.0% and 6.0% unless otherwise noted.
- K. Grounding: Ground the core of the transformer to the enclosure with a flexible grounding conductor sized according to NEC requirements.
- L. Infrared (IR) Viewing Port to address NFPA 70E/CSA-Z462 Arc Flash Standard
  - 1. Provide integrated IR viewing port that provides single point viewing point that enables the thermal scanning of all live connections including primary and secondary feeder terminations and taps without requiring opening of the transformer enclosure or exposure to live parts.
  - 2. The port shall be easily usable by a wide variety of makes and models of commercially available thermal scanning devices, without requiring any proprietary connectors, adapters or other components.
- M. Lug Kit: supply with Compression lugs configured as specified at time of order

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

- A. Delivery. Deliver transformers individually wrapped for protection and mounted on shipping skids.
- B. Storage. Store transformers in a clean, dry space, elevated above grade, and protected from weather, moisture, sunlight, and dirt. Maintain factory wrapping or provide an additional heavy canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Temporary Heating. Apply temporary heat for protection from insulation moisture absorption and metallic component corrosion in accordance with paragraph 3.2B of Section 26 00 00, Basic Electrical Requirements, and according to manufacturer's written instructions.



tions. Apply temporary heat within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

- D. Stacking. Do not stack transformers.
- E. Work Surface. Transformers shall not be used as work tables, scaffolds, platforms, or ladders.
- F. Handling. Handle transformers carefully to avoid damage to material components, enclosure and finish. Use only lifting eyes and brackets provided for that purpose. Damaged transformers shall be rejected and not be installed on project.
- G. General Provisions. Refer to Part 3 of Section 26 00 00, Basic Electrical Requirements.

### 3.2 INSPECTION

- A. Installer shall examine the areas and conditions under which dry type transformers are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install dry type transformers in locations indicated on Drawings, in accordance with the applicable requirements of the NEC, NEMA, and ANSI.
- B. Set transformers plumb and level.
- C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- D. Ventilation.
  - 1. Provide adequate clearance around transformer for ventilation of core, coil and internal components; minimum 1 foot – 0 inch all sides unless noted otherwise.
  - 2. Where transformers are proposed for installation vertically one above the other, provide sufficient vertical separation between transformers to permit adequate air circulation for proper cooling of each transformer, in accordance with manufacturer recommendations. Take temperature measurements of transformers under load and document temperature rise and temperature of each transformer where mounted in a vertical arrangement. Where the temperatures exceed manufacturer's recommendations or the requirements of this Section, relocate transformers to provide adequate cooling.
- E. Verify removal of coil shipping anchor bolts before transformer is energized.
- F. Check for damage and tight connections prior to energizing transformer.

### 3.4 FLOOR MOUNTING

- A. Provide concrete pad for floor-mounted transformers. Refer to structural Drawings and specifications for design criteria. Where not otherwise indicated, and in addition to the requirements of Section 26 00 00, Electrical General Provisions, and Section 26 05 29, Metal Framing and Supports, construct pads of nominal 4 inch thick 2500 pound concrete reinforced with 6 inch x 6 inch steel wire mesh. Size pads 3 inches wider than transformer and chamfer edges to a 3/4 inch bevel.
- B. Maintain a minimum of 12 inches free air space between enclosure and walls.
- C. Vibration isolation. Provide vibration and sound isolation system suitable for isolating the transformer noise from the building structure.
  - 1. Provide spring-type isolators in suspension system sized to support the transformer weight, one at each corner of transformer lower mounting rails. Manufacturer: Korfund/Aeroflex type LK, or accepted substitution.
  - 2. Use one pad type Korfund Elasto-Grip, waffle, or accepted substitution, at each corner of the transformer, below the spring-type isolators, sized for load of 50 lbs./sq.-in.
- D. Secure the transformer and vibration isolators to the pad as recommended by the manufacturer.
- E. Refer to Section 26 05 29, Metal Framing and Supports.

### 3.5 CONDUIT CONNECTIONS

- A. Flexible Metallic Conduit. Attach incoming and outgoing conduits to the transformer enclosure with flexible metallic conduit (FMC), minimum length 24 inches.
  - 1. Make conduit connections to side panel of enclosure using an appropriately sized 90-degree elbow connector.
  - 2. Provide grounding-type coupling at each end of flexible metallic conduit. Provide a bonding jumper on outside of flexible conduit, sized per NEC Table 250.122 or NEC Table 250.66 as appropriate. The exterior bonding jumper shall be provided in addition to the grounding conductor run with the transformer circuit conductors inside the conduit. Where grounding conductor or jumper size is shown larger on Drawings, provide the larger size.
- B. Liquid Tight Flexible Metallic Conduit. Where indicated, use liquid-tight flexible conduit for connections to transformer case, maximum length 6 feet, minimum length 3 feet, with slack or dip to attenuate noise transmitted through conduit.
  - 1. Make conduit connections to side panel of enclosure using an appropriately sized 90-degree elbow connector.
  - 2. Provide grounding-type coupling at each end of liquid-tight flexible conduit. Provide a bonding jumper on exterior of liquid-tight flexible conduit, sized per NEC Table 250.122 or NEC Table 250.66 as appropriate. The exterior bonding jumper shall be provided in addition to the grounding conductor run with the transformer circuit conductors inside the conduit. Where grounding conductor or jumper size is shown larger on Drawings, provide the larger size.

### 3.6 CABLE CONNECTIONS

- A. Lugs. Make transformer cable connections with compression-type lugs suitable for termination of 90°C rated conductors. Position lugs so that field connections and wiring will not be exposed to temperature above 75°C.
- B. Grounding. Ground the neutral (X0) of the transformer secondary winding in accordance with the requirements of NEC-250.30, paragraph 3.3G of Section 26 05 26, and as indicated on Drawings. Connect equipment grounding conductors, system bonding jumper(s), and isolated grounding conductors to transformer neutral (X0) bus. Provide equipment bonding jumper from transformer neutral (X0) bus to transformer metallic enclosure. Expose bare metal of transformer enclosure to ensure proper contact between transformer enclosure and equipment bonding jumper.

### 3.7 TAP SETTING

- A. Check for damage and tight connections prior to energizing transformer. Verify removal of all shipping anchor bolts and shipping supports prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.
- C. Select the appropriate tap setting on transformer so that the actual secondary voltage is  $\pm 1/2$  of a tap span at full load.

### 3.8 TESTING

- A. Test and record no-load amperages of all dry type transformers. Replace at no cost to Owner all transformers with no load amperage exceeding four percent of rated full load.
- B. Submit record of field testing and tap settings to the Owner's Representative and to the Architect/Engineer, in accordance with the requirements of Division One and Section 26 00 00. Where not specified elsewhere, provide three copies of the record.

END OF SECTION