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OFFICE OF ARCHITECTURE

March 20, 2023

GS# 210-073 New Men's Residence Hall
Mississippi Delta Community College
Moorhead, Mississippi

Addendum No. 2

This Addendum forms part of the Contract Documents for the above referenced project. All other requirements of the original Contract Documents shall remain in effect except as specifically modified in this Addendum. Bidder is to acknowledge receipt of this Addendum with their bid proposal. Failure to do so may subject the Bidder to disqualification. This Addendum is issued to all known Plan Holders.

1. Clarifications:

- a. Contractor to provide a Building Plaque for this project. Provide Cast Bronze, 24" x 36". Provide lettering as directed within capacity of plaque size. Satin polished raised letters, textured background. Concealed mounting. Location shall be verified with Owner and Using Agency prior to installation.
- b. Clarification - Contract Time: Following acceptance of bid, the Contractor is encouraged to produce submittals for long lead time items as quickly as possible. Once submittals are approved, the Contractor is to order the items with predicted long lead times. The BoB asks the contractor to provide correspondence from respective suppliers which speaks to delays and expected delivery times for the offer of additional contract time via Change Order thereafter.
- c. Clarification - Temporary Utilities: Regarding the required Utility Agreement with the Using Agency, for electricity the Contractor shall install a temporary meter and be responsible for the electricity Service to the job site until the building is transferred to MDCC. For water service, the rate is \$60 per month, payable to MDCC.
- d. Clarification – Access Control: Access Control components called out 'By access Control Contractor' in Section 08 71 00 shall now be provided by the Contractor under this contract. The new access control shall be Lenel S2 Netbox system added to the current server on campus. Provide power supplies, cabling, card readers, and all other components necessary for a complete install compatible with the current server.
- e. Revision: Door Schedules
 - i. Revise A601 to clarify multiple characteristics of doors 103, 108.1, 201, 202, 203 and 204 in Opening Schedule – Lobby and Commons First & Second Floor – See attached A601R
 - ii. Revision – Door 200A Revise opening Frame Glazing to "---"
 - iii. Revision – Door 200.1A Revise opening Door Material to "HM (Hollow Metal)"
 - iv. Bidders are to refer to opening schedules for all door and framing characteristics.
- f. Replace all occurrences of "Pre-Finished, Flat-Top 3-Bar, Galvanized Steel Fence w ¾" Vertical Pickets" in drawings to "Commercial grade prefinished aluminum fencing and gates – See specs". All ornamental and enclosure fencing shall be prefinished aluminum.
- g. Drawing Sheet A130, Roof Type Legend: all references to "Roof Type 1 – Asphalt Shingle System" will now change. This roof type is detailed on the bottom right corner of the page. This roof type is

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also referenced on the “Overall Roof Plan” on drawing sheet A130, multiple wall sections, and on the Roof Edge Details 1/A350 & 2/A350 on drawing sheet A350. All other similar references shall also be changed as follows:

- i. New nailable roof insulation panels with a total thickness of 4 ½” are to be installed in lieu of the 4” Rigid Insulation and ½” Nailer/Cover Board that are shown on the “Roof Type 1 – Asphalt Shingle System” detail.
 - ii. The new nailable roof insulation panels are to be anchored to the metal deck as recommended by the manufacturer. The contractor must supply and install all components as recommended for proper installation of the nailable roof insulation panels for this application. The new nailable roof deck insulation panels are to now be installed with a gap of approximately 1” between the panels and the blocking at the fascia to allow airflow from the vented soffit. Follow all manufacturer’s recommendations for installation for the given conditions.
 - iii. The new nailable roof insulation panels are to be constructed with polyisocyanurate insulation core and a built-in ventilation space that is between nailable OSB board that is approximately ½” thick (both sides). The nailable roof insulation panels are to be equal to GAF ThermaCal Nail Base Roof Insulation Panels. The required R Value will be per the system described.
 - iv. Ice and Water Shield underlayment is to be installed over the entire nailable surface.
 - v. All roofing products must be equal to the products listed above and be approved by the manufacturer for a 20-year watertightness warranty.
- h. Drawing Sheet A130, Overall Roof Plan: A new vented ridge vent will now be required to be installed at all ridge locations on the shingled portion of the roof. The ridge vent is to be installed so that the new nailable roof insulation panels can ventilate properly. The Contractor shall coordinate the nailable roof insulation panel installation with the vented ridge vent installation so that all materials and accessories that are required are supplied and installed. The contractor shall provide the proper gap in the decking so that the system properly ventilates. Blocking is to be installed as recommended by the ridge vent and the nailable roof insulation panel manufacturers. The ridge vent must be an approved product that meets the requirements of the roofing material(s) manufacturer that are necessary for the required warranty.
- i. Drawing Sheet A350, Details 1/A350 and 2/A350: All references to “Cement Board Soffit Panel(s)” shall now be Vented Cement Board Soffit Panels equal to smooth Hardie Soffit Panels. All installation is to be as recommended by the soffit panel manufacturer and the soffit is to be installed in a manner to properly vent. The new nailable roof deck insulation panels are to now be installed with a gap between the panels and the blocking at the fascia to allow airflow from the vented soffit. The sheathing and decking must also be slotted (or have holes) to allow the soffit panels to vent through the nailable roof insulation panels.
- j. Clarification – Special Inspections: TAB is to be carried by SINERGI, not the mechanical contractor. The 4 tests that are outlined in the Building Envelope Commissioning Specification, 01-91-15, are to be performed by a third party hired by the GC or Subcontractor.
- k. Revisions to Finish Schedules A901 and A902 – See A901R and A902R
 - i. Revise ROOM FINISH SCHEDULE – ‘B WING 1ST FLOOR AND ROOM FINISH SCHEDULE’ – ‘B WING 2ND FLOOR’ to reflect actual room number on B wing.

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- ii. All dorm rooms and associated closets withing on first and second floor to receive LVT-5 in lieu of LVT-1
- iii. Revise laundry and storage closets within in finish schedule to receive LVT 3 in lieu of LVT 1 (100A,A128A,A100B, 200A, 200.2A, 200B)
- iv. Revise South Stair and East stair 2nd floor and intermediate landings to receive LVT-3 in lieu of concrete
- l. All plastic laminate countertops shown with bullnose edge detail in drawings may be provided with a bullnose or an eased square edge profile. However, counter substrate is to remain as detailed in drawings.
- m. Clarification - References to quartz transaction counters countertops, backsplashes and side splashes are to be equal to Cambria – Signature Series – Kirkstead. Provide gloss finish.
- n. For interior finish “FCB-1” (Fiber Cement Board), paint grade poplar is acceptable in lieu of the V-Groove cement board siding; board sizes and profile, detailing, finish, trim components, and accessories shall meet the Basis of Design indicated in the Documents.
- o. Clarification: For closet rods shown in drawings, provide steel closet rod with a minimum 1 5/16” outside diameter, and minimum rod-wall thickness of .075”
- p. Structural Clarifications:
 - i. Sheet S307 – Deleted Details 1 & 2
 - ii. Sheet S308 – On Detail 1, changed the name of the schedule from “STEEL STUD HEADER SCHEDULE” TO “SHEAR WALL SCHEDULE”
- q. Civil Clarifications
 - i. Revisions – See sheets C100R and C203R
- r. Electrical Clarifications
 - i. Item No. 1: Specifications, Section 284600 Fire Detection and Alarm: Delete Paragraph 2.02.A.4 and Paragraph 2.02.A.6. The system notification shall be via horns and horn/strobes and not voice based via speakers and speaker/strobes.
 - ii. Item No. 2: Specifications, Section 284600 Fire Detection and Alarm: Delete “-Integrated Voice Emergency Evacuation Panel” from Paragraph 2.04.C.
 - iii. Item No. 3: Specifications, Section 284600 Fire Detection and Alarm: Delete Paragraph 2.04.C.2 “Voice Integration”.
 - iv. Item No. 4: Specifications, Section 284600 Fire Detection and Alarm: Delete Paragraph 2.05.F “Speakers” and Paragraph 2.05.G “Speaker Strobes and Strobes” and replace with Paragraph 2.05.F:

“2.05.F Notification Appliances:

1. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
2. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated,

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- and with screw terminals for system connections.
3. Combination Devices: Factory-integrated audible and visible devices in a single mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
 4. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
 5. Visible Notification Appliances: visuals complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - a. Rated Light Output: 15/30/5/110/177 per drawings and field selectable.
 - b. Mounting: Wall mounted unless otherwise indicated.
 - c. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - d. Flashing shall be in a temporal pattern, synchronized with other units.
 - e. Visuals Leads: Factory connected to screw terminals.
 - f. Mounting Faceplate: Factory finished, white."
- v. Item No. 5: Specifications, Section 260519 Low-Voltage Electrical Power Conductors and Cables: Delete all references to MC cable including Paragraphs 1.0.C, 2.04, 3.03D, and 3.03.I. MC cable will not be allowed for this Project. Refer to Section 260533.13 Conduit for Electrical Systems for wiring methods.
 - vi. Item No. 6: Drawings, Sheet E001, Electrical Legend & Notes: Changed description of the symbols for Fire Alarm Devices in the Legend to from speakers to horns.
 - vii. Item No. 7: Drawings Sheet E002, Fire Alarm Riser: Modified General Notes deleting voice notification requirements.
 - viii. Item No. 8: Drawings, Sheet E004, Luminaire Schedule: Modified the Luminaire Schedule to add the requirements of Luminaire "SA". Added Pole Foundation Requirements.
 - ix. Item No. 9: Drawings, Sheet E100, Overall Site Electrical Plan: Added Keyed Note #3 to provide an unswitched conductor for the receptacles in each pole of Luminaire "SA" assembly.
 - x. Item No. 10: Drawings, Sheet E208, 1st Floor Plan-A Wing-Mechanical Connections: Added circuit for the electric wall heater in Room 126A.
 - xi. Item No. 11: Drawings, Sheet E208, 1st Floor Plan-A Wing-Mechanical Connections: Modified Floor Plan Keyed Notes to reflect Alternate No. 2 conditions and added Base Bid Conditions for connections of Mechanical Equipment.
 - xii. Item No. 12: Drawings, Sheet E209, 1st Floor Plan-B Wing-Mechanical Connections: Modified Floor Plan Keyed Notes to reflect Alternate No. 2 conditions and added Base Bid Conditions for connections of Mechanical Equipment.
 - xiii. Item No. 13: Drawings, Sheet E211, 2nd Floor Plan -A Wing-Mechanical Connections: Modified Floor Plan Keyed Notes to reflect Alternate No. 2 conditions and added Base

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Bid Conditions for connections of Mechanical Equipment. Added Fire Alarm System Duct Detectors to Units OAHU-1, OAHU-1A.

- xiv. Item No. 14: Drawings, Sheet E212, 2nd Floor Plan -B Wing-Mechanical Connections: Modified Floor Plan Keyed Notes to reflect Alternate No. 2 conditions and added Base Bid Conditions for connections of Mechanical Equipment. Added Fire Alarm System Duct Detectors to Units OAHU-2, OAHU-2A.
- xv. Item No. 15: Drawings, Sheets E005, Electrical Circuit Schedules; E006, Electrical Circuit Schedules; E007 Electrical Circuit Schedules; E008 Electrical Circuit Schedules: A Series Rated distribution system is acceptable. Loadcenter construction in lieu of panelboard construction is acceptable to allow arc fault/ground fault functions of circuit breakers. Panelboard construction shall be maintained for Panel LDP. Revise the AIC ratings from that shown on the schedules to: SWBD: 42kAIC, LDP: 42kAIC; L1A, L1C, L1D, L1E, L2A, L2C, L2D: 22kAIC; L1B, L2B, L2E to 10kAIC. The available fault currents shown on these panelboards are not to be used and Specifications, Section 284600 Fire Detection and Alarm: Delete Paragraph 2.02.A.4 and Paragraph 2.02.A.6. The system notification shall be via horns and horn/strobes and not voice based via speakers and speaker/strobes. will be modified based on the results of the final Power Systems Study as specified.

Mechanical Clarifications

- i. Item No 1: Specifications, Section 230900: Replace with attached Section 230900 clarifying controls allowance breakdown for Base Bid, Alternates, and existing control vendors with front ends currently on campus.
- ii. Item No 2: Specifications, Section 238129: Replace with attached Section 238129 clarifying filter.
- iii. Item No 3: Drawings, Sheet M200: Replace with attached Drawing M200 modifying model numbers on corridor indoor heat pumps, accessories on variable refrigerant equipment, and reheat capacity on dedicated outside air units.

Contents: This addendum consists of **60** (8 ½" x 11") sheets and 16 (24" x 36") sheets.

End of Addendum No. 2 for: GS# 210-073 New Men's Residence Hall

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SHEET **A601R**

OPENING
DETAILS/SCHEDULE
- LOBBY AND
COMMONS

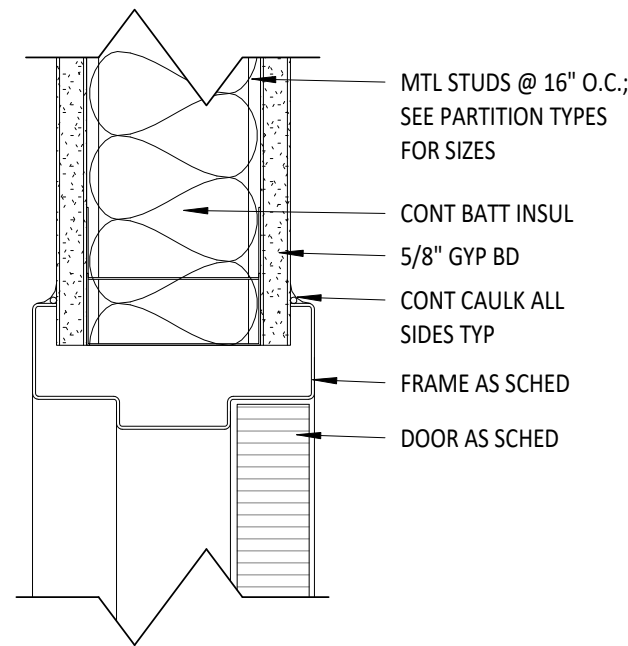
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CHECKED BY: SZ

REVISIONS:
3.20.2023 - ADDENDUM 2

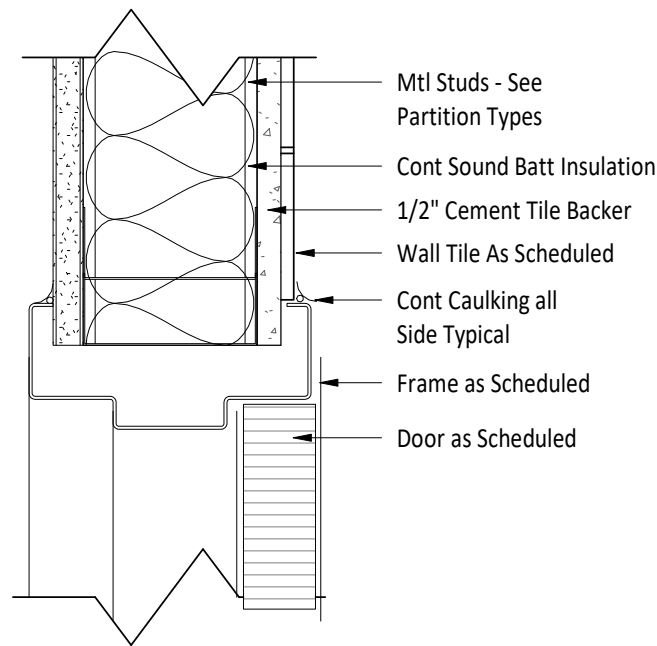
OPENING SCHEDULE - LOBBY AND COMMONS (FIRST & SECOND FLOOR)

OPENING	SINGLE/PAIR	DOOR				DOOR MATERIAL	DOOR GLAZING	FRAME TYPE	FRAME MATERIAL	FRAME		HEAD DETAIL	JAMB DETAIL	SILL DETAIL	OPENING RATING	HARDWARE SET	ACCESS CONTROL	REMARKS	OPENING
		W	H	THK	TYPE					GLAZING	GLAZING								
100.5	S	3'-0"	7'-0"	1 3/4"	1	WD	-	2	HM	-	1/A601	1/A601	-	1/3 HR	5	---	---	---	100.5
100.6	S	3'-0"	7'-0"	1 3/4"	3	AL	GL-2	5	AL	GL-2	3/A601	3/A601	-	1/3 HR	6	CR	---	PROVIDE BLINDS	100.6
101	P	6'-0"	7'-0"	1 3/4"	3	AL	GL-1	6	AL	GL-1	4/A610	2/A500	5/A601	---	1	-	---	---	101
101.1	P	6'-0"	7'-0"	1 3/4"	3	AL	GL-2	2	AL	---	7/A601	7/A601	---	---	2	SA,CR	---	---	101.1
102	P	6'-0"	7'-0"	1 3/4"	3	AL	GL-1	6	AL	GL-1	4/A610	2/A500	5/A601	---	1	---	---	---	102
102.1	P	6'-0"	7'-0"	1 3/4"	3	AL	GL-2	2	AL	---	7/A601	7/A601	---	---	2	SA,CR	---	---	102.1
103	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	1/3 HR	3	CR	---	---	103
104	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	1 HR	4.4	---	---	---	104
105	P	6'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	4.1	---	---	---	105
106	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	4	---	---	---	106
107	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	7	---	---	PROVIDE OCCUPANCY IND.	107
108.1	S	3'-0"	7'-0"	1 3/4"	1	GHM	---	1	GHM	---	1/A610	2/A610	5/A601	---	8	---	---	---	108.1
108.2	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	9	---	---	---	108.2
108.3	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	9	---	---	---	108.3
108.4	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	1/3 HR	5	---	---	---	108.4
108.5	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	10	---	---	---	108.5
108.6	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	AL	---	1/A601	1/A601	---	---	9	---	---	---	108.6
108.7	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	10	---	---	---	108.7
108.8	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	9	---	---	---	108.8
108.9	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	10	---	---	---	108.9
109	P	6'-0"	7'-0"	1 3/4"	1	GHM	---	1	GHM	---	1/A610	2/A610	5/A601	---	11	---	---	---	109
110	S	3'-1"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	1/3 HR	4.4	---	---	---	110
201	S	3'-0"	7'-0"	1 3/4"	1	WD	---	5	HM	GL-2	3/A601	1/A601	---	---	6.1	---	---	PROVIDE BLINDS	201
202	S	3'-0"	7'-0"	1 3/4"	1	WD	---	5	HM	GL-2	3/A601	1/A601	---	---	6.1	---	---	PROVIDE BLINDS	202
203	S	3'-0"	7'-0"	1 3/4"	1	WD	---	5	HM	GL-2	3/A601	1/A601	---	---	6.1	---	---	PROVIDE BLINDS	203
204	S	3'-0"	7'-0"	1 3/4"	1	WD	---	5	HM	GL-2	3/A601	1/A601	---	---	6.1	---	---	PROVIDE BLINDS	204
205	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	4	---	---	---	205
206	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	4	---	---	---	206
207	S	3'-0"	7'-0"	1 3/4"	1	WD	---	2	HM	---	1/A601	1/A601	---	---	7	---	---	PROVIDE OCCUPANCY IND.	207

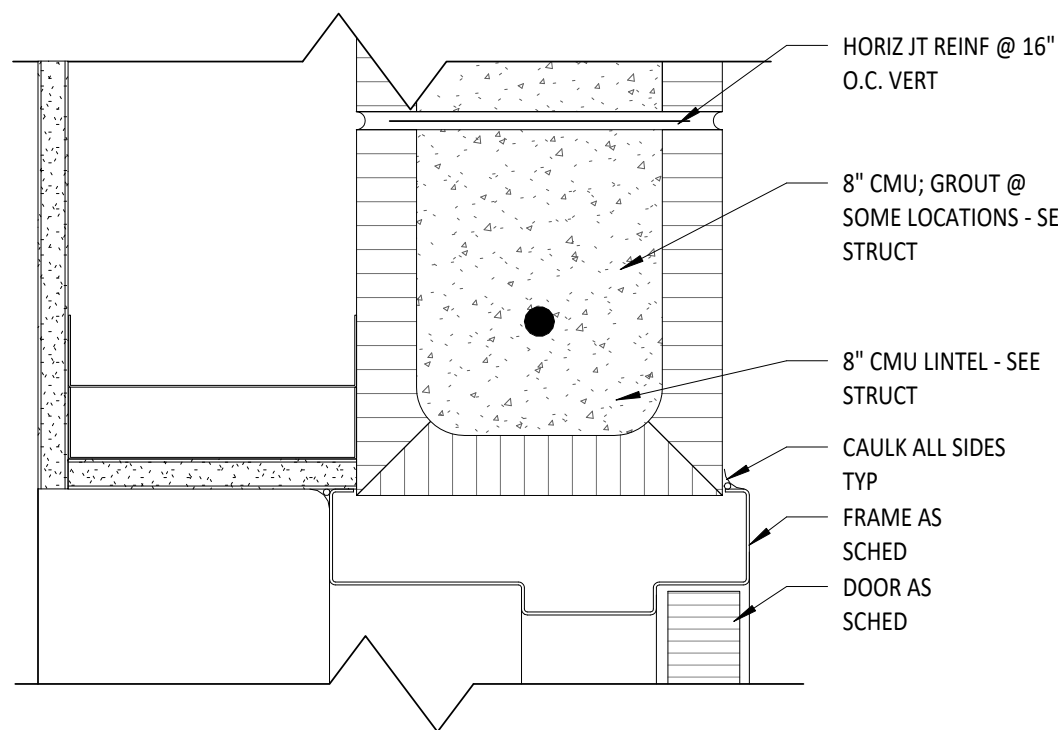
ADDENDUM # 2 EDITS:
- REVISIONS TO DOORS 103, 108.1, 201,202, 203, 204 ON THIS SCHEDULE, SEE WRITTEN CLARIFICATIONS FOR REVISIONS NOT SHOWN HERE.



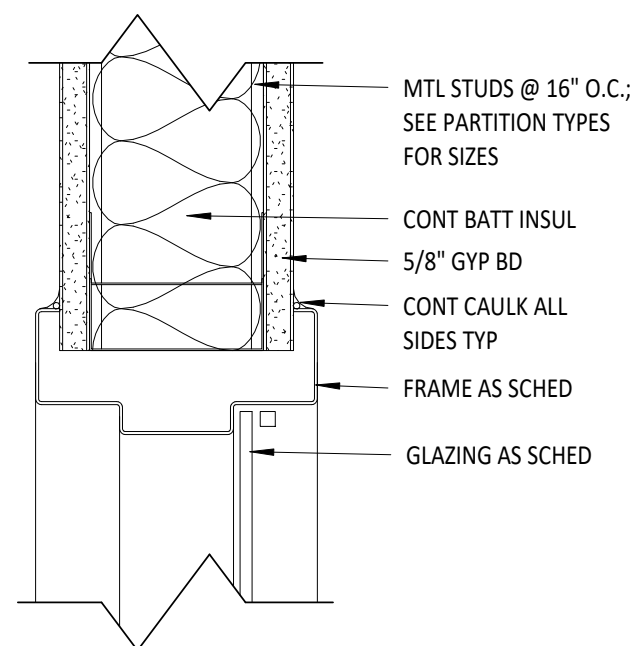
1 TYP HEAD/JAMB @ GYP BD
3" = 1'-0"



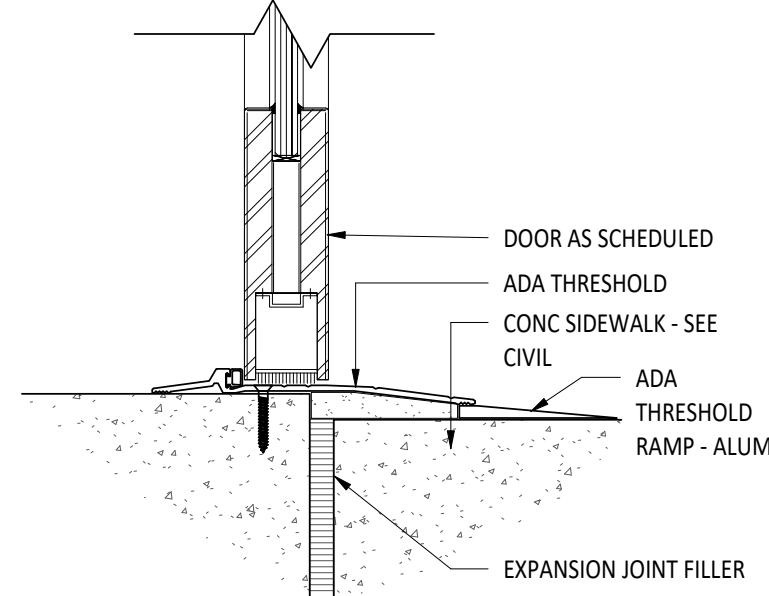
2 TYP HEAD/JAMB @ TILE
3" = 1'-0"



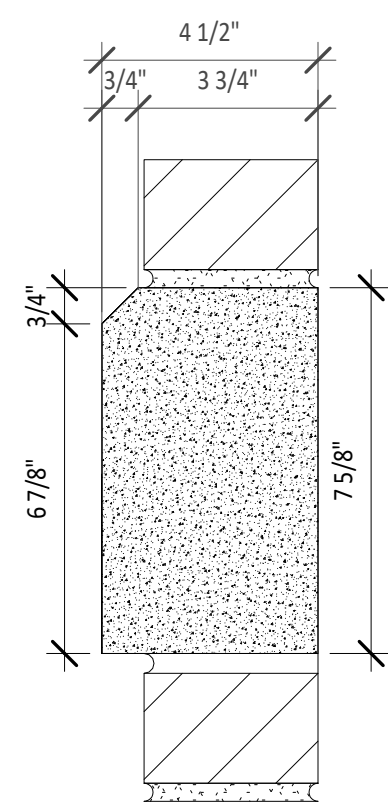
6 TYP HEAD @ 8" CMU w/ Gyp
3" = 1'-0"



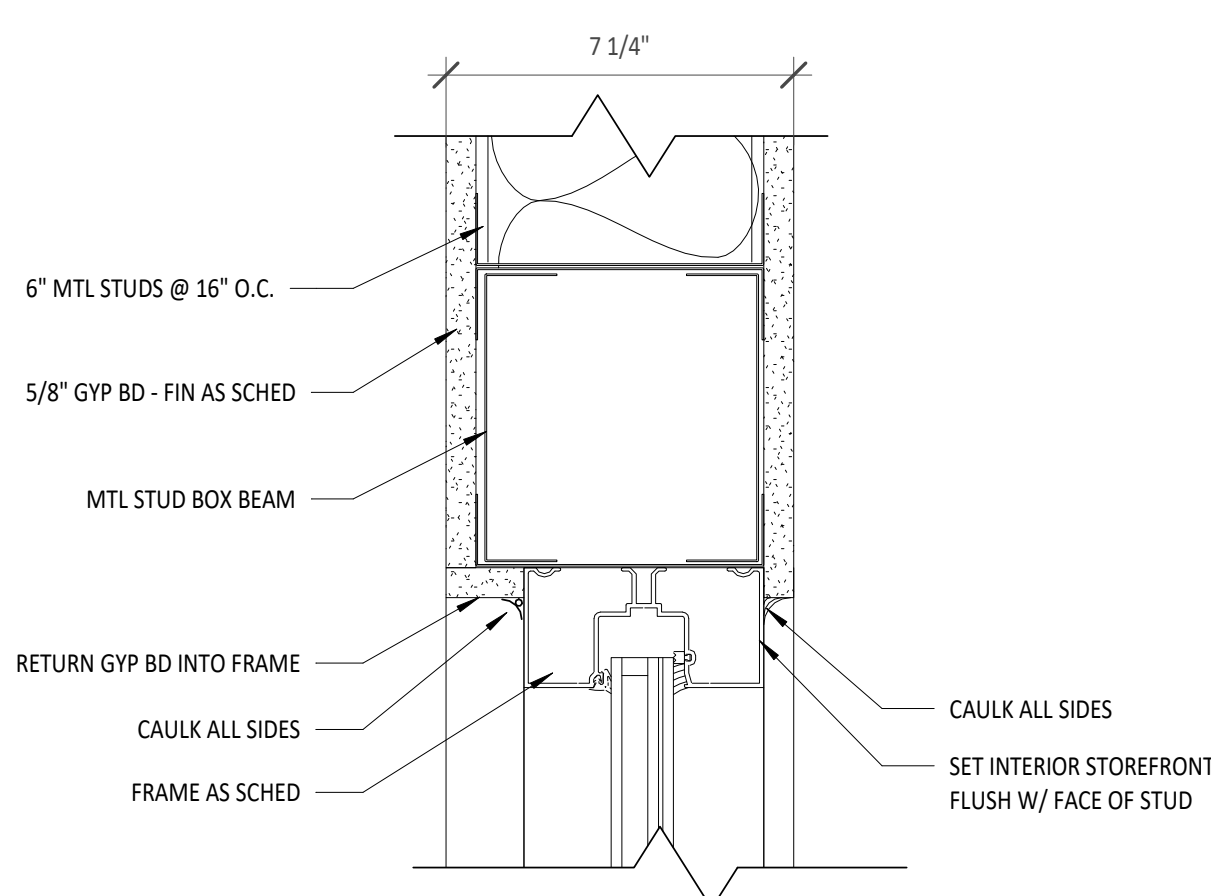
3 TYP HEAD/SILL @ GYP BD
3" = 1'-0"



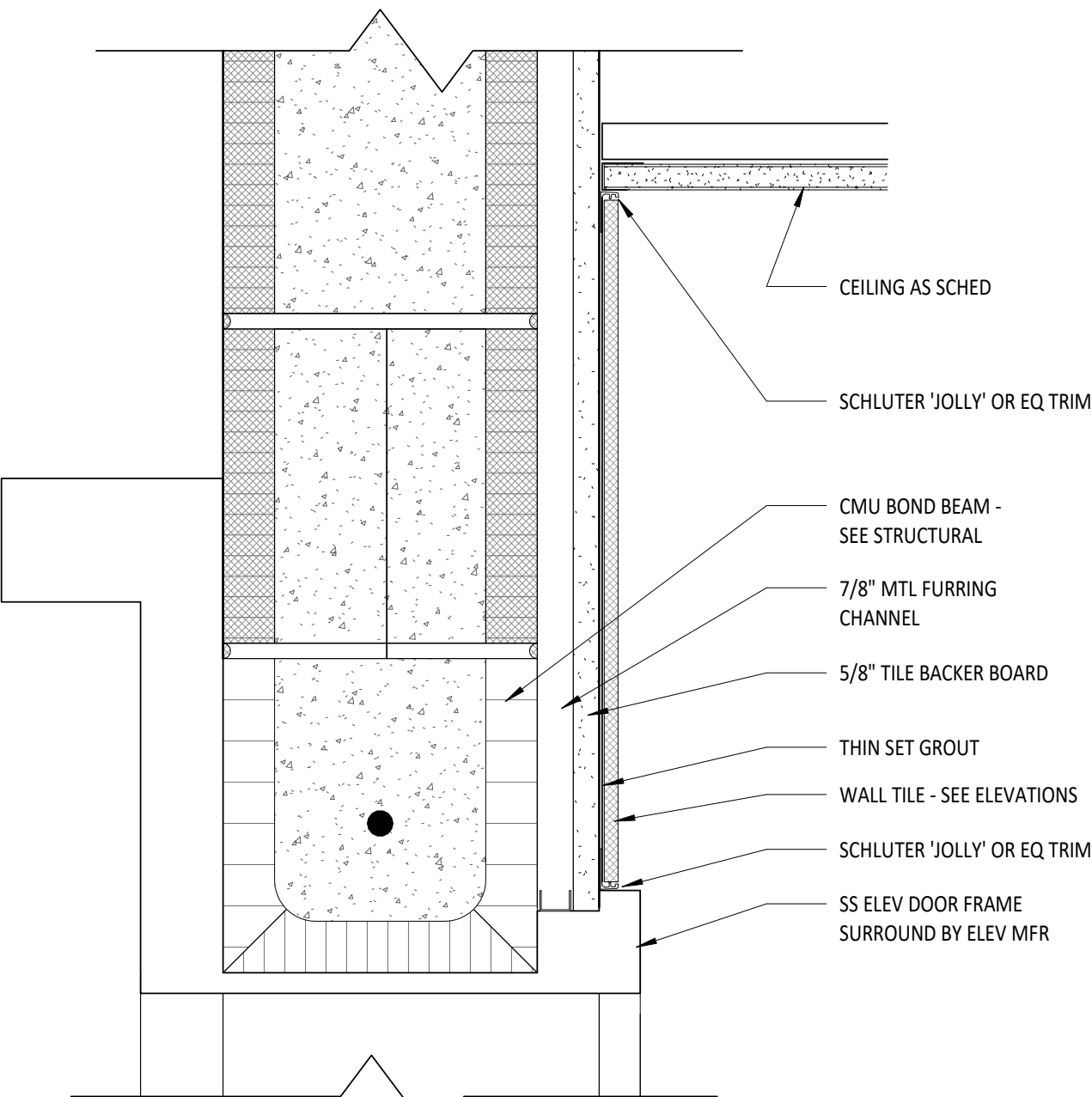
5 TYP THRESHOLD
3" = 1'-0"



4 CAST STONE PROFILES
3" = 1'-0"



7 TYP HEAD/JAMB - INT STOREFRONT
3" = 1'-0"



8 ELEVATOR HEADER DETAIL
3" = 1'-0"

OPENING SCHEDULE GENERAL NOTES

NOTES:

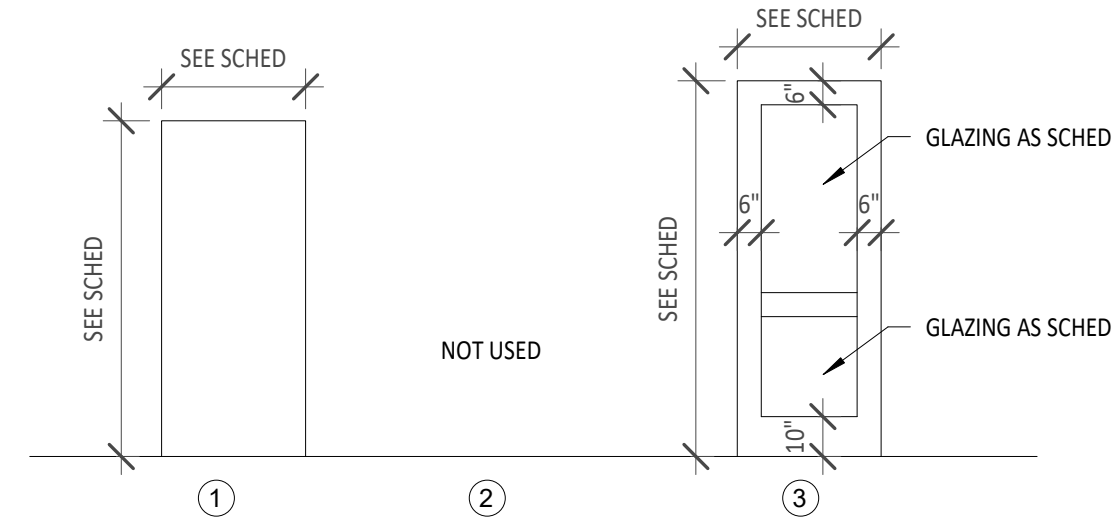
- PROVIDE FLOORING TRANSITIONS BETWEEN TILE ROOMS AND ADJACENT FLOORING MATERIALS TO MEET ADA AT OPENINGS WHERE TILE IS TO BE INSTALLED.
- ALL HOLLOW METAL DOORS AND FRAMES, INCLUDING GALVANIZED HOLLOW METAL DOORS AND FRAMES ARE TO BE PREPPED, PRIMED, AND PAINTED. CAULK TO ADJACENT MATERIALS OR SEALANT TO EXTERIOR MATERIALS, TYPICAL AT ALL SIDES.
- SEE WINDOW TYPES FOR ADDITIONAL FRAMES AND GLAZING NOTES.
- ACCESS CONTROL - CONTRACTOR TO PROVIDE ALL ITEMS FOR THE ACCESS CONTROL SYSTEM INCLUDING ALL INTEGRATED HARDWARE, POWER SUPPLIES, POWER CABLING THROUGH HINGE, ETC.
- 1 HR RATED DOORS SHALL BE A RATED ASSEMBLY IN ACCORDANCE WITH NFPA 80.
- FOR ALL DOUBLE DOORS WITH EGRESS AND/OR ACCESS CONTROL HARDWARE, PROVIDE REMOVABLE ASTRAGAL FINISHED TO MATCH DOOR FRAME
- IN ACCESSIBLE ROOMS, PROVIDE ADDITIONAL PEEPHOLE VIEWER AT 43" AFF.

ABBREVIATIONS:

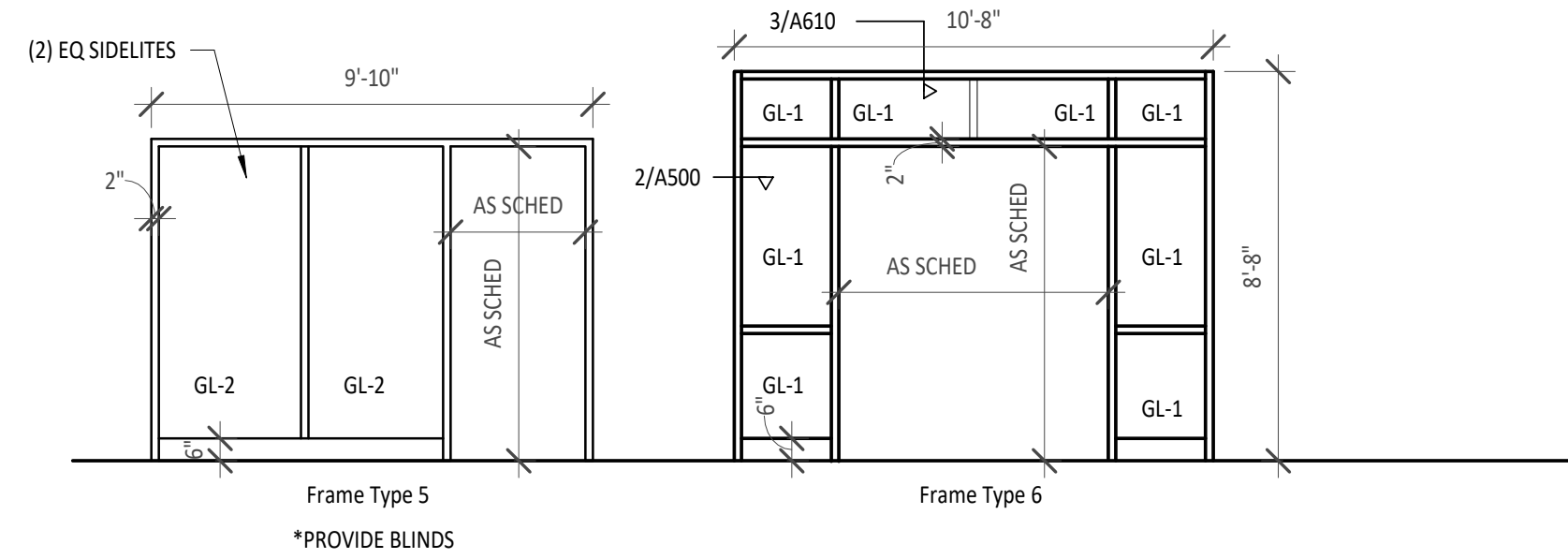
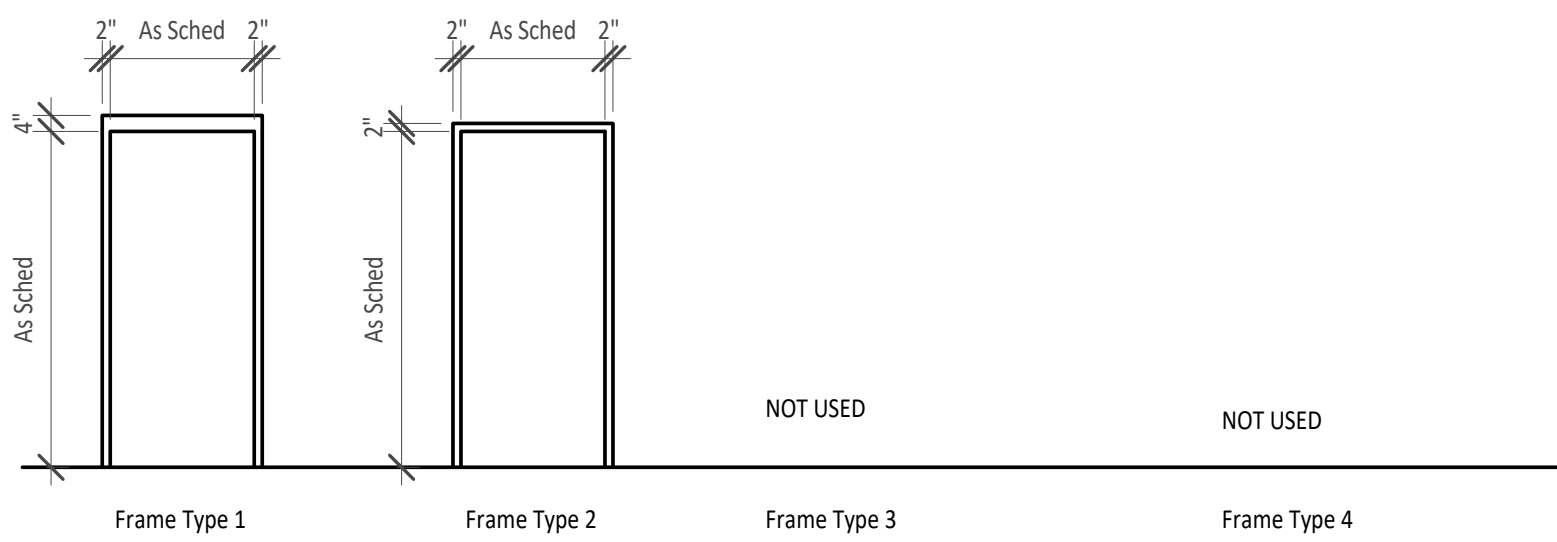
WD - WOOD
AL - ALUMINUM
STL - STEEL
S - SINGLE
P - PAIR
GHM - GALVANIZED HOLLOW METAL, PREP PRIME AND PAINT
HM - HOLLOW METAL, PREP PRIME AND PAINT
SA - SCHEDULED ACCESS
CR - CARD READER

GLAZING TYPES:

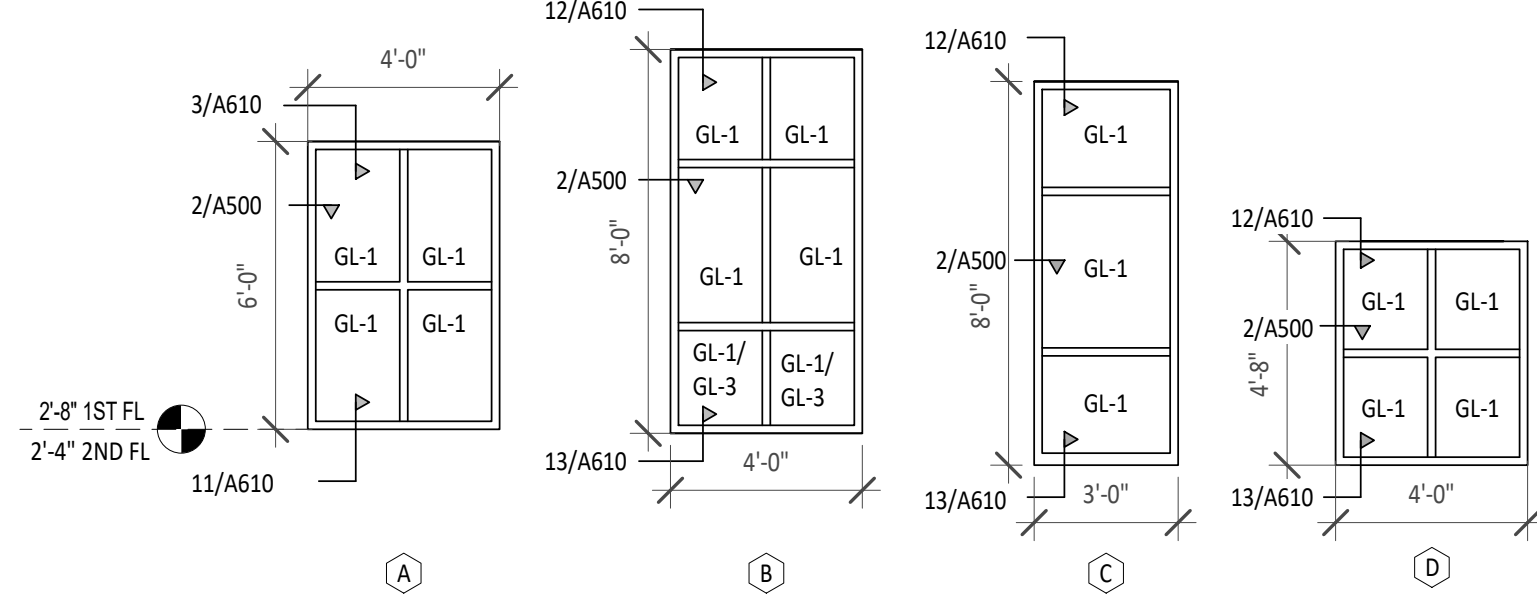
GL-1: TINTED INSULATED GLASS
GL-2: SAFETY GLASS
GL-3: SPANDREL GLASS



A DOOR TYPES
1/4" = 1'-0"

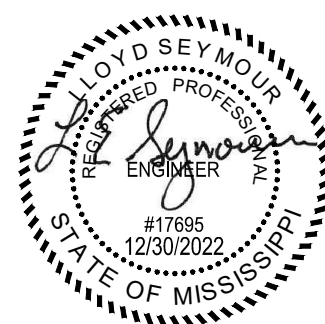


B FRAME TYPES
1/4" = 1'-0"



*ALL WINDOWS TO RECEIVE BLINDS
NOTE: PROVIDE GL-3 SPANDREL GLAZING AT ROOM 103 COMPUTER LAB

C WINDOW TYPES
1/4" = 1'-0"



DEMOLITION NOTES

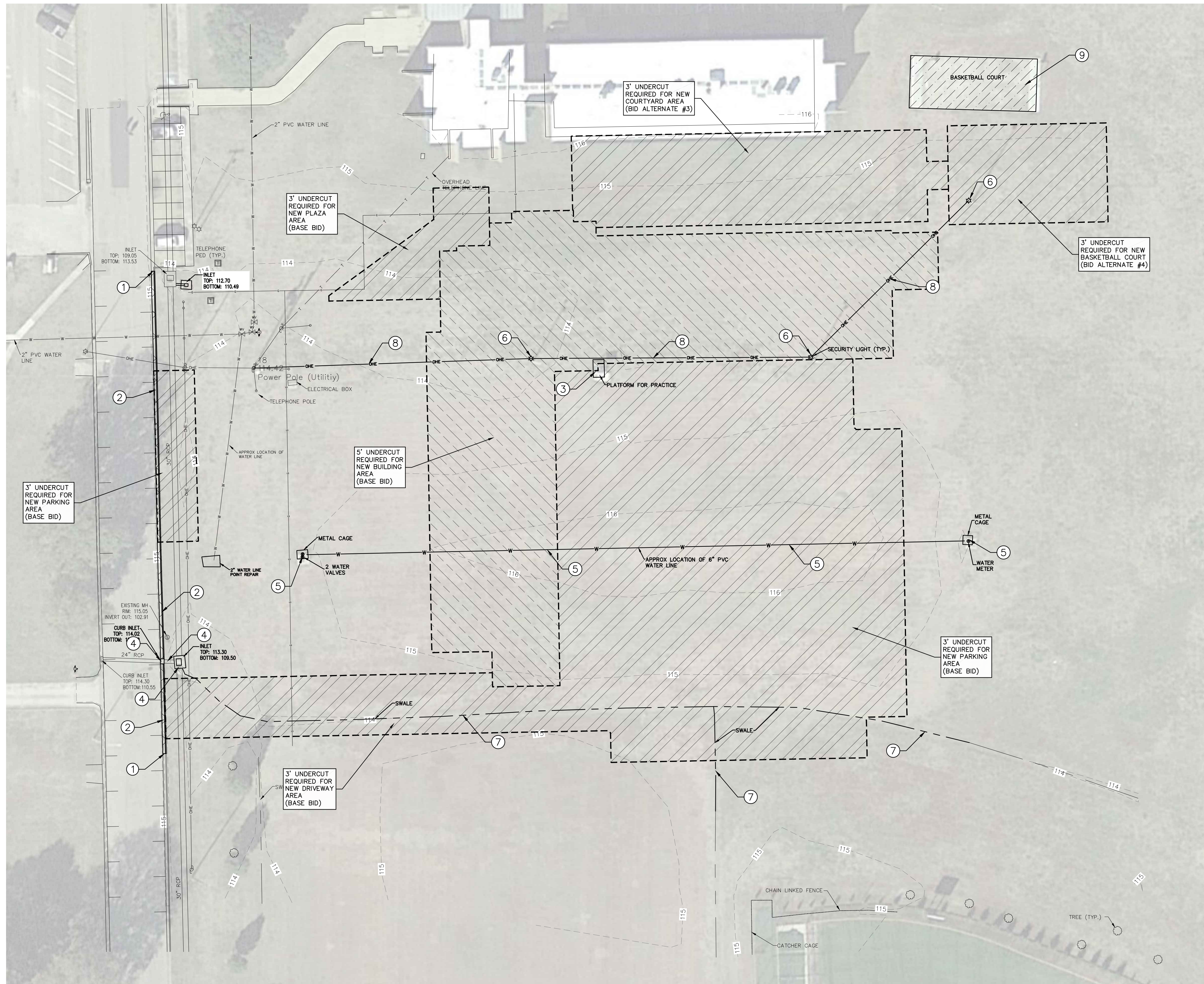
1. INFORMATION GIVEN WAS TAKEN FROM TOPOGRAPHICAL SURVEY SUPPLIED BY GARDNER ENGINEERING P.A., AND ON-SITE MEASUREMENTS. CONTRACTOR IS TO FIELD VERIFY ALL DIMENSIONS AND CONDITIONS AND REPORT ANY DISCREPANCIES, CONFLICTS, OR OTHER UNSATISFACTORY CONDITIONS TO THE ARCHITECT/ENGINEER PRIOR TO CONSTRUCTION.
2. THE CONTRACTOR SHALL CALL THE MISSISSIPPI DAMAGE PREVENTION NUMBER (1-800-227-6477) BY LAW TO LOCATE ALL EXISTING UTILITIES ON SITE PRIOR TO THE START OF HIS WORK.
3. SEE ARCHITECTURAL, MECHANICAL, & ELECTRICAL PLANS FOR ADDITIONAL INFORMATION.
4. **EROSION CONTROL:** THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENT CONTROLS DURING THE ENTIRE COURSE OF WORK AS DETAILED ON EROSION CONTROL PLAN AND IN ACCORDANCE WITH THE SPECIFICATIONS.
5. **SITE UTILITIES:** CONTRACTOR IS TO FIELD VERIFY ALL SUBSURFACE UTILITIES PRIOR TO STARTING ANY CONSTRUCTION AND CONTACTING THE ASSOCIATED UTILITY COMPANY AND COORDINATING ANY REQUIRED DISCONNECTS AND/OR CONNECTION TO EXISTING UTILITIES.

DEMOLITION KEYNOTES

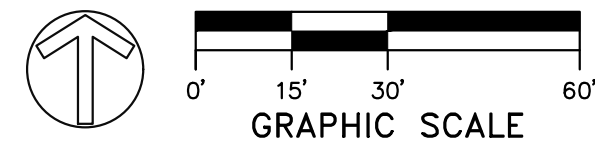
1. SAW-CUT EXISTING CURB
2. REMOVE EXISTING CONCRETE CURB.
3. REMOVE EXISTING PRACTICE PLATFORM.
4. REMOVE EXISTING DRAINAGE PIPING AND STRUCTURES.
5. REMOVE EXISTING WATER VALVES, WATER METER, IRRIGATION LINE, AND PROTECTION CAGE. CAP WATER LINE WHERE NEEDED.
6. REMOVE EXISTING LIGHT POLE.
7. REMOVE EXISTING SWALE.
8. REMOVE OVERHEAD ELECTRICAL WIRING.
9. REMOVE EXISTING BASKETBALL COURT AND ALL ASSOCIATED STRUCTURES.

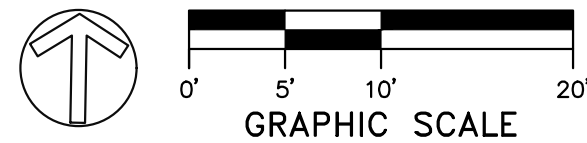
SITE EXCAVATION NOTES

1. **EROSION CONTROL MEASURES:** THE INITIAL STEP FOR SITE PREPARATION SHALL BE TO ESTABLISH EROSION AND SEDIMENT CONTROL MEASURES.
 2. **DRAINAGE:** EFFECTIVE DRAINAGE, INCLUDING DITCHING AND/OR POSITIVE GRADING, SHOULD BE ESTABLISHED AT THE START OF SITE DEVELOPMENT AND MODIFIED AS NECESSARY DURING CONSTRUCTION. SEE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
 3. **CLEARING:** UPON COMPLETION OF DEMOLITION WORK THE CONTRACTOR SHALL VERIFY THAT ALL EXISTING PAVEMENTS, SLABS, FOUNDATIONS, SIDEWALKS, ABANDONED UTILITIES, AND OTHER MISCELLANEOUS DEBRIS HAVE BEEN COMPLETELY REMOVED TO AT LEAST A MINIMUM OF 5 FEET BEYOND THE PROPOSED BUILDING FOOTPRINTS AND NEW PAVEMENT AREAS.
 4. **STRIPPING:** ONCE ALL PAVEMENTS, FOUNDATION AND DEBRIS HAVE BEEN REMOVED, STRIPPING EXCAVATIONS SHOULD BE CONTINUED TO APPROXIMATELY 6" BELOW EXISTING GRADE. STRIPPING EXCAVATION SHALL BE CARRIED OUT TO AT LEAST A MINIMUM OF 5 FEET BEYOND THE PROPOSED BUILDING FOOTPRINTS AND NEW PAVEMENT AREAS.
 5. **TOPSOIL:** CONTRACTOR SHALL STOCKPILE TOPSOIL AND OTHER SUITABLE FILL MATERIAL TO BE REUSED ON SITE. ALL UNSUITABLE SOILS SHALL BE REMOVED FROM THE SITE.
 6. **OVER-EXCAVATION:** AS AN INITIAL STEP OF SITE PREPARATION, UNDERCUTTING SHOULD BE PERFORMED WITHIN THE PAVEMENT AREAS AS REQUIRED TO REMOVE THE EXPANSIVE CLAY (CH) IN ORDER TO CREATE THE RECOMMENDED MINIMUM BUFFER THICKNESS OF 3 FT. UNDERCUTTING TO REMOVE THE EXPANSIVE CLAYS (CH) SHOULD EXTEND LATERALLY NOT LESS THAN 3 FT. BEYOND THE PAVEMENT EDGES.
 7. **SUB-GRADE PREPARATION:** ONCE ALL TOPSOIL, ORGANIC MATERIALS, AND/OR OTHER UNSUITABLE SOILS HAVE BEEN REMOVED, THE FILL AREAS SHOULD BE LEVELED AND SEATED USING A STATIC ROLLER AND THEN PROOF-ROLLED USING A LOADED TANDEM AXLE DUMP TRUCK WEIGHING AT LEAST 20 TONS TO IDENTIFY AREAS OF WEAK SOIL.
 8. **MUCK:** WHEN EXCAVATIONS ENCOUNTER UNSUITABLE MATERIALS BELOW THE BOTTOM OF THE STRIPPING AND UNDERCUT EXCAVATIONS, THE CONTRACTOR WILL BE REQUIRED TO REMOVE THE MATERIAL AND BACKFILL WITH APPROPRIATE FILL MATERIAL AS APPROVED BY THE ENGINEER. THE DEPTH AND WIDTH OF MUCK EXCAVATION WILL BE AS DIRECTED OR APPROVED BY THE ENGINEER. THE CONTRACTOR WILL NOT BE COMPENSATED FOR EXCAVATION BEYOND THE DIMENSIONS AND ELEVATIONS AS SHOWN ON THE PLANS OR EXCAVATION THAT HAS NOT BEEN DIRECTED OR APPROVED BY THE ENGINEER.
- THE CONTRACTOR SHALL ALLOW IN HIS BASE BID PRICE FOR THE REMOVAL OF UNSUITABLE MATERIAL AND THE REPLACEMENT WITH STRUCTURAL FILL MATERIAL IN THE AMOUNT OF 500 CUBIC YARDS (FIELD MEASURED).
9. **STRUCTURAL FILL:** IMPORTED FILL SOILS SHOULD CONSIST OF SELECT, NON-ORGANIC AND DEBRIS-FREE, SILTY CLAYS (CL) HAVING A PLASTICITY INDEX (PI) WITHIN THE RANGE OF 10 TO 24, A LIQUID LIMIT LESS THAN 45, AND NOT LESS THAN 70 PERCENT PASSING THE NO. 200 SIEVE.
 10. **COMPACTION:** MATERIALS SHOULD BE COMPACTED TO A MINIMUM OF 95% OF MAXIMUM DRY DENSITY PER STANDARD PROCTOR (ASTM D 698). COMPACTION SHOULD BE ACHIEVED PRIOR TO PLACING SUBSEQUENT LIFTS. FILL SOILS SHOULD BE PLACED IN MAXIMUM LOOSE LIFTS OF 9" AT A MOISTURE CONTENT COMPARABLE ($\pm 3\%$) TO THE OPTIMUM MOISTURE CONTENT ESTABLISHED IN THE LABORATORY.
 11. **TESTING:** IN PLACE DENSITY TESTS SHOULD BE MADE PER 2,500 SQUARE FEET PER LIFT WITHIN THE BUILDING FOOTPRINT AND 5,000 SQUARE FEET PER LIFT UNDER PAVEMENT.



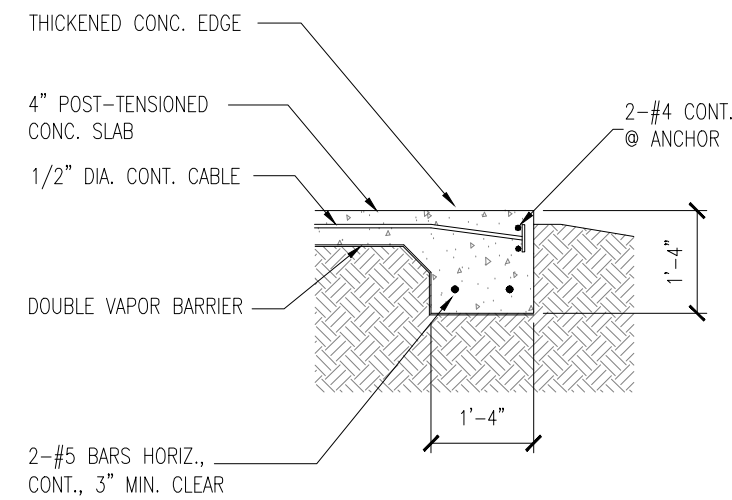
1 SITE DEMOLITION PLAN
SCALE: 1" = 30'



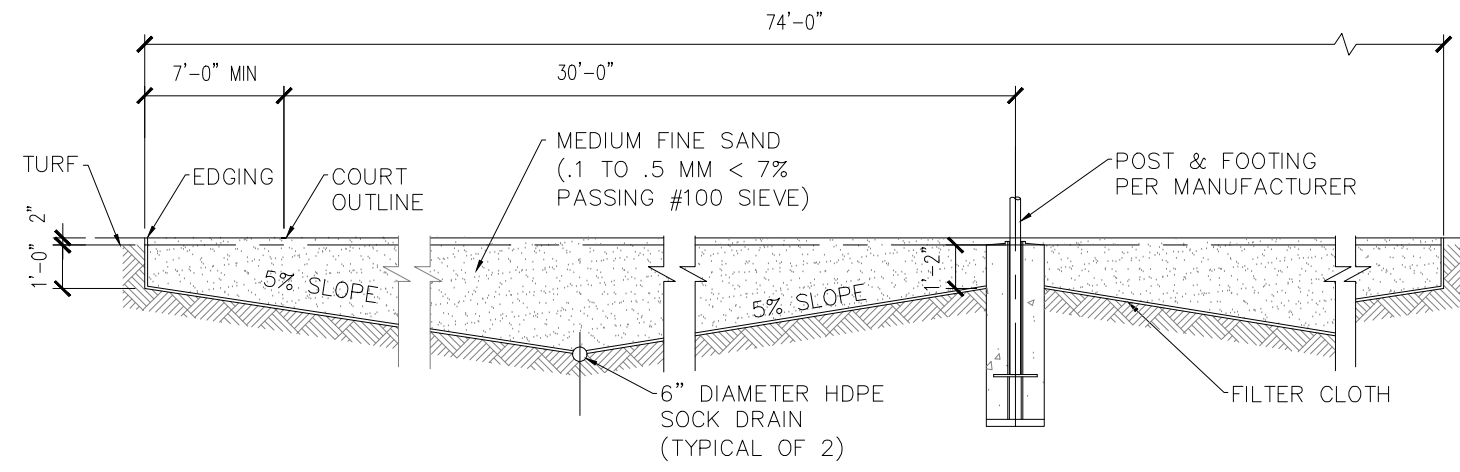


BASKETBALL GOAL SYSTEM

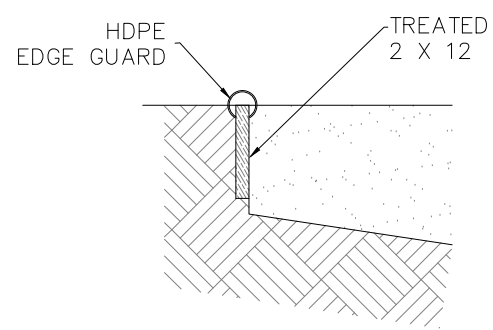
- WORK SHALL CONSIST OF FURNISHING AND THE CONSTRUCTION OF TWO OUTDOOR BASKETBALL GOAL SYSTEMS TO BE PROVIDED FOR THE NEW BASKETBALL COURT. SYSTEMS SHALL INCLUDE VERTICAL POLE, FRAME, BACKBOARD, RIM, NET, AND ALL OTHER ITEMS REQUIRED TO PROVIDE AND COMPLETE BASKETBALL GOAL SYSTEM.
- BASIS OF DESIGN: THE BASKETBALL GOAL SYSTEMS SHALL BE TYRANT SUPREME BASKETBALL SYSTEM MANUFACTURED BY FIRST TEAM, INC. OR APPROVED EQUAL.
- ALL MATERIALS AND INSTALLATION SHALL BE PER MANUFACTURER'S RECOMMENDATIONS.
- BASKETBALL GOAL SYSTEM SHALL MEET THE MINIMUM REQUIREMENTS:
 - VERTICAL POLE — VERTICAL POST SHALL BE CONSTRUCTED OF 6 5/8" O.D. SCHEDULE 40 GALVANIZED TUBING. DESIGN SHALL ALLOW FOR A 48" BURY INTO THE GROUND AND A 72" SETBACK FROM POST TO BACKBOARD. BACKBOARD ATTACHMENT SHALL BE TELESCOPING TO ALLOW UP TO 78" EXTENSION IF DESIRED. TWO 1" ROUND TUBULAR BRACES SHALL SUPPORT THE TOP CORNERS OF THE BACKBOARD AND CONNECT DIRECTLY TO THE POLE. THE POLE SHALL BE DESIGNED SO THAT THE RIM MOUNTS DIRECTLY THROUGH THE BACKBOARD INTO THE HORIZONTAL EXTENSION TO ELIMINATE BACKBOARD STRESS DURING PLAY. POLE SYSTEMS WHERE RIM MOUNTS TO BACKBOARD ARE NOT CONSIDERED EQUAL.
 - H-FRAME STRUCTURE — AN H-FRAME SHALL BE PROVIDED WITH WALL STRUCTURE. THE H-FRAME SHALL BE CONSTRUCTED OF 1 1/2" SQUARE X 11 GAUGE TUBING. H-FRAME SHALL BE 42" TALL AND PROVIDE MOUNTING SLOTS FOR INDUSTRY STANDARD 20" X 35" MOUNTING. H-FRAME SHALL ALSO INCLUDE A FACEPLATE NO LESS THAN 3/16" THICK, THAT ALLOWS FOR RIM BOLTS TO PASS THROUGH BACKBOARD AND INTO H-FRAME TO ELIMINATE RISK OF BACKBOARD BREAKAGE WHEN ADDED WEIGHT IS APPLIED TO THE RIM.
 - BACKBOARD — BACKBOARD SHALL BE 42" X 72" RECTANGULAR 1/2" THICK CLEAR ACRYLIC FRAMED IN A COMPETITION GRADE ANODIZED ALUMINUM FRAMEWORK. BACKBOARD SHALL HAVE BRIGHT WHITE 2" BORDER AND OFFICIAL SIZE SHOOTERS SQUARE SCREEN-PRINTED ON BACKSIDE TO ELIMINATE WEAR.
 - RIM — STANDARD RIM SHALL BE FLEXIBLE TYPE SO AS TO ABSORB THE STRESS OF PLAYER CONTACT. SPRING ACTION SHALL BE PROVIDED BY A HEAVY DUTY COMPRESSION WIRE SPRING. A STEEL COVERPLATE MUST ENCLOSE ENTIRE INTERNAL MECHANISM. ALL STRUCTURAL COMPONENTS SHALL BE BUILT OF NO LESS THAN 3/16" STEEL. RIM SHALL BE OF INSTITUTIONAL QUALITY WITH AN OFFICIAL 5/8" DIAMETER HIGH STRENGTH STEEL RING SUPPORTED BY A 3/16" BRACE SUPPORTING 60% OF THE RING. RIM SHALL BE PUNCHED TO MOUNT EITHER A 3" X 4" OR 5" X 5" HOLE PATTERN. ORANGE POWDERCOATED FINISH.
 - WARRANTY — POLE, BACKBOARD, AND STANDARD RIM SHALL CARRY A LIFETIME UNCONDITIONAL WARRANTY. ENTIRE SYSTEM WEIGHT SHALL BE APPROXIMATELY 540#.



2 BASKETBALL COURT SECTION - BID ALTERNATE #4
SCALE: NTS



VOLLEYBALL COURT SECTION

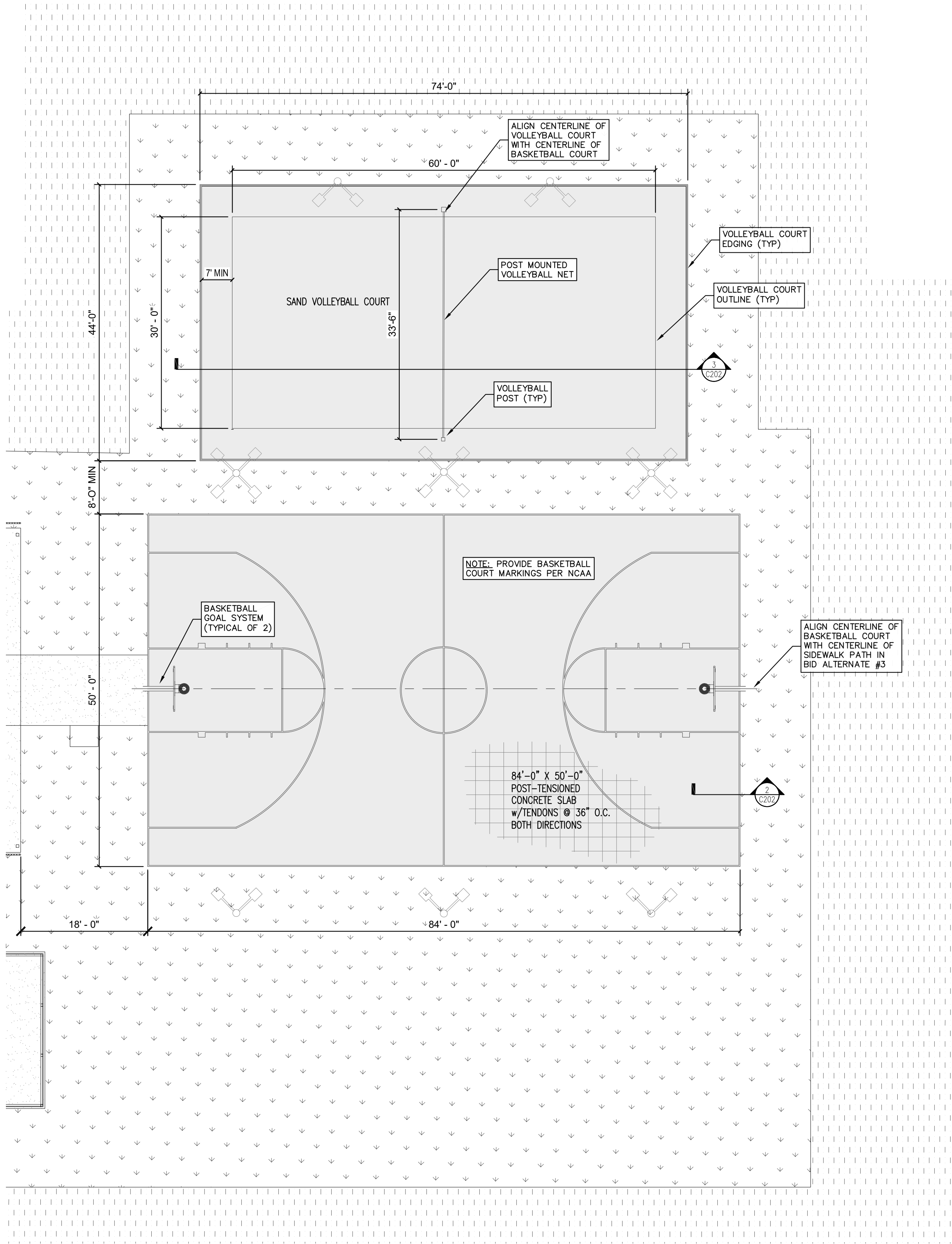


VOLLEYBALL EDGING DETAIL

3 VOLLEYBALL SECTION AND DETAILS - BID ALTERNATE #4
SCALE: NTS

OUTDOOR SAND VOLLEYBALL COURT SYSTEM

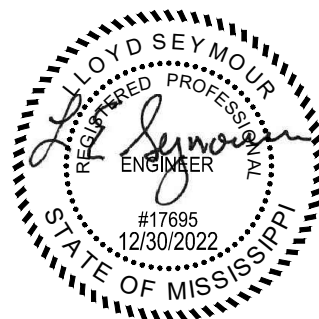
- WORK SHALL CONSIST OF FURNISHING AND THE CONSTRUCTION OF AN OUTDOOR RECREATIONAL VOLLEYBALL COURT SYSTEM. THE SYSTEM SHALL INCLUDE POLES, NET, PADDING, SAND, UNDER-DRAIN, EDGING, AND ALL OTHER ITEMS REQUIRED TO PROVIDE A COMPLETE OUTDOOR RECREATIONAL VOLLEYBALL COURT SYSTEM.
- BASIS OF DESIGN: THE OUTDOOR VOLLEYBALL SAND COURT SYSTEM SHALL BE STELLAR COMPLETE RECREATIONAL VOLLEYBALL SYSTEM MANUFACTURED BY FIRST TEAM, INC. OR APPROVED EQUAL.
- ALL MATERIALS AND INSTALLATION SHALL BE PER MANUFACTURER'S RECOMMENDATIONS.
- OUTDOOR VOLLEYBALL SAND COURT SYSTEM SHALL MEET THE MINIMUM REQUIREMENTS:
 - UPRIGHTS SHALL CONSIST OF AN EXTERNAL 3 1/4" OUTSIDE DIAMETER, 1/4" WALL 6063-T6 ALUMINUM POWDER COATED TUBE. TOP OF POST SHALL BE CAPPED. NON-WINCH STANDARDS SHALL WEIGH APPROXIMATELY 30 LBS. AND WINCH END STANDARD SHALL WEIGH APPROXIMATELY 35 LBS.
 - THE NET SHALL BE ONE METER HIGH, BE CONSTRUCTED OF BLACK POLYPROPYLENE 3.5MM KNOTLESS WOVEN WEBBING. HAVE A KEVLAR TOP ROPE AND POLYPROPYLENE BOTTOM ROPE. THE TOP ROPE SHALL REST IN A GROOVE OF A 4" DIAMETER STEEL PULLEY AT THE TOP OF THE WINCH STANDARD FOR EASE OF NET TENSIONING. THE TOP, BOTTOM, AND SIDES OF THE NET SHALL BE FINISHED WITH WHITE TARPULIN FABRIC WITH DOUBLE STITCHED HEMMED EDGES. THE TOP OF THE NET SHALL BE TENSIONED BY MEANS OF A 28:1 RATIO WORM GEAR WINCH. WINCH SHALL BE DESIGNED TO WIND A 2" WIDE NYLON WEBBING STRAP THAT IS ATTACHED TO THE NET TOP ROPE AND HAVE A NON REMOVABLE FOLDING HANDLE. NET BOTTOM ROPE SHALL BE TENSIONED BY MEANS OF A RATCHETING STYLE TENSIONER. EACH NET SIDE TAPE SHALL HAVE INTERNAL DOWELS TENSIONED BY MEANS OF NO LESS THAN TWO RATCHET TYPE TENSIONERS PER SIDE.
 - NET HEIGHT SHALL BE INFINITELY VARIABLE FROM A MINIMUM OF 36" TO 96" WITH SINGLE THREADED RELEASE KNOB PER NET CORNER. HEIGHT SETTING SHALL BE CLEARLY IDENTIFIED ON AN EASY TO READ NET HEIGHT LABEL AFFIXED TO THE OUTSIDE OF EACH POST.
 - TOP AND BOTTOM ROPES SHALL BE COVERED BETWEEN THE STANDARDS AND THE EDGE OF THE NET FOR PLAYER SAFETY BY NO LESS THAN 1/2" THICK FOAM PADDING WITH WHITE VINYL COVER. EACH STANDARD SHALL BE PADDED TO A MINIMUM HEIGHT OF 72" WITH 1 1/2" THICK HIGH-DENSITY FOAM COVERED WITH VINYL IN CUSTOMERS CHOICE OF 12 SCHOOL COLORS. SYSTEM SHALL INCLUDE OFFICIAL BOUNDARY ANTENNAS.
 - UPRIGHT STANDARDS SHALL CARRY NO LESS THAN A LIFETIME LIMITED WARRANTY. ALL OTHER COMPONENTS SHALL CARRY A 2-YEAR LIMITED WARRANTY. ENTIRE SYSTEM SHALL MEET OR EXCEED ALL NCAA, USVBA, NFHS, AND FIVB REQUIREMENTS FOR COMPETITION.
 - COURT OUTLINE SHALL BE FIRST TEAM FT5015 OUTDOOR VOLLEYBALL BOUNDARY KIT OR EQUAL.



1 CIVIL SITE PLANS - BID ALTERNATE #4
SCALE: 1" = 10'

GS# 210-073 NEW RESIDENCE HALL

Mississippi Delta Community College - Moorhead, MS



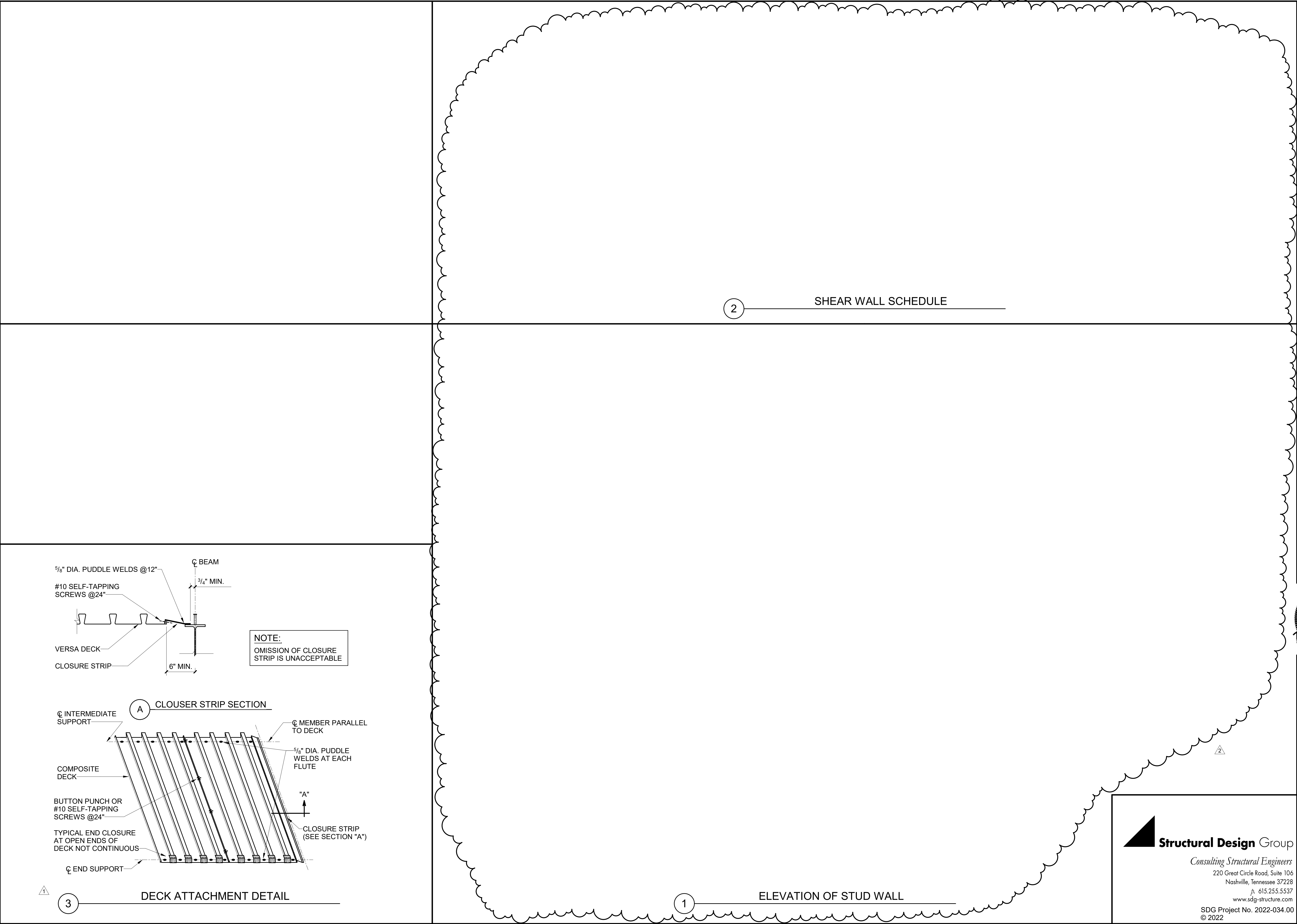
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szzarch.com T(662) 323-1628

SHEET **C203R**

**CIVIL SITE
PLANS
BID ALTERNATE #4**

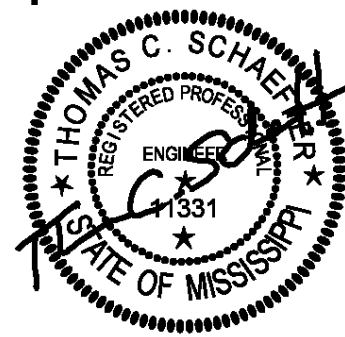
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SZZARCH# 2111
DRAWN BY: DMI
CHECKED BY: LES

REVISIONS:
3.20.2023 - ADDENDUM 2



GS# 210-073 NEW RESIDENCE HALL

Mississippi Delta Community College - Moorhead, MS



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STARKVILLE, MISSISSIPPI 39759
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SHEET S307

FRAMING
SECTIONS &
DETAILS

DATE: 12/30/2022
SZSARCH# 2111
DRAWN BY: S.T.
CHECKED BY: W.G./T.S.

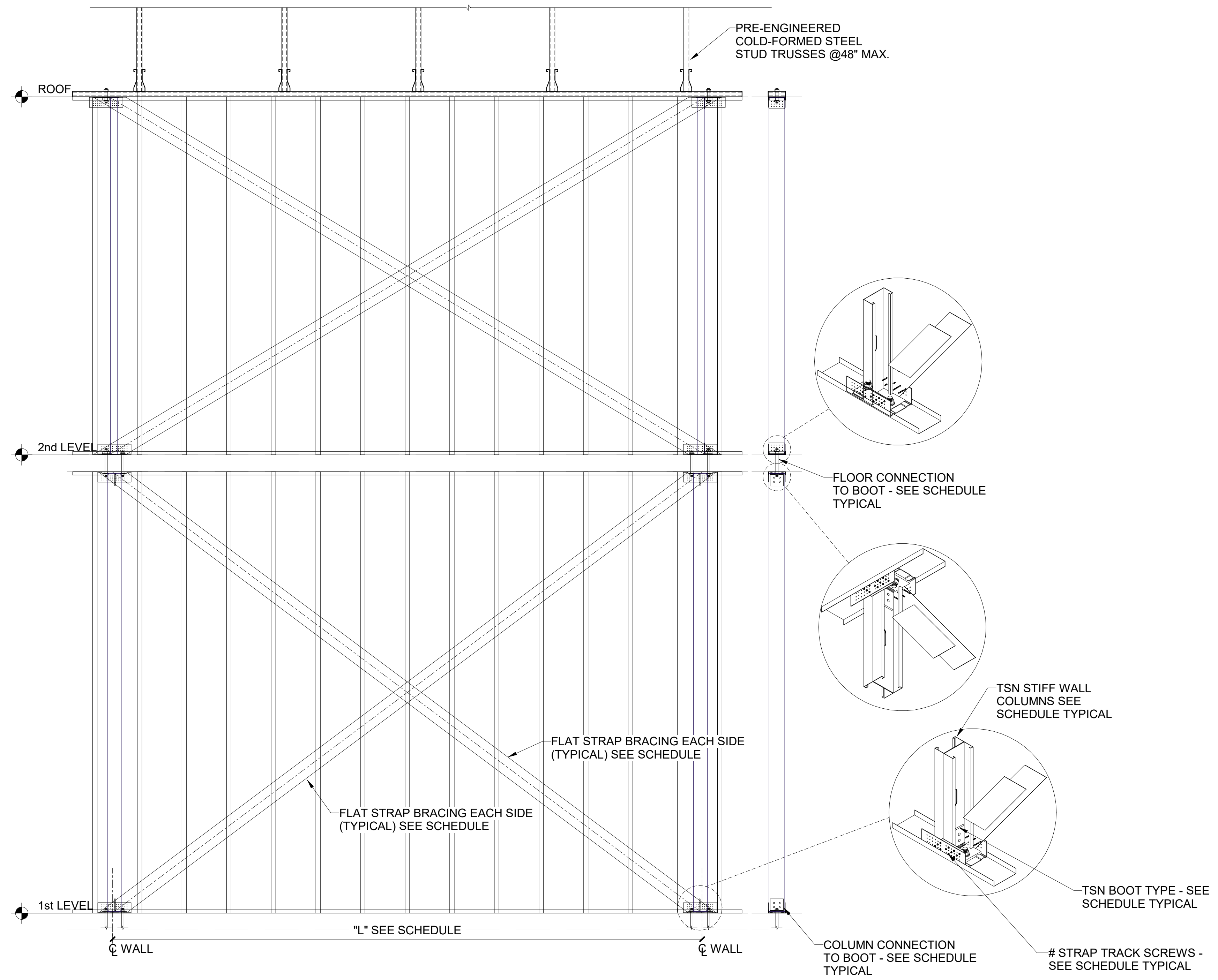
REVISIONS:
REVISION #1 - 03/13/23
ADDENDUM #2 - 03/20/23

Structural Design Group

Consulting Structural Engineers
220 Great Circle Road, Suite 106
Nashville, Tennessee 37228
p. 615.255.5537
www.sdg-structure.com
SDG Project No. 2022-034.00
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2

SHEAR WALL SCHEDULE											
FLAT STRAP BRACE WALL	FLOOR	COLUMN	LENGTH	BRACING	STRAP TRACK #12 SCREWS	BOOT LOCATION	BOOT TYPE	COLUMN CONNECTION TO BOOT	FLOOR CONNECTION TO BOOT	REMARKS	
SW1	2ND	600C/STW250-54 MIL	17'-6"	2 STRAP, 6" x 54 MILS	8	UPPER	MEDIUM BOOT	(6)1/2" BOLTS	(2)7/8" BOLTS	-	
	1ST	(2) 600C/STW250-54 MIL				LOWER	TRANSITION BOOT	(6)1/2" BOLTS	(2)1 1/4" BOLTS	-	
						UPPER	LARGE BOOT	(14)1/2" BOLTS	(2)1 1/4" BOLTS	-	
						LOWER	LARGE BOOT	(14)1/2" BOLTS	(2)PAB10 w/6" EMBED	-	
SW2	2ND	600C/STW250-54 MIL	8'-6"	2 STRAP, 6" x 54 MILS	8	UPPER	MEDIUM BOOT	(6)1/2" BOLTS	(2)7/8" BOLTS	-	
	1ST	(2) 600C/STW250-54 MIL				LOWER	TRANSITION BOOT	(6)1/2" BOLTS	(2)1 1/4" BOLTS	-	
						UPPER	LARGE BOOT	(14)1/2" BOLTS	(2)1 1/4" BOLTS	-	
						LOWER	LARGE BOOT	(14)1/2" BOLTS	(2)PAB10 w/13" EMBED	-	

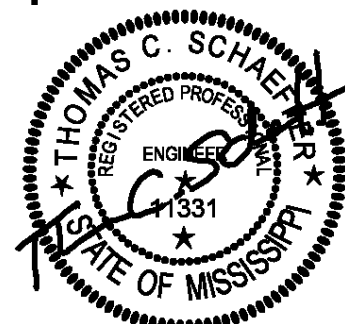


1

X-BRACE SHEAR WALL DETAIL
WITH STEEL STUD HEADER SCHEDULE

GS# 210-073 NEW RESIDENCE HALL

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SHEET S308

FRAMING
SECTIONS &
DETAILS

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SDG Project No. 2022-034.00
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DATE:	12/30/2022
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CHECKED BY:	W.G./T.S.
REVISIONS:	
REVISION #1 -	03/13/23
ADDENDUM #2 -	03/20/23

ALTERNATE 2
ALTERNATE 2
ALTERNATE 2
ALTERNATE 2

ALTERNATE 1
ALTERNATE 1
ALTERNATE 1
ALTERNATE 1

1. PROVIDE ALL UNITS WITH CONDENSATE PUMPS.
2. PROVIDE DUCTED UNITS WITH FILTER BOX AND PLEATED MERV 9 FILTERS.
3. PROVIDE ALL UNITS WITH HARD-WIRED ZONE LEVEL CONTROLLER.
4. PROVIDE ISOLATION VALVES AT ALL UNIT CONNECTIONS.
5. PROVIDE ALL CEILING CASSETTES WITH HIGH EFFICIENCY FILTER ADAPTER AND PLEATED MERV 9 FILTERS
6. PROVIDE ALL UNITS WITH BIPOLAR IONIZATION DEVICE.

ALTERNATE 1
ALTERNATE 1
ALTERNATE 2

1. PROVIDE WITH LOW AMBIENT KIT
2. PROVIDE WITH HAIL GUARDS
3. PROVIDE WITH TWINNING KIT
4. PROVIDE TOUCHSCREEN VRF CONTROL PANEL EQUAL TO MITSUBISHI AE-200A

* 1@43;1@33
** 1@70;1@50

ALTERNATE 1

ALTERNATE 1
ALTERNATE 2

- 1) 2" MERV 13 PLEATED FILTERS
- 2) SINGLE POINT POWER CONNECTION WITH FACTORY INSTALLED CIRCUIT BREAKER
- 4) PROVIDE 15AMP 120V, 1ph CIRCUIT FOR NATURAL GAS
- 3) HINGED ACCESS DOORS
- 4) 120v SERVICE OUTLET
- 5) SAME SIDE SERVICE CONNECTIONS AND CONTROLS
- 6) MODULATING HOT GAS REHEAT
- 7) VIBRATION ISOLATION
- 8) DOUBLE WALL INSULATED CABINET
- 9) MOTORIZED O/A DAMPER
- 10) UNIT INTEGRAL VFD
- 11) VENT TERMINATION KIT
- 12) EVAPORATOR FROST STAT
- 13) NATURAL GAS HEAT
- 14) PROVIDE WITH BACNET CAPABLE CONTROLLER WITH HUMIDITY AND TEMPERATURE CONTROL. CONNECT INTO ENERGY MANAGEMENT SYSTEM.

ALTERNATE 1
ALTERNATE 2

ALTERNATE 1
ALTERNATE 2

- 1) PROVIDE WITH COIL GUARDS
- 2) PROVIDE WITH LOW AMBIENT KIT
- 3) PROVIDE TWINNING KIT FOR OAHU-1-1/OAHU-1-2

ALTERNATE
ALTERNATE

1. PROVIDE ALL UNITS WITH CONDENSATE PUMPS.
2. PROVIDE DUCTED UNITS WITH FILTER BOX AND PLEATED MERV 9 FILTERS.
3. PROVIDE ALL UNITS WITH HARD-WIRED ZONE LEVEL CONTROLLER.
4. PROVIDE ISOLATION VALVES AT ALL UNIT CONNECTIONS.
5. PROVIDE ALL CEILING CASSETTES WITH HIGH EFFICIENCY FILTER ADAPTER AND PLEATED MERV 9 FILTERS.
6. PROVIDE ALL UNITS WITH BIPOLAR IONIZATION DEVICE.

ACCESSORIES:

1. PROVIDE TRAPPED CONDENSATE CONNECTIONS
2. PROVIDE DIAMONDBACK SERVICE VALVES AT ALL CONNECTION PORTS (INCLUDING UNUSED PORTS), CAP EXTRA PORTS.
3. PROVIDE EXTRA PORTS ON ALL BRANCH CONTROLLERS (MINIMUM 2 EXTRA PORTS).

A circular professional engineer seal for Donald L. Green, State of Mississippi. The seal features the text "DONALD L. GREEN" at the top, "REGISTERED PROFESSIONAL" on the left, "ENGINEER" at the bottom, and "STATE OF MISSISSIPPI" on the right. In the center, it says "No. 13816" and includes a signature. There are three stars around the central text.

12/30/22

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OFFICE OF ARCHITECTURE

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STARKVILLE, MISSISSIPPI 39759
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SHEET M200

Mechanical Schedules

DATE: 12/30/2022
SZZARCH# 2111
DRAWN BY: DAG
CHECKED BY: DLG

REVISIONS:

REVISÉ PAR ADDENDUM #1: 03/13/2023

REVISÉ BY ADDENDUM #2: 03/20/2023

TELE/DATA

	DATA OUTLET PROVIDE DOUBLE GANG JUNCTION BOX WITH SINGLE GANG EXTENSION. ROUTE 1" C. TO NEAREST ACCESSIBLE CEILING, BUSH AND LABEL.
CBB	BACKBOARD, 4'X8'X3/4" PLYWOOD WITH 2 COATS OF FIRE RETARDANT BLUE ENAMEL PAINT.

FIRE ALARM

	FIRE ALARM CONTROL PANEL SURFACE OR FLUSH MOUNTED. (AS SHOWN ON PLANS).
	FIRE ALARM ANNUNCIATOR
	FIRE ALARM NAC, PROVIDE 120V POWER AS REQUIRED
	DUCT SMOKE DETECTOR WITH REMOTE LED INDICATOR WHERE REQUIRED.
	HEAT DETECTOR - 135 DEGREE RELAY
	SMOKE DETECTOR
	CONTROL MODULE WITH RELAY (SEE DETAIL)
	MONITOR MODULE
	FIRE ALARM FLOW SWITCH
	FIRE ALARM TAMPER SWITCH
	LOW AIR PRESSURE SWITCH
	FIRE ALARM PULL BOX
	FIRE ALARM HORN/STROBE
	FIRE ALARM - COMBINATION HORN/STROBE. 87DB MIN.
	FIRE ALARM STROBE ONLY. cd AS SHOWN ON PLANS
	FIRE ALARM HORN - CEILING
	FIRE ALARM HORN - PHONE
	REMOTE MIC FOR EVACUATION
	REMOTE TEST SWITCH
	LOW VOLTAGE SURGE SUPPRESSOR
	LINE VOLTAGE SURGE SUPPRESSOR

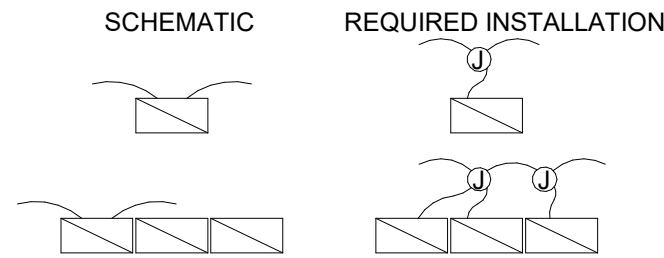
SITE ELECTRICAL

	PAD MOUNTED TRANSFORMER
	PAD MOUNTED SWITCH
	ELECTRICAL SERVICE RISER POLE
	MANHOLE
	HANDHOLE
	UTILITY POLE

BRANCH CIRCUITS

	CONCEALED IN CEILING, WALL, OR IN CEILING SLAB.
	CONCEALED IN OR BELOW FLOOR OR UNDERGROUND.
	EXPOSED.
	EMERGENCY.
	RUN IN FLEXIBLE METAL CONDUIT.
	EMPTY CONDUIT, 3/4" UNLESS OTHERWISE NOTED WITH NYLON PULL CORD.
	CONDUIT SEAL FITTING: CROUSE-HINDS #EYS OR APPROVED EQUIVALENT.
	HOMERUN TO PANELBOARD AND 20A, 1P BREAKER, UON.
NOTE: SHOWN 2#12 AND 1#12(G)-1/2" C.	
	3#12 AND 1#12(G)-3/4" C
	4#12 AND 1#12(G)-3/4" C
	2#10 AND 1#10(G)-3/4" C
	3#10 AND 1#10(G)-3/4" C
SIZE CONDUIT PER NEC FOR GREATER NUMBER OF CONDUCTORS OR AS NOTED. THE NUMBER IN THE CIRCUIT INDICATES AWG WIRE SIZE AND HASHMARKS INDICATE NUMBER OF WIRES REQUIRED. GROUND WIRE SHALL BE SIZED IN ACCORDANCE WITH NEC TABLE 250-95. NUMBER OF HASHMARKS DO NOT INCLUDE GROUND WIRE.	
•	RISER: UP, RUNNING TO SOURCE.
◦	RISER: DOWN, RUNNING TO SOURCE.

BRANCH CIRCUIT WIRING FOR LIGHTING IS SHOWN SCHEMATICALLY. EACH LUMINAIRE IS TO BE INSTALLED WITH AN INDIVIDUAL FLEXIBLE CONNECTION. FOR EXAMPLE:



RECEPTACLES

WALL MOUNTED	
	DUPLEX RECEPTACLE - NEMA 5-20R
	DUPLEX RECEPTACLE - NEMA 5-20R, DEDICATED SERVICE/CIRCUIT
GFI	GROUND FAULT RECEPTACLE - NEMA 5-20R GF
	RECEPTACLE - MTD ABOVE COUNTER - NEMA 5-20R
IG	ISOLATED GROUND RECEPTACLE - NEMA 5-20R IG
	SIMPLEX RECEPTACLE - NEMA 5-20R
	SPLIT WIRED RECEPTACLE - NEMA 5-20R
WP	WEATHER PROOF RECEPTACLE - NEMA 5-20R GFCI W/ WET LOCATION COVER
	QUADRUPLX RECEPTACLE - NEMA 5-20R
	SIMPLEX RECEPTACLE - NEMA 5-20R, DEDICATED SERVICE/CIRCUIT
	QUADRUPLX RECEPTACLE - MTD ABOVE COUNTER - NEMA 5-20R
	SINGLE RECEPTACLE - EQUIPMENT CONNECTION OR PROVISION
	SINGLE RECEPTACLE - SPECIAL PURPOSE
	SINGLE RECEPTACLE - A=NEMA 5-30R; B=NEMA 6-30R; C=NEMA 14-30R
X	SINGLE RECEPTACLE - A=NEMA 5-50R; B=NEMA 6-50R; C=NEMA 14-50R
	MULTI-SERVICE WALL RECEPTACLE
USB	DUPLEX RECEPTACLE - NEMA 5-20R WITH TWO FULL OUTPUT USB PORTS
TL	SINGLE RECEPTACLE - TWISTLOCK, AS SPECIFIED.
EWC	SINGLE RECEPTACLE - ELECTRIC WATER COOLER, GFCI.
	VACANCY DUPLEX RECEPTACLE - NEMA 5-20R, PROVIDED WITH CONTROLLED RECEPTACLE LABEL.

CEILING MOUNTED

	DUPLEX RECEPTACLE - NEMA 5-20R
	DUPLEX RECEPTACLE - NEMA 5-20R, DEDICATED SERVICE/CIRCUIT
	SIMPLEX RECEPTACLE - NEMA 5-20R
	SINGLE RECEPTACLE - EQUIPMENT CONNECTION OR PROVISION
	SINGLE RECEPTACLE - SPECIAL PURPOSE

POWER

	FAN / FAN-COIL UNIT
	PACKAGED AIR CONDITIONING UNIT
	ELECTRIC DUCT HEATER
	UNIT HEATER WITH FAN
	ELECTRIC BASEBOARD HEATER
	ELECTRIC CABINET HEATER
	PHOTO-ELECTRIC / PHOTOCELL SWITCH
	MAGNETIC MOTOR STARTER
	COMBINATION MAGNETIC STARTER & DISCONNECT SWITCH
	RELAY
	ELECTRIC MOTOR
	DISCONNECT SWITCH, UNFUSED, 30A, 3P UNLESS OTHERWISE NOTED.
	DISCONNECT SWITCH, FUSED, 30A, 3P UNLESS OTHERWISE NOTED.
	TIME CLOCK SWITCH
	VARIABLE SPEED / VARIABLE FREQUENCY DRIVE
	CONTACTOR
	CIRCUIT BREAKER, INDIVIDUALLY ENCLOSED
	CONTROL PANEL
	AUTOMATIC TRANSFER SWITCH
	MANUAL TRANSFER SWITCH
	METER (WITH SOCKET ASSEMBLY)
	TRANSFORMER, GENERAL PURPOSE DRY-TYPE, REFER TO SCHEDULE

LIGHTING - EXTERIOR
(SEE LUMINAIRE SCHEDULE)

	BOLLARD
	GROUND MOUNTED SPOT, FLOOD OR WELL LIGHT
	POLE MOUNTED-FLOOD LIGHT
	POLE-ARM MOUNTED AREA LIGHT
	POLE-TOP MOUNTED AREA LIGHT
	WALL MOUNTED FLOOD OR AREA LIGHT

JUNCTION & OUTLET BOXES

	JUNCTION BOX - CEILING MOUNTED
C	POWER JUNCTION BOX - CEILING MOUNTED
TD	TELE DATA JUNCTION BOX - CEILING MOUNTED
	JUNCTION BOX - FLOOR MOUNTED
	JUNCTION BOX - WALL MOUNTED
	OUTLET BOX - WALL MOUNTED, WITH FLEXIBLE HARD WIRED CONNECTION TO EQUIPMENT
C	OUTLET BOX - CEILING MOUNTED, WITH FLEXIBLE HARD WIRED CONNECTION TO EQUIPMENT
	OUTLET BOX - FLOOR MOUNTED, WITH FLEXIBLE HARD WIRED CONNECTION TO EQUIPMENT

LIGHTING (SEE LUMINAIRE SCHEDULE)

	RECESSED FLUORESCENT LUMINAIRE - SINGLE OR CONTINUOUS LENGTHS AS SHOWN
	RECESSED FLUORESCENT LUMINAIRE - SINGLE OR CONTINUOUS LENGTHS AS SHOWN. LIFE SAFETY EMERGENCY EGRESS LIGHTING.
	RECESSED LUMINAIRE
	RECESSED LUMINAIRE. LIFE SAFETY EMERGENCY EGRESS LIGHTING.
	SURFACE OR STEM MOUNTED FLUORESCENT STRIP LUMINAIRE - SINGLE OR CONTINUOUS LENGTHS AS SHOWN.
	SURFACE OR STEM MOUNTED FLUORESCENT STRIP LUMINAIRE - SINGLE OR CONTINUOUS LENGTHS AS SHOWN.
	WALL MOUNTED LUMINAIRE CONTINUOUS LENGTHS AS SHOWN. LIFE SAFETY EMERGENCY EGRESS LIGHTING. EXIT SIGN - CEILING MOUNTED, DOUBLE FACE WITH CHEVRONS AS SHOWN. SEE LUMINAIRE SCHEDULE
	EXIT SIGN - CEILING MOUNTED, SINGLE FACE WITH CHEVRONS AS SHOWN. SEE LUMINAIRE SCHEDULE
	EXIT SIGN - BACK MOUNTED, SINGLE FACE WITH CHEVRONS AS SHOWN. SEE LUMINAIRE SCHEDULE
	EXIT SIGN - END MOUNTED, DOUBLE FACE WITH CHEVRONS AS SHOWN. SEE LUMINAIRE SCHEDULE
	EMERGENCY EGRESS LIGHT.

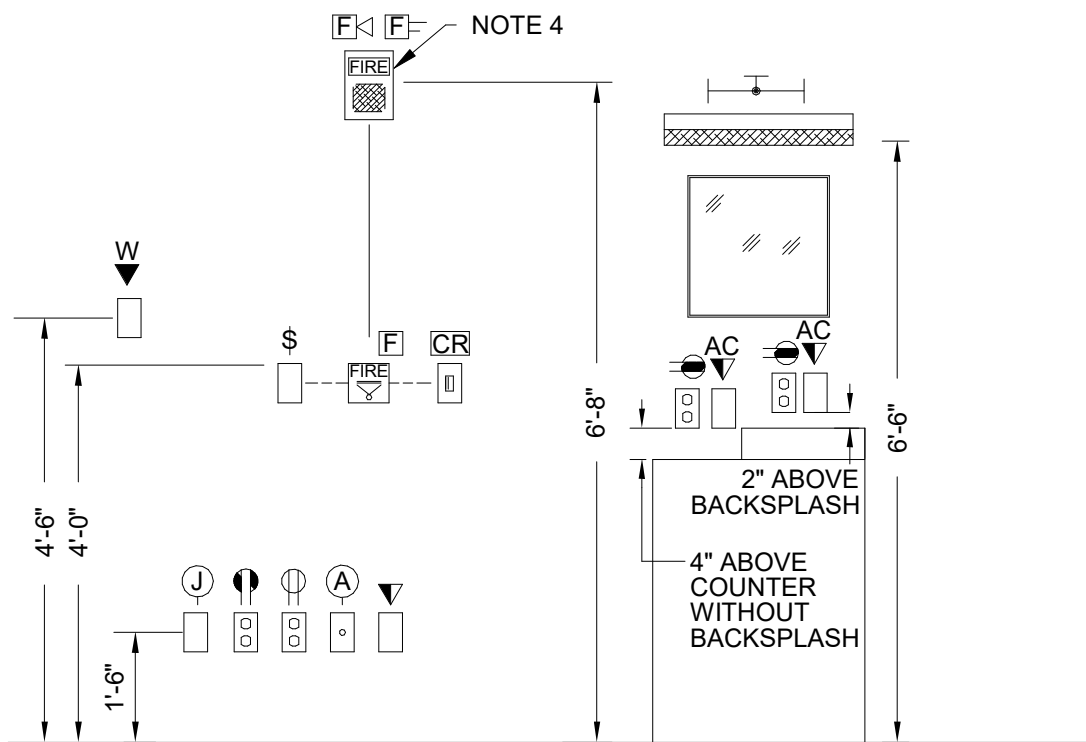
SWITCHES

	SINGLE POLE SWITCH, 20A, 125/277V.
	THREE WAY SWITCH, 20A, 125/277V.
	FOUR WAY SWITCH, 20A, 125/277V.
	DOUBLE POLE SWITCH, 20A, 125/277V.
	LOW VOLTAGE SWITCH - TWO BUTTON "ON/OFF"
	DIMMER SWITCH, ON/OFF AND 0-10V DIMMING
	VACANCY SENSOR, WALL MTD (MANUAL ON / AUTO OFF)
	OCCUPANCY SENSOR, WALL MTD (AUTO ON / AUTO OFF)
	VACANCY SENSOR, CEILING MTD (MANUAL ON / AUTO OFF)
	OCCUPANCY SENSOR, CEILING MTD (AUTO ON / AUTO OFF). LOWER CASE DESIGNATOR INDICATES WHICH POWER PACK CONTROLS SENSOR.
	DAYLIGHT SENSOR, CEILING MTD
	PHOTO-ELECTRIC / PHOTOCELL SWITCH
	POWER PACK FOR 0-10V OCCUPANCY SENSOR. LOWER CASE DESIGNATOR INDICATES WHICH SENSOR IS CONTROLLED.
	LIGHTING CONTROL MODULE - EMERGENCY BYPASS, UL 924 LISTED.
	RECEPTACLE CONTROL MODULE.
	LIGHTING CONTROL PANEL, SURFACE MOUNTED, SEE DETAIL FOR WIRING

ABBREVIATIONS

A	AMPERES	OC	ON CENTER
AIC	AMPERES INTERRUPTING CAPACITY	P	POLES
AFF	ABOVE FINISHED FLOOR	PF	POWER FACTOR
AL	ALUMINUM	PH	PHASES
ATS	AUTOMATIC TRANSFER SWITCH	PMT	PAD MOUNT TRANSFORMER
AWG	AMERICAN WIRE GAUGE	PVC	POLYVINYL CHLORIDE RACEWAY
C	CONDUIT RACEWAY	RGS	RIGID GALVANIZED STEEL
CU	COPPER	UON	UNLESS OTHERWISE NOTED
CKTS	CIRCUITS	V	VOLTS
EC	ELECTRICAL CONTRACTOR	W	WIRES
FMC	FLEXIBLE METAL CONDUIT	WP	WEATHERPROOF, NEMA 3R.
G	GROUND		
HP	HORSE POWER		
KVA	KILOVOLT-AMPERES		
KW	KILOWATT		
MV	MEDIUM VOLTAGE		
N	NEUTRAL		
NEC	NATIONAL ELECTRICAL CODE		

STANDARD MOUNTING HEIGHTS



- NOTES:
- MOUNTING HEIGHTS SHOWN ARE FROM FINISHED FLOOR TO CENTERLINE OF OUTLET, UNLESS OTHERWISE NOTED.
 - LOCATIONS OF OUTLETS SHOWN ON ARCHITECTURAL ELEVATIONS SHALL TAKE PRECEDENCE OVER THESE MOUNTING HEIGHTS. FIELD LOCATE OUTLETS WITH ARCHITECT DURING ROUGH-IN.
 - INSTALL OUTLETS THAT ARE IN CLOSE PROXIMITY ON THE SAME CENTERLINE. OUTLETS THAT ARE WITHIN 2'-0" HORIZONTALLY AND WITHIN 1'-0" VERTICALLY SHALL BE INSTALLED ON THE SAME HORIZONTAL CENTERLINE LOCATED HALF WAY BETWEEN THE HEIGHTS SHOWN. OUTLETS THAT ARE MORE THAN 1'-0" APART VERTICALLY SHALL BE INSTALLED ON THE SAME VERTICAL CENTERLINE.
 - VERIFY MOUNTING HEIGHT WITH LOCAL AUTHORITY.

ELECTRICAL NOTES

- THESE DRAWINGS ARE A PART OF A COMPLETE SET OF ARCHITECTURAL/ENGINEERING CONTRACT DOCUMENTS. ELECTRICAL CONTRACTOR SHOULD REFER TO THE ARCHITECTURAL DRAWINGS FOR ACTUAL LOCATION OF ITEMS WHERE SPECIFIED. SEE SAID CONFIGURATIONS FOR WALL DEFINITIONS, ELEVATIONS, CASEWORK, REFLECTED CEILING PLAN, ETC. ROUGH-IN INSTALLATIONS WHICH ARE NOT LOCATED ACCORDING TO THE ARCHITECTURAL ELEVATIONS SHALL BE RELOCATED AT NO ADDITIONAL COST.
- CEILING CLEARANCES ARE CRITICAL FOR THIS PROJECT. GENERAL CONTRACTOR MUST COORDINATE ALL TRADES TO AVOID POTENTIAL INTERFERENCES. CONFLICTS BETWEEN TRADES SHALL BE REFERRED TO THE ARCHITECT FOR RESOLUTION.
- ALL ELECTRICAL WORK SHALL BE DONE IN ACCORDANCE WITH THE NEC AND LOCAL ORDINANCES. CONTRACTOR SHALL OBTAIN AND PAY FOR ALL NECESSARY PERMITS.
- ALL SYMBOLS SHOWN ON THIS LEGEND MAY NOT BE USED.
- ALL PANELBOARDS ARE 3Ø 4W UNLESS OTHERWISE NOTED.
- ALL BRANCH CIRCUIT CONDUIT SHALL BE GALVANIZED EMT. 3/4" CONDUIT MINIMUM.
- ALL CIRCUITS SHOWN CONCEALED SHALL BE RUN IN FURRED CEILING SPACES AND SHALL BE CONCEALED IN CONCRETE SLAB ONLY WHEN NO FURRED CEILING SPACE IS PROVIDED.
- ALL CONDUITS CROSSING EXPANSION JOINTS SHALL HAVE EXPANSION TYPE FITTINGS.
- ALL OUTLET BOXES MOUNTED BACK-TO-BACK IN WALLS SHALL HAVE FIREPROOF SOUND INSULATING MATERIAL INSTALLED BETWEEN THE BOXES TO PREVENT SOUND TRANSMISSION FROM ONE ROOM TO THE OTHER.
- ALL FLUSH MOUNTED PANELS SHALL HAVE 3-1" EMPTY CONDUITS STUBBED OUT ABOVE CEILING FOR FUTURE CIRCUITS.
- ALL WALL OUTLETS NOT PROVIDED WITH A DEVICE BY THIS CONTRACTOR SHALL BE PROVIDED WITH BLANK WALL PLATES.
- ALL BRANCH CIRCUITS SHALL INCLUDE A GREEN COVERED GROUND WIRE SIZED PER NEC OR AS SHOWN. CONNECT TO EACH DEVICE AND OUTLET BOX ON THE CIRCUIT AND TO THE PANELBOARD GROUND BUS. MULTIPLE WIRE BRANCH CIRCUITS WITH COMMON NEUTRAL REQUIRE ONLY ONE GROUND WIRE. NUMBER OF WIRES SHOWN ON DRAWINGS DOES NOT INCLUDE GROUND WIRE.
- FINAL EQUIPMENT CONNECTIONS - THIS CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL LABOR & MATERIALS REQUIRED TO MAKE FINAL CONNECTIONS TO ALL EQUIPMENT FURNISHED BY THIS CONTRACTOR AND/OR EQUIPMENT FURNISHED BY OTHERS. VERIFY ALL REQUIREMENTS, CONDUCTOR SIZE, OVERCURRENT PROTECTION, PHASE, VOLTAGE, MOTOR ROTATION, ETC.. WITH EQUIPMENT SUPPLIER PRIOR TO ROUGH-IN. PROVIDE FUSED DISCONNECT IF REQUIRED BY MANUFACTURER.
- FURNISH & INSTALL FIRE ALARM SYSTEM WHICH CONFORMS TO ALL NATIONAL, STATE, & LOCAL CODES. PROVIDE ADDITIONAL DEVICES AS REQUIRED. PROVIDE TO ARCHITECT A COMPLETE SET OF MANUFACTURER'S SYSTEM INSTALLATION PLANS INCLUDING RISER DIAGRAM, CONDUIT & WIRING, INTERCONNECTION DIAGRAMS, DEVICE LOCATIONS AND ALL REQUIRED CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS. PROVIDE CONDUIT & WIRING AS DIRECTED BY SYSTEM SUPPLIER. FIRE ALARM CONTRACTOR TO HOLD A CURRENT LICENSE TO CONDUCT BUSINESS ISSUED BY THE STATES FIRE MARSHAL'S OFFICE.
- CONTRACTOR SHALL PROVIDE ARC-FLASH WARNING LABELS COMPLYING WITH NEC ARTICLE 110.16 ON NEW ELECTRICAL EQUIPMENT OR EXISTING EQUIPMENT THAT IS MODIFIED.
- FOR 120 OR 208V CIRCUITS, CONTRACTOR SHALL INCREASE WIRE SIZE FROM THAT SHOWN ONE SIZE A.W.G. FOR EVERY 100' HOMERUN LENGTH, AND ONE SIZE EVERY 200' FOR 277V OR 480V CIRCUITS TO INSURE VOLTAGE DROP OF 2% FROM SWITCHBOARD TO PANELBOARD AND 3% FOR ALL BRANCH CIRCUITS FOR A TOTAL MAXIMUM VOLTAGE DROP OF 5%.
- CONTRACTOR SHALL LABEL ELECTRICAL SERVICE EQUIPMENT WITH AVAILABLE FAULT CURRENT IN ACCORDANCE WITH NEC 110.24.
- CONTRACTOR SHALL LABEL ELECTRICAL PANELBOARDS TO INDICATE THE DEVICE OR EQUIPMENT WHERE FEEDER ORIGINATES IN ACCORDANCE WITH NEC 408.4(B).
- ALL BREAKERS IN SWITCHBOARD AND PANEL BOARDS SHALL BE FULLY RATED. SERIES RATING IS NOT ALLOWED.
- PROVIDE MINIMUM 4" BETWEEN CONDUITS LOCATED PARALLEL OR ADJACENT TO FIRE WALL OR SMOKE BARRIER.
- PROVIDE GROUNDING BUSHING CONNECTORS ON ALL METALLIC CONDUIT TERMINATIONS. PROVIDE FOR ALL 120 VOLT AND 208 VOLT CIRCUITS RATED 15 AMPS OR GREATER.



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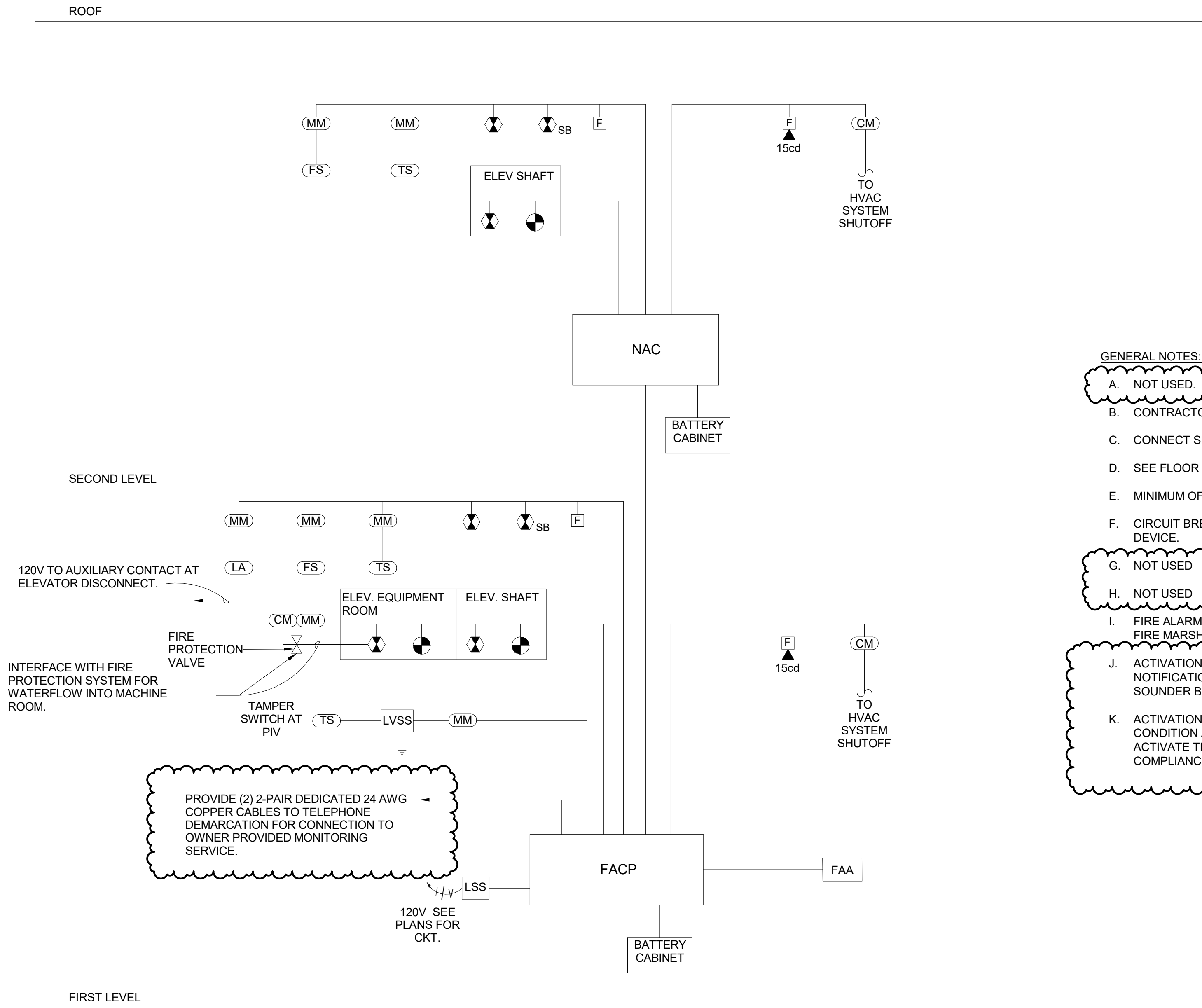
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ELECTRICAL
LEGEND &
NOTES

DATE: 12/30/2022
SZZARCH#: 2111
DRAWN BY: MBC, ZM
CHECKED BY: VGL

REVISIONS:

REVISED BY ADDENDUM 2 03.20.2023



- GENERAL NOTES:
- A. NOT USED.
 - B. CONTRACTOR SHALL LOOP ALL CIRCUITS IN CONDUIT PER SPECIFICATIONS.
 - C. CONNECT SPRINKLER WATER FLOW BELL PER MANUFACTURER'S REQUIREMENTS.
 - D. SEE FLOOR PLANS FOR THE NUMBER AND LOCATION OF EQUIPMENT AND DEVICES.
 - E. MINIMUM OF #12 AWG GROUNDS SHALL BE USED.
 - F. CIRCUIT BREAKERS SERVING THE FACP SHALL BE RED AND PROVIDED WITH A MECHANICAL LOCKING DEVICE.
 - G. NOT USED
 - H. NOT USED
 - I. FIRE ALARM CONTRACTOR SHALL BE CERTIFIED AND PERMITTED THROUGH THE STATE OF MISSISSIPPI FIRE MARSHAL'S OFFICE.
 - J. ACTIVATION OF ANY INITIATING DEVICES OF THE BUILDING FIRE ALARM SYSTEM SHALL ACTIVATE ALL NOTIFICATION APPLIANCES OF THE BUILDING FIRE ALARM SYSTEM, INCLUDING SLEEPING ROOM SOUNDER BASES AND VISUAL DEVICES WITHIN THE SLEEPING ROOMS AND BATHROOM.
 - K. ACTIVATION OF A SLEEPING ROOM SMOKE DETECTOR SHALL PROVIDE A SUPERVISORY TROUBLE CONDITION AT THE FIRE ALARM CONTROL PANEL AND REMOTE ANNUNCIATOR. THE DETECTOR SHALL ACTIVATE THE SLEEPING ROOM SOUNDER BASE AND BATHROOM VISUAL NOTIFICATION DEVICES IN COMPLIANCE WITH IBC 907.5.2.3.3 AND ICC A117.1.

① FIRE ALARM SYSTEM RISER DIAGRAM
NOT TO SCALE



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SHEET E002

FIRE ALARM
RISER

DATE: 12/30/2022
SZZARCH# 2111
DRAWN BY: ZM
CHECKED BY: VGL

REVISIONS:

REVISED BY ADDENDUM 1 03.13.2023

REVISED BY ADDENDUM 2 03.20.2023

LUMINAIRE SCHEDULE															
TYPE MARK	MANUFACTURER	MODEL	VOLT	LAMP	WATT	COLOR TEMP	DESCRIPTION	COMMENTS / OPTIONS	CONCRETE BASE	CLG LAY-IN	CLG FLANGED	WALL	RECESSED	SURFACE	PENDENT
A	LITHONIA	LBL4 30L MVOLT EZ1 LP835	120	3000 LM	27 W	3500 K	48" LED SURFACE MOUNTED, ACRYLIC DIFFUSER, 0-10 DIMMING							•	
AE	LITHONIA	LBL4 30L MVOLT EZ1 LP835 EL14L	120	3000 LM	27 W	3500 K	48" LED SURFACE MOUNTED, ACRYLIC DIFFUSER, 0-10 DIMMING	WITH EMERGENCY BATTERY						•	
B	GOTHAM	EVO 35/15 6AR MD LSS MVOLT EZ1 TRW	120	1500 LM	19 W	3500 K	DOWNLIGHT, 6" APERTURE, SEMI-SPECULAR REFLECTOR, WHITE TRIM						•		
BE	GOTHAM	EVO 35/15 6AR MD LSS MVOLT EZ1 TRW EL	120	1500 LM	19 W	3500 K	DOWNLIGHT, 6" APERTURE, SEMI-SPECULAR REFLECTOR, WHITE TRIM	WITH EMERGENCY BATTERY					•		
C	LITHONIA	FMVTSL 24IN MVOLT 30K 90CRI BN	120	1300 LM	18 W	3000 K	24" WALL MOUNTED VAINITY, EXTRUDED ACRYLIC DIFFUSER, BRUSHED NICKEL FINISH	C.L. 12" ABOVE MIRROR				•			
D	GOTHAM	EVO 35/10 6AR MD LSS MVOLT EZ1 TRW	120	1000 LM	12 W	3500 K	DOWNLIGHT, 6" APERTURE, SEMI-SPECULAR REFLECTOR, WHITE TRIM						•		
DE	GOTHAM	EVO 35/10 6AR MD LSS MVOLT EZ1 TRW EL	120	1000 LM	12 W	3500 K	DOWNLIGHT, 6" APERTURE, SEMI-SPECULAR REFLECTOR, WHITE TRIM	WITH EMERGENCY BATTERY					•		
E	LITHONIA	ENVX 2x2 HRCG 2000LM 80CRI 35K MIN1 ZT 120	120	2000 LM	17 W	3500 K	2x2 LOW GLARE TROFFER, CURVED LUMINOUS SURFACE, IP5X RATED, 0-10V DIMMING TO 1%, 5-YEAR WARRANTY			•			•		
EE	LITHONIA	ENVX 2x2 HRCG 2000LM 80CRI 35K MIN1 ZT 120 E10WLCP	120	2000 LM	17 W	3500 K	2x2 LOW GLARE TROFFER, CURVED LUMINOUS SURFACE, IP5X RATED, 0-10V DIMMING TO 1%, 5-YEAR WARRANTY	WITH EMERGENCY BATTERY		•			•		
F	LITHONIA	ENVX 2x2 HRCG 3300LM 80CRI 35K MIN1 ZT 120	120	3300 LM	30 W	3500 K	2x2 LOW GLARE TROFFER, CURVED LUMINOUS SURFACE, IP5X RATED, 0-10V DIMMING TO 1%, 5-YEAR WARRANTY			•			•		
FE	LITHONIA	ENVX 2x2 HRCG 3300LM 80CRI 35K MIN1 ZT 120 E10WLCP	120	3300 LM	30 W	3500 K	2x2 LOW GLARE TROFFER, CURVED LUMINOUS SURFACE, IP5X RATED, 0-10V DIMMING TO 1%, 5-YEAR WARRANTY	WITH EMERGENCY BATTERY		•			•		
G	LITHONIA	ZL1D L48 5000LM FST 120V 35K 80CRI WH ZACVH	120	3700 LM	38 W	3500 K	48" INDUSTRIAL STRIP, AIRCRAFT CABLE MOUNTING, ACRYLIC DROP LENS	BOTTOM 9'-0" A.F.F.							••
GE	LITHONIA	ZL1D L48 5000LM FST 120V 35K 80CRI E7W WH ZACVH	120	3700 LM	38 W	3500 K	48" INDUSTRIAL STRIP, AIRCRAFT CABLE MOUNTING, ACRYLIC DROP LENS	WITH EMERGENCY BATTERY BOTTOM 9'-0" A.F.F.							••
H	LANDSCAPE FORMS	AP-108L3-070F-40K-UV1-MW1-NTW	120	2000 LM	40 W	4000 K	DECORATIVE WALL PACK	C.L. 13' A.F.F., UON							
HE	LANDSCAPE FORMS	AP-108L3-070F-40K-UV1-MW1-NTW	120	2000 LM	40 W	4000 K	DECORATIVE WALL PACK	WITH EMERGENCY BATTERY, C.L. 13'-0" A.F.F., UON				•			
K	LITHONIA	ENVX 2x2 HRCG 2000LM 80CRI 35K MIN10 ZT 120	120	2000 LM	17 W	3500 K	2x2 LOW GLARE TROFFER, CURVED LUMINOUS SURFACE, IP5X RATED, 5-YEAR WARRANTY			•			•		
KE	LITHONIA	ENVX 2x2 HRCG 2000LM 80CRI 35K MIN10 ZT 120 E10WLCP	120	2000 LM	17 W	3500 K	2x2 LOW GLARE TROFFER, CURVED LUMINOUS SURFACE, IP5X RATED, 5-YEAR WARRANTY	WITH EMERGENCY BATTERY							
ME	PHOENIX	RLED-2-EMB2	120	1975 LM	19 W	4000 K	LED ELEVATOR PIT LIGHT, 2', COORDINATE LOCATION WITH ELEVATOR PROVIDER	WITH EMERGENCY BATTERY				•			
N	GOTHAM	EVO 35/07 4AR MD LSS MVOLT EZ1 TRW	120	750 LM	10 W	3500 K	DOWNLIGHT, 4" APERTURE, SEMI-SPECULAR REFLECTOR, WHITE TRIM								
NE	GOTHAM	EVO 35/07 4AR MD LSS MVOLT EZ1 TRW EL	120	750 LM	10 W	3500 K	DOWNLIGHT, 4" APERTURE, SEMI-SPECULAR REFLECTOR, WHITE TRIM	WITH EMERGENCY BATTERY		•			•		
P	MARK ARCHITECTURAL	SL2L LOP 4FT FLP FL 80CRI 35K 400LMF 120 ZT	120	400 LMF	12 W	3500 K	SLOT 2 RECESSED LINEAR LED, FLUSH, SSNAP-N ACRYLIC LENS, 0-10V DIMMING TO 1%, GYP CEILING MOUNTING				•		•		
R	ALIGHTS	RLY2 L6 W4 ILS+DLS 35 CRI80 U BW S W 1 D E OC C1	120	649LMF + 687LMF	175 W	3500 K	RELAY SERIES, HEXAGONAL, DIRECT / INDIRECT DISTRIBUTION, AIRCRAFT CABLE	WITH EMERGENCY BATTERY							•
SA	STERNBERG	PT A850SRLED 990 32L40T3 MDL016 A GFIV56111FP5, 188 GFULPIUC/BKT	120	14,550 LM	134 W	4000 K	CAMPUS STANDARD AREA LIGHT, POST TOP	WITH GFI RECEPTACLE, MOUNT ON CONCRETE POLE BASE 4" ABOVE GRADE	•						
SA2	LANDSCAPE FORMS	AP-212L5-100F-40K-UV1-20K-P2-TW1	120	212L5	55 W	4000 K	ASHBERRY AREA LIGHT, SINGLE HEAD, 1000mA, SINGLE TENON MOUNT, 12' POLE (AP-12-P2-4-CVR-DARK BRONZE)	MOUNT ON CONCRETE POLE BASE 4" ABOVE GRADE							
SB	LITHONIA	DSX1 P4 40K TFTM MVOLT SPA DDBXD G1	208	LED	250 W	4000 K	AREA LIGHT, DOUBLE HEAD, 180 DEGREE CONFIGURATION, 25' STRAIGHT SQUARE STEEL POLE	MOUNT ON CONCRETE POLE BASE 3' ABOVE GRADE							
SC	LITHONIA	DSX1 P4 40K TFTM MVOLT SPA DDBXD G1	208	LED	500 W	4000 K	AREA LIGHT, DOUBLE HEAD, 90 DEGREE CONFIGURATION, 25' STRAIGHT SQUARE STEEL POLE	MOUNT ON CONCRETE POLE BASE 3' ABOVE GRADE							
SE	LITHONIA	DSXF2 LED 3 A530/40K WFL MVOLT DDBXD	208	LED	500 W	4000 K	SPORTS FLOOD LIGHTS, TWIN HEAD, 20' STRAIGHT SQUARE STEEL POLE	MOUNT ON CONCRETE POLE BASE 3' ABOVE GRADE							
SF	LITHONIA	DSXF2 LED 3 A530/40K WFL MVOLT DDBXD	208	LED	1000 W	4000 K	SPORTS FLOOD LIGHTS, FOUR HEADS, 20' STRAIGHT SQUARE STEEL POLE	MOUNT ON CONCRETE POLE BASE 3' ABOVE GRADE							
SG	LANDSCAPE FORMS	AP-012L5-035F-40K-UV1-SM	120	012L5	20 W	4000 K	ASHBERRY BOLLARD, 350mA, TYPE 5 DISTRIBUTION, SURFACE MOUNT	MOUNT ON CONCRETE POLE BASE 4" ABOVE GRADE						•	
SH	LITHONIA	DSX1 P4 40K TFTM MVOLT SPA DDBXD G1	208	LED	250 W	4000 K	AREA LIGHT, SINGLE HEAD, 25' STRAIGHT SQUARE STEEL POLE								
X1	LITHONIA	LQC 1 R EL N	120	LED	3 W	3200 K		90-MINUTE NI-CAD EMERGENCY BATTERY							
X2	LITHONIA	LQC 2 R EL N	120	LED	3 W	3200 K	EXIT SIGN, ALUMINUM HOUSING, DOUBLE FACE, RED LETTERING	90-MINUTE NI-CAD EMERGENCY BATTERY							

CLARIFICATION / REVISION TO FIXTURE TYPE MARKS: R, SA, SA2.

GS# 210-073 NEW MEN'S RESIDENCE HALL

Mississippi Delta Community College - Moorhead, MS



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SHEET E004

LIGHTING
FIXTURE
SCHEDULE

DATE: 12/30/2022
SZZARCH#: 2111
DRAWN BY: MBC
CHECKED BY: VGL

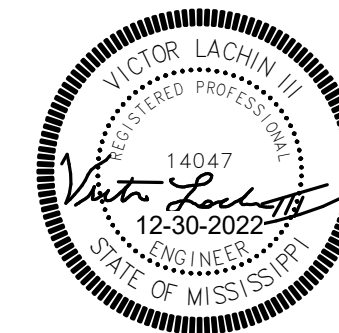
REVISIONS:

REVISED BY ADDENDUM 1 03.13.2023

REVISED BY ADDENDUM 2 03.20.2023

GS# 210-073 NEW MEN'S RESIDENCE HALL

Mississippi Delta Community College - Moorhead, MS



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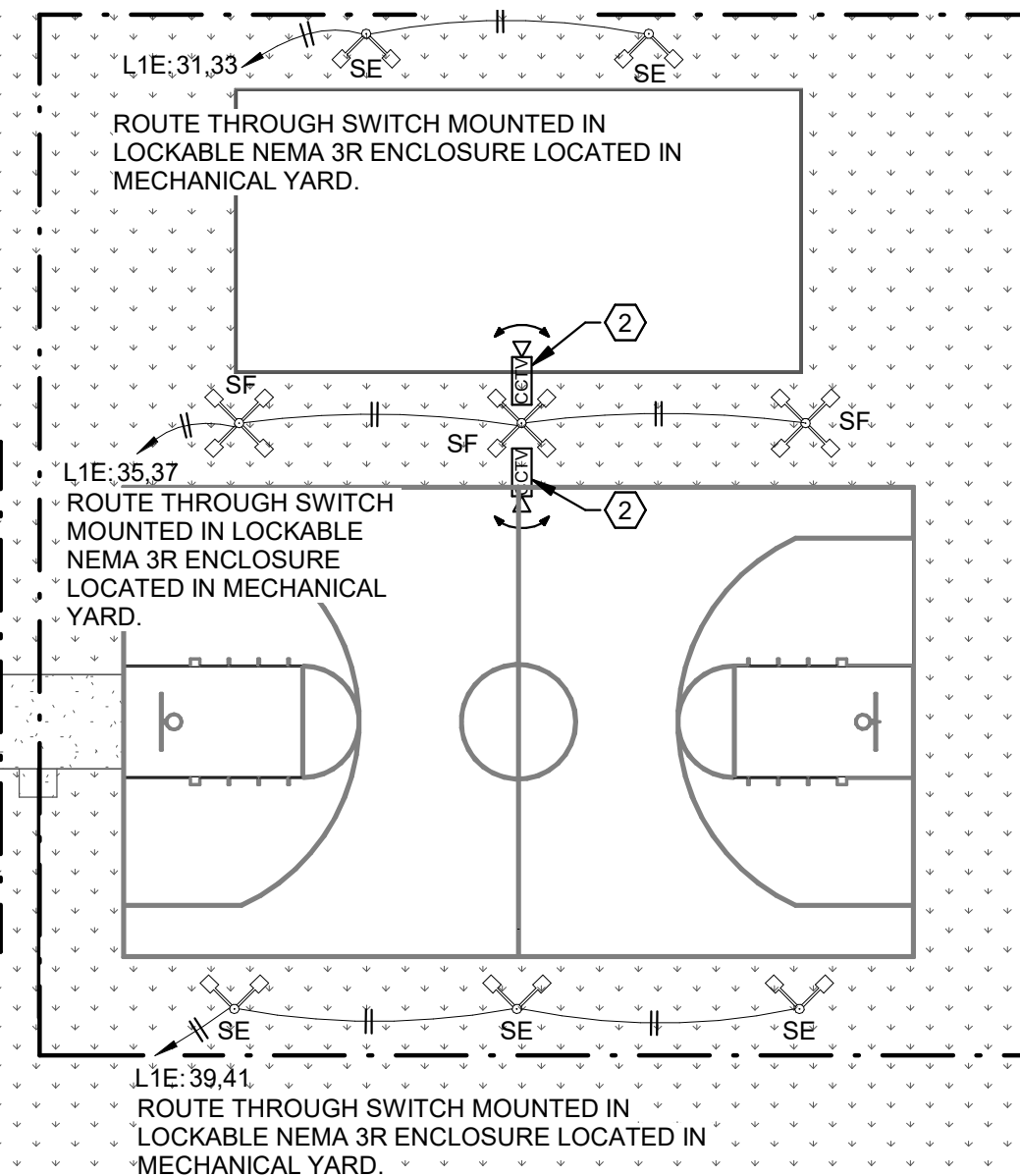
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**OVERALL
ELECTRICAL
SITE PLAN**

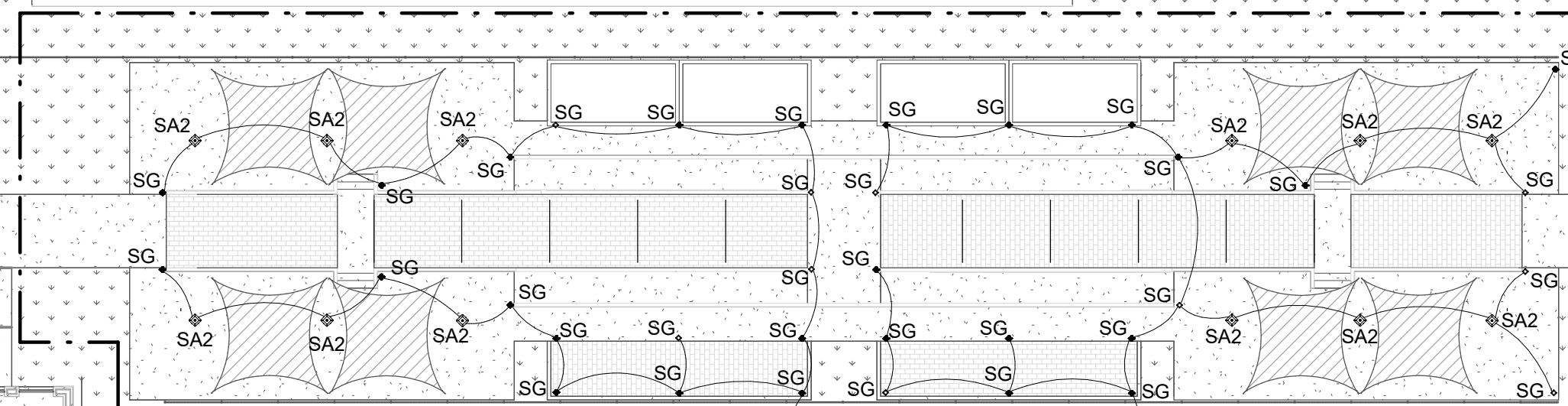
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SZARCH#: 2111
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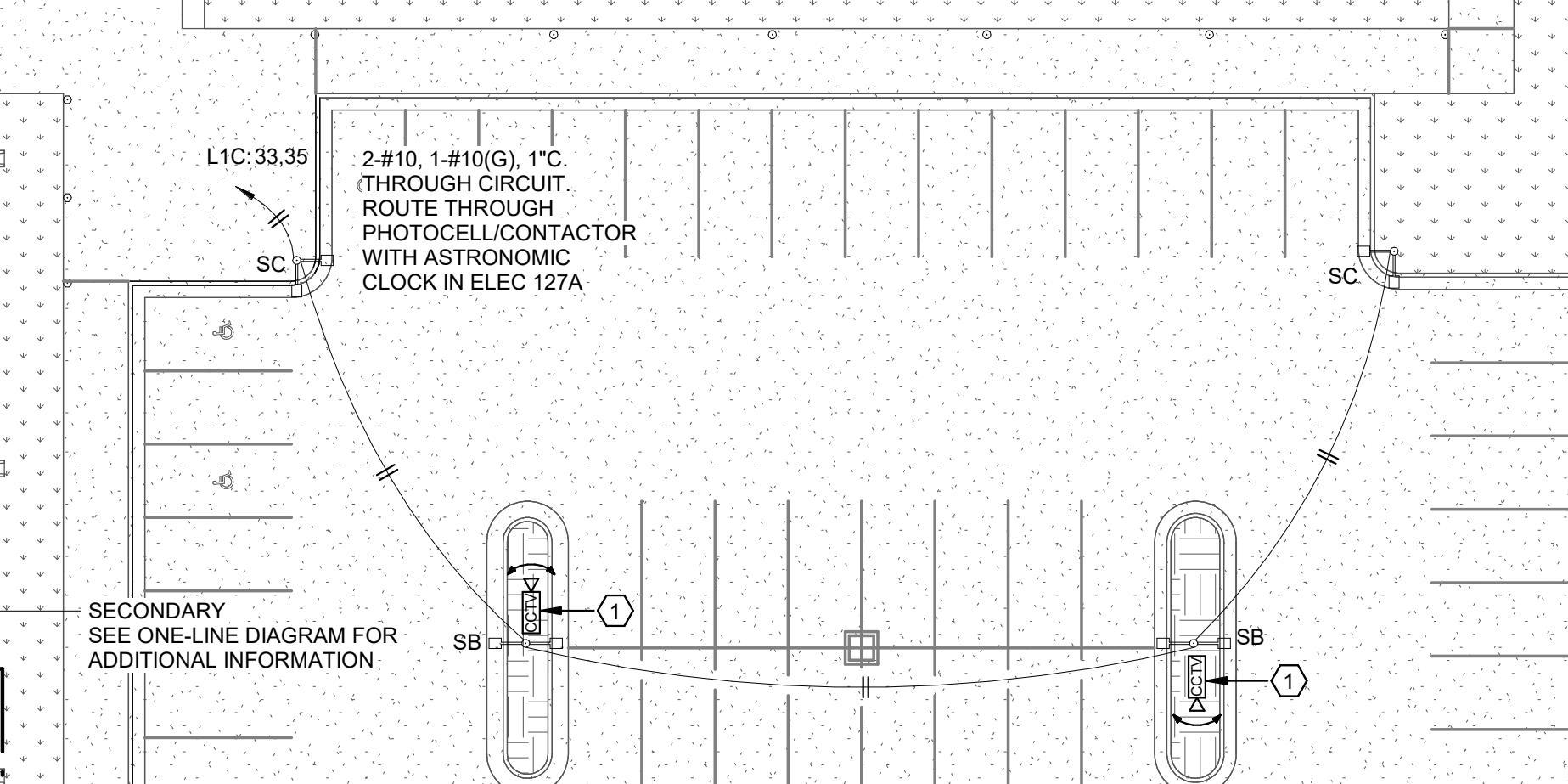
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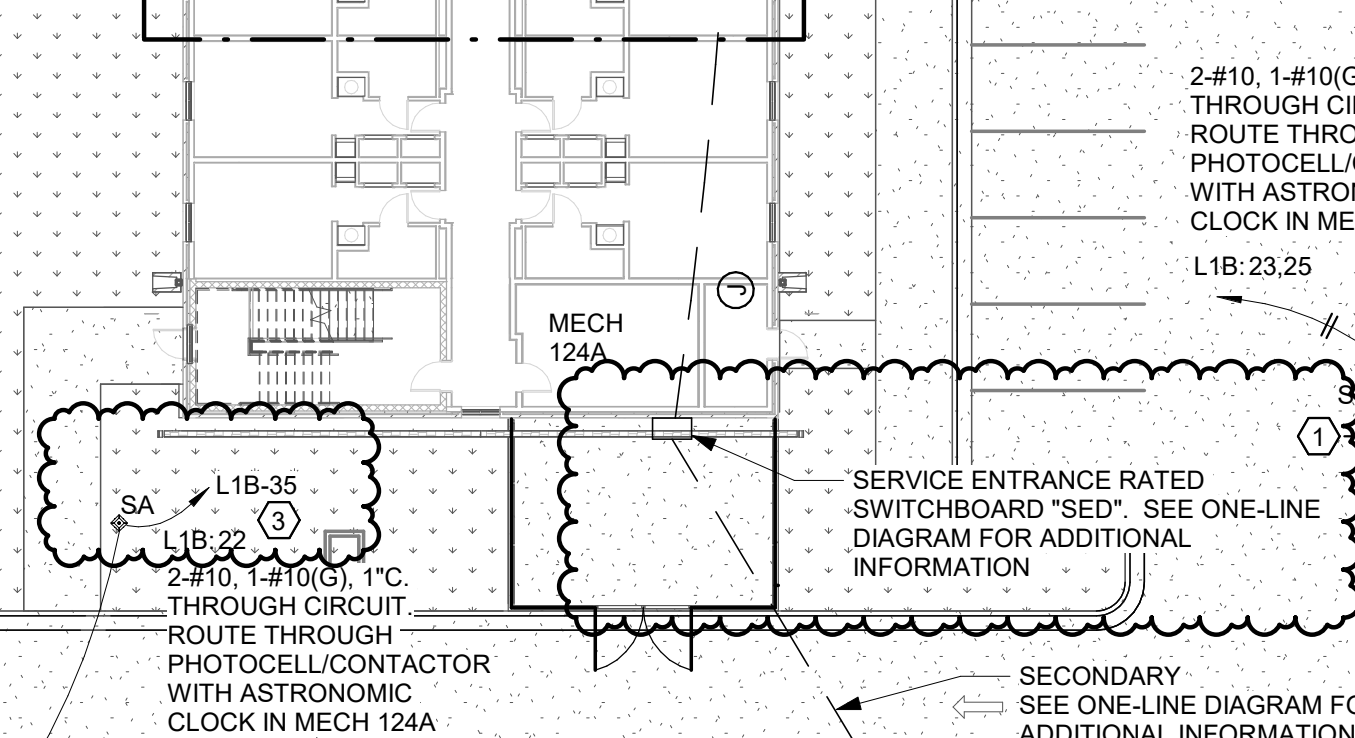
ALTERNATE #3 IF TAKEN



ALTERNATE #2 IF TAKEN



ALTERNATE #1 IF TAKEN



SITE PLAN KEYNOTES:

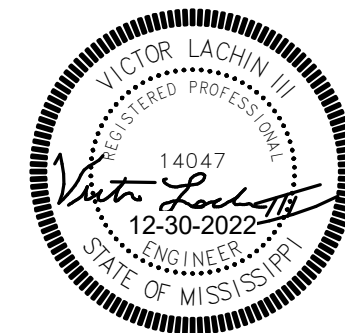
- ROUTE 1" C. FROM MECHANICAL ROOM 124A TO AREA LIGHTING POLE FOR POWER. SERVE FROM SPARE 1P20A CIRCUIT BREAKER IN PANEL L1B WITH 2-#10, 1-#10(G). STUB 1" C. TO JUST BELOW HANDHOLE AND TRANSITION TO FLEXIBLE CONDUIT ROUTED TO J-BOX INSIDE POLE AT MOUNTING HEIGHT, AS DIRECTED BY CAMPUS I.T. FOR MOUNTING HEIGHT FOR EACH CAMERA. PROVIDE MOUNTING LOCATION IN POLE SUBMITTAL INFORMATION. ALL PENETRATIONS OF POLE SHALL BE PERFORMED BY THE MANUFACTURER. COORDINATE WITH POLE PROVIDER FOR ANY KNOCKOUTS REQUIRED. ROUTE 1 1/4" C. FROM MAIN I.T. ROOM 110, FOR FIBER, TO EACH CAMERA LOCATION SHOWN. STUB CONDUIT, WITH BUSHING, TO JUST BELOW HANDHOLE HEIGHT.
- ROUTE 1" C. FROM MECHANICAL ROOM 125B, OR POWER, TO CAMERA LOCATION SHOWN. SERVE FROM SPARE 1P20A CIRCUIT BREAKER IN PANEL L1E WITH 2-#10, 1-#10(G). STUB 1" C. TO JUST BELOW HANDHOLE AND TRANSITION TO FLEXIBLE CONDUIT ROUTED TO J-BOX INSIDE POLE AT MOUNTING HEIGHT, AS COORDINATED WITH, AND DIRECTED BY, CAMPUS I.T. ALL PENETRATIONS SHALL BE PERFORMED BY THE POLE MANUFACTURER. COORDINATE WITH POLE PROVIDER FOR ANY KNOCKOUTS REQUIRED. ROUTE 1 1/4" C. FROM MAIN I.T. ROOM 110, FOR FIBER, TO EACH CAMERA LOCATION SHOWN. STUB CONDUIT, WITH BUSHING, TO JUST BELOW HANDHOLE HEIGHT.
- LUMINAIRE ASSEMBLIES "SA" CONTAIN A GCFI, 120V DUPLEX RECEPTACLE IN EACH POLE. PROVIDE AN UNSWITCHED CIRCUIT BETWEEN EACH POLE AND HOMERUN TO PANEL LC1. UTILIZE 20A/1P BREAKER IN PANEL LC1 TO PROTECT CIRCUIT. CIRCUITS SHALL BE LABELED LC1-51, LC1-53 AND L1B-35. BRANCH CIRCUIT CONDUCTORS FOR LC1-51, LC1-53 AND L1B-35 SHALL BE 2-8, 1-#8(G). ROUTE IN SAME RACEWAY AS CIRCUITS LC1-31, LC1-32. SIZE RACEWAY PER NEC FOR 40% FILL.

Overall Site
1" = 20'-0"



REVISED BY ADDENDUM 1 03.13.2023

REVISED BY ADDENDUM 2 03.20.2023



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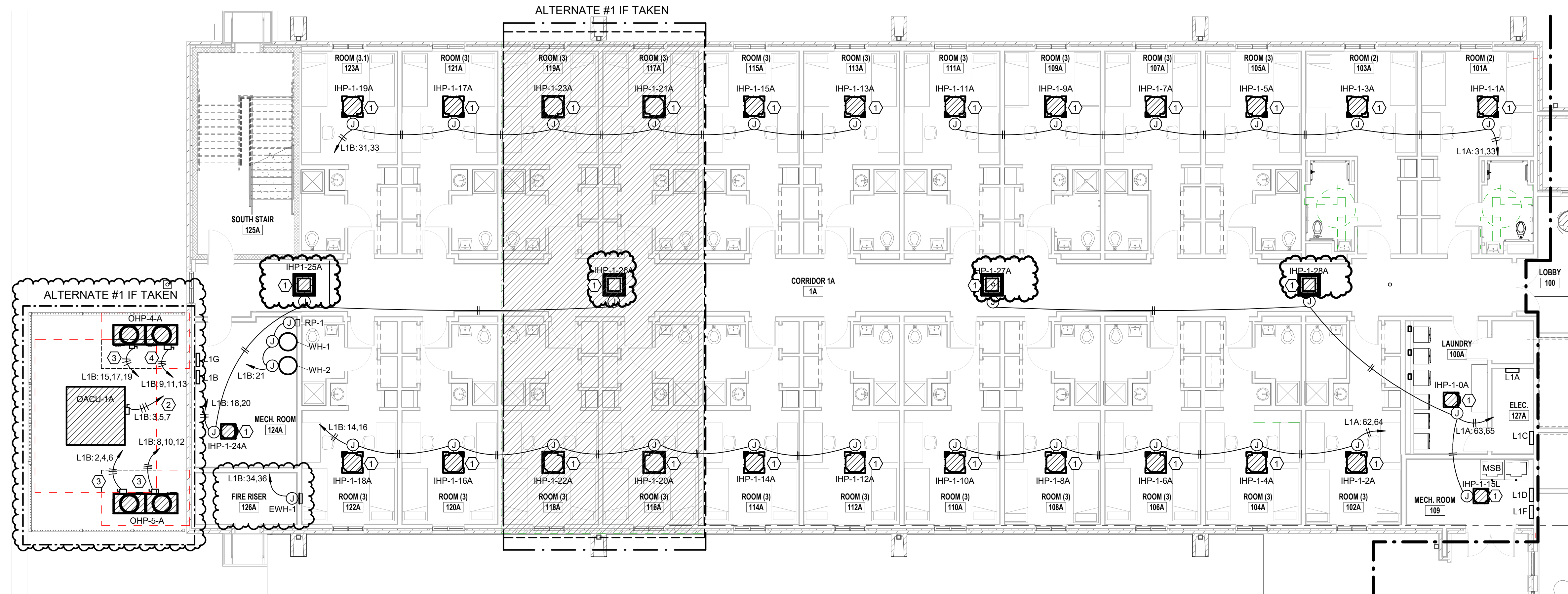
SHEET **E208**

**1st FLOOR
PLAN - A WING
- MECHANICAL
CONNECTIONS**

DATE: 12/30/2022
SZZARCH# 2111
DRAWN BY: MBC, ZM
CHECKED BY: VGL

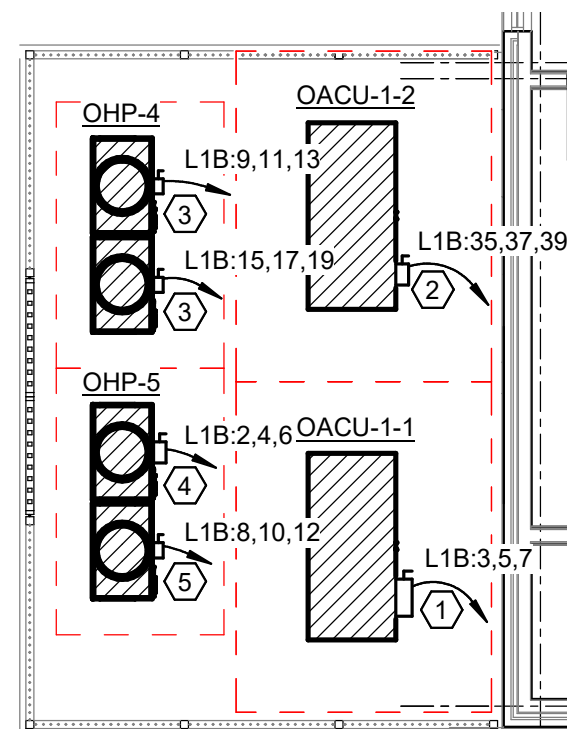
REVISIONS:

REVISED BY ADDENDUM 2 03.20.2023



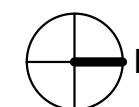
FLOOR PLAN KEYNOTES - BASE BID:

- ① 3-#1, 1-#6G, 1 1/2"C., 3P200A/125AF NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1B TO 125A/3P FOR CIRCUIT L1B-3,5,7 UNDER BASE BID CONDITIONS.
- ② 3-#3, 1-#8G, 1 1/4"C., 3P100A NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1B TO 100A/3P FOR CIRCUITS L1B-35,37,39 UNDER BASE BID CONDITIONS.
- ③ 3-#8, 1-#10G, 3/4"C., 3P60A/50AF NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1B TO 50A/3P FOR CIRCUITS L1B-9,11,13 AND L1B-15,17,19 UNDER BASE BID CONDITIONS.
- ④ 3-#4, 1-#8G, 1 1/4"C., 3P100A/70AF NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1B TO 70A/3P FOR CIRCUITS L1B-2,4,6 UNDER BASE BID CONDITIONS.
- ⑤ 3-#8, 1-#10G, 3/4"C., 3P60A/50AF NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1B TO 50A/3P FOR CIRCUITS L1B-8,10,12 UNDER BASE BID CONDITIONS.



First Floor Plan - Power - A Wing - Mech
Connections - Base Bid
1/8" = 1'-0"

First Floor Plan - Power - A Wing - Mech
Connections
1/8" = 1'-0"

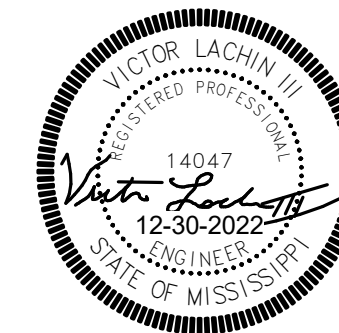


FLOOR PLAN KEYNOTES - ALTERNATE #1:

- ① PROVIDE A 3P MOTOR RATED TOGGLE SWITCH, MOUNTED IN A NEMA 1 ENCLOSURE ADJACENT TO THE UNIT, FOR DISCONNECTING MEANS. FINAL CONNECTION WITH LIQUID TIGHT FLEXIBLE CONDUIT.
- ② 3-#4/0, 1-#4, 2"C.; 3P400A/225AF NEMA 3R SAFETY SWITCH.
- ③ 3-#4, 1-#8(G), 1"C.; 3P100A/70AF NEMA 3R SAFETY SWITCH.
- ④ 3-#8, 1-#10(G), 3/4"C.; 3P60/50AFA NEMA 3R SAFETY SWITCH.

GS# 210-073 NEW MEN'S RESIDENCE HALL

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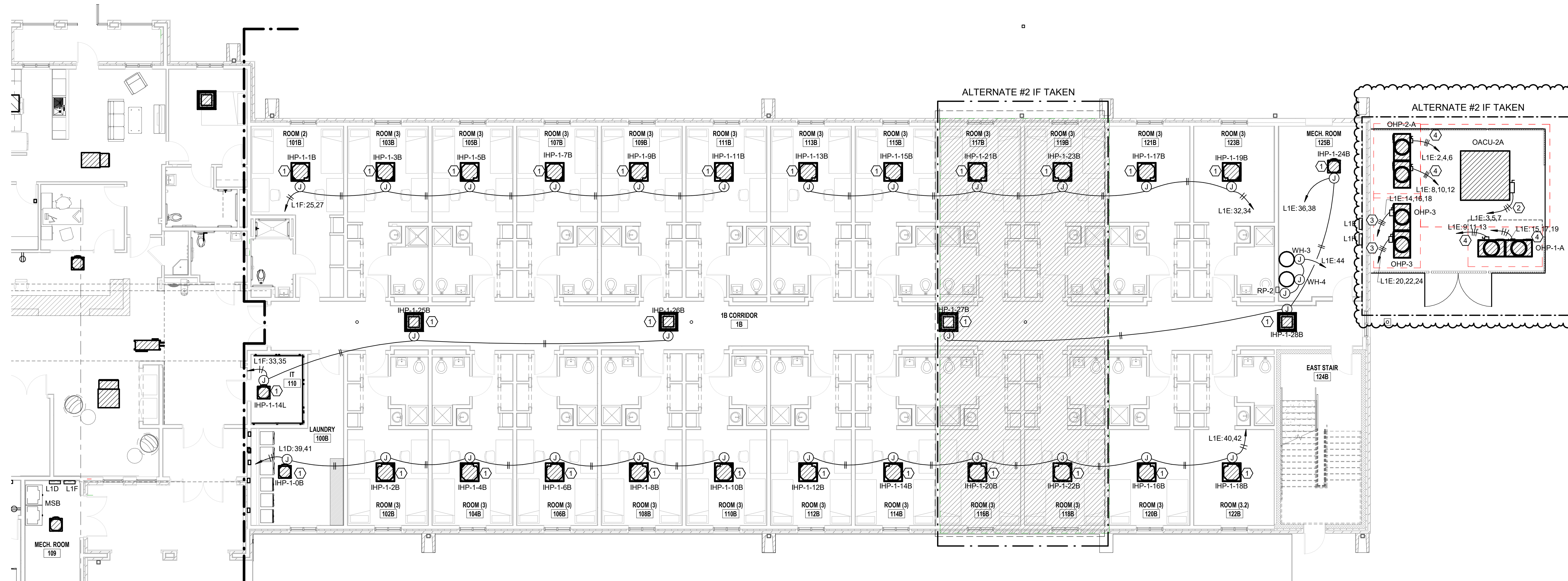
SHEET **E209**

**1st FLOOR
PLAN - B WING
- MECHANICAL
CONNECTIONS**

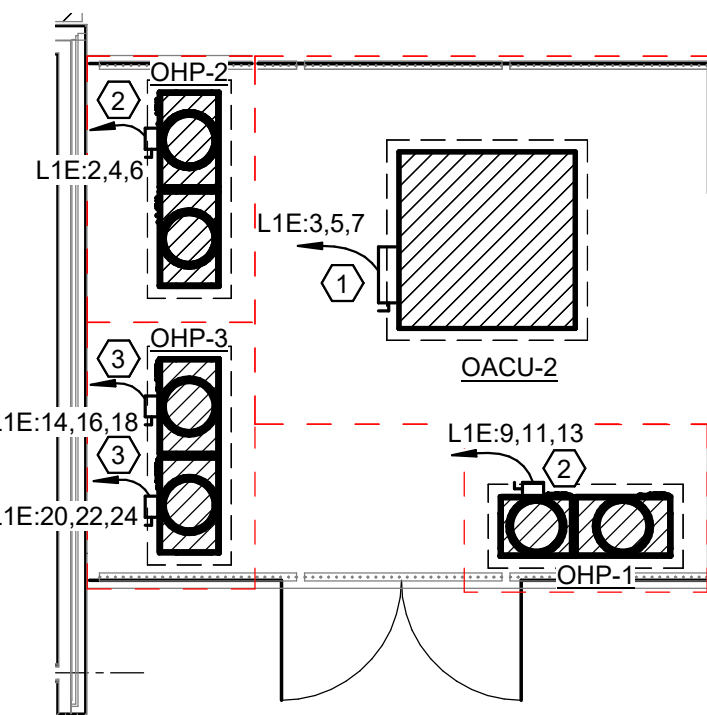
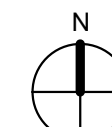
DATE: 12/30/2022
SZZARCH#: 2111
DRAWN BY: MBC, ZM
CHECKED BY: VGL

REVISIONS:

REVISED BY ADDENDUM 2 03.20.2023



First Floor Plan - Power - B Wing - Mech
Connections
1/8" = 1'-0"



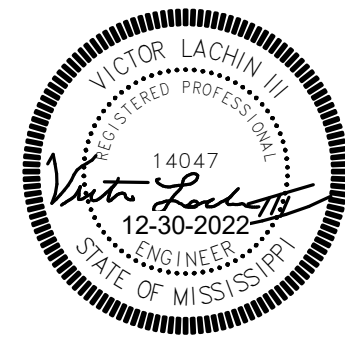
Mechanical Yard Connections - B Wing -
Base Bid
1/8" = 1'-0"

FLOOR PLAN KEYNOTES - BASE BID:

- ① 3-#4/0, 1-#4G, 2"C., 3P400A/225AF NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1E TO 225A/3P FOR CIRCUIT L1E-3,5,7 UNDER BASE BID CONDITIONS.
- ② 3-#3, 1-#8G, 3P100A NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1E TO 100A/3P FOR CIRCUITS L1E-2,4,6 AND L1E-9,11,13 UNDER BASE BID CONDITIONS.
- ③ 3-#4, 1-#8G, 3P100A/70AF NEMA 3R SAFETY SWITCH. CHANGE CIRCUIT BREAKER IN PANEL L1E TO 70A/3P FOR CIRCUITS L1E-14,16,18 AND L1E-20,22,24 TO UNDER BASE BID CONDITIONS.

FLOOR PLAN KEYNOTES - ALTERNATE #2:

- ① PROVIDE A 3P MOTOR RATED TOGGLE SWITCH, MOUNTED IN A NEMA 1 ENCLOSURE ADJACENT TO THE UNIT, FOR DISCONNECTING MEANS. FINAL CONNECTION WITH LIQUID TIGHT FLEXIBLE CONDUIT.
- ② 3-#4/0, 1-#4, 2"C.; 3P400A/225AF NEMA 3R SAFETY SWITCH.
- ③ 3-#4,1-#8(G), 1"C.; 3P100A/70AF NEMA 3R SAFETY SWITCH.
- ④ 3-#8,1-#10(G), 3/4"C.; 3P60/50AFA NEMA 3R SAFETY SWITCH.



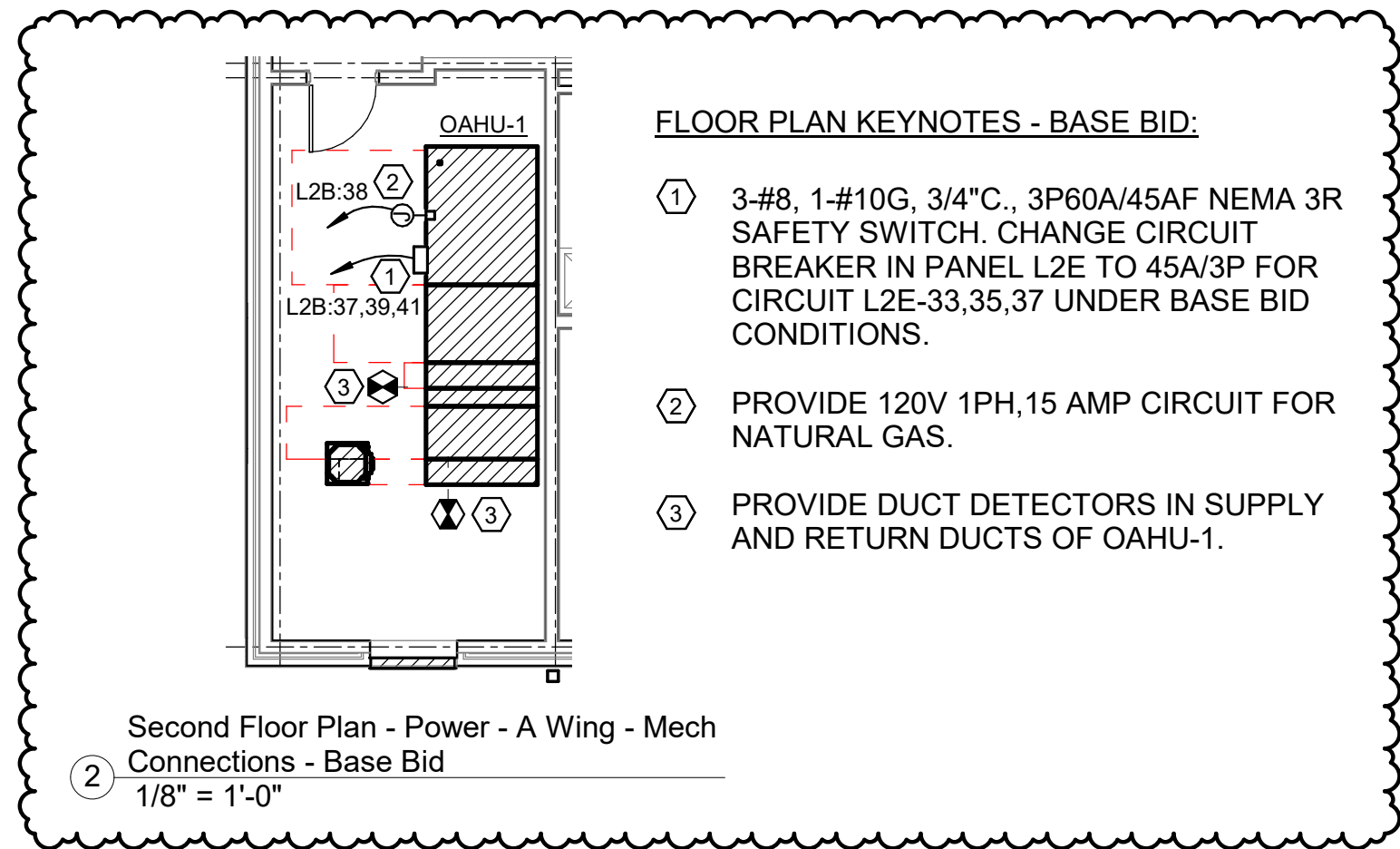
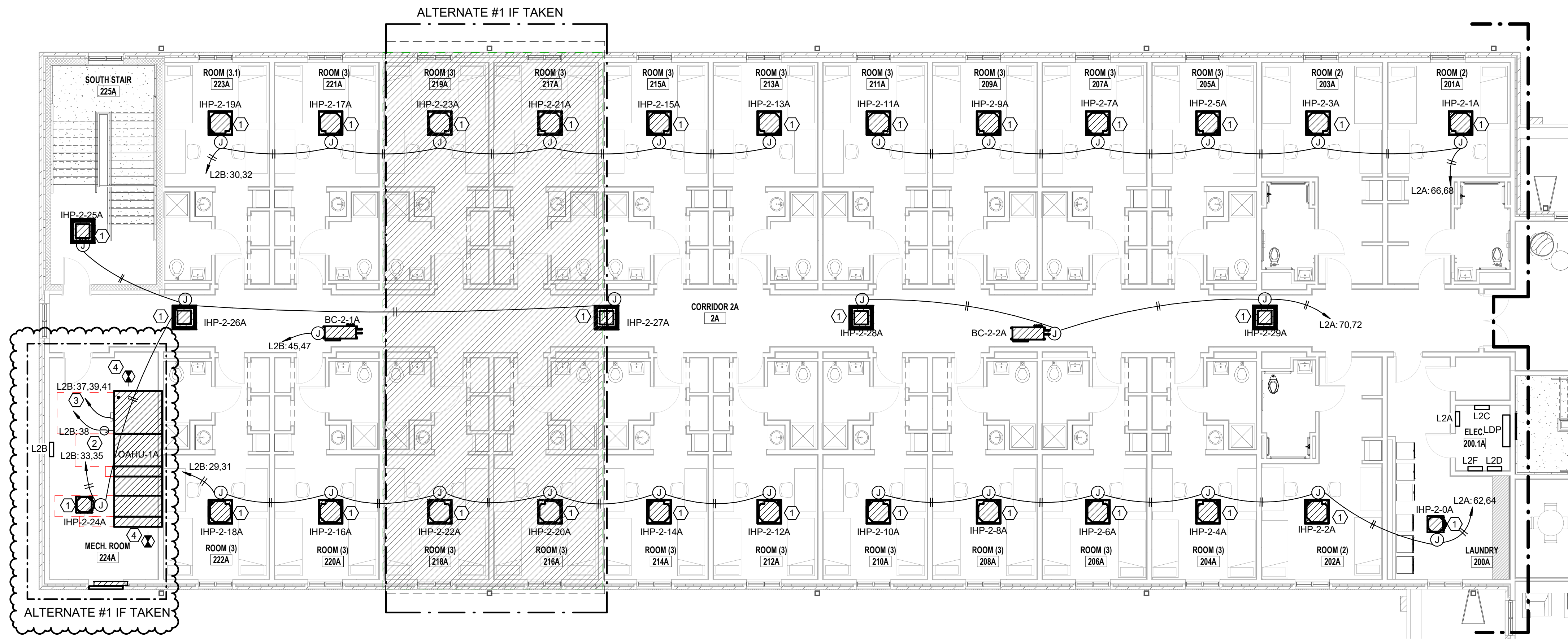
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SHEET **E211**

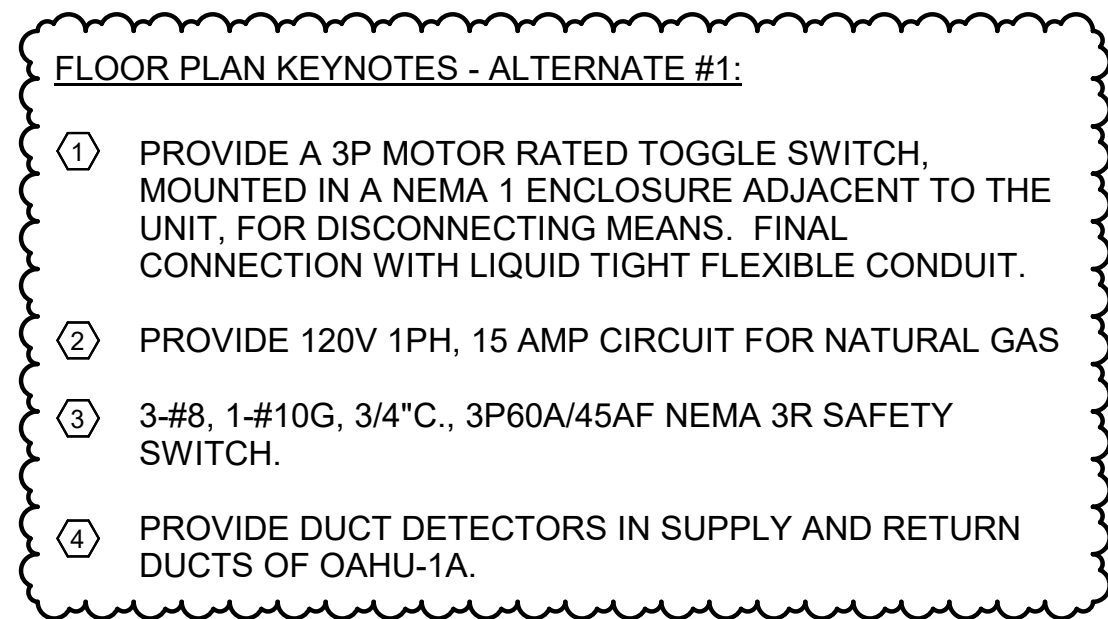
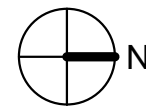
2nd FLOOR
PLAN - A WING
- MECHANICAL
CONNECTIONS

DATE: 12/30/2022
SZZARCH# 2111
DRAWN BY: MBC, ZM
CHECKED BY: VGL

REVISIONS:



Second Floor Plan - Power - A Wing - Mech Connections
1/8" = 1'-0"



SECTION 230900

INSTRUMENTATION AND CONTROL FOR HVAC

THIS CONTRACTOR SHALL INCLUDE IN THEIR QUOTE AN ALLOWANCE OF \$196,800.00 (\$180,800.00 ALLOWANCE FOR BASE BID, \$8,000.00 ALLOWANCE FOR ALTERNATE NO. 1 AND \$8,000.00 ALLOWANCE FOR ALTERNATE NO. 2) FOR SECTION 230900. SEE SECTION 018000 FOR ALLOWANCE BREAKDOWN.

A REQUEST FOR PROPOSAL WILL BE ISSUED BY THE PROFESSIONAL FOR THE PROJECT HVAC INSTRUMENTATION AND CONTROL AS SPECIFIED IN SECTION 230900 AND SHOWN ON DRAWINGS. THE SEALED PROPOSAL WILL BE SUBMITTED TO THE PROFESSIONAL WHO WILL REVIEW THEM, THEN MAKE A RECOMMENDATION TO THE OWNER.

AN ALLOWANCE OF INCLUSION IN THE CONTRACT SUM HAS BEEN SPECIFIED IN DIVISION ONE, SECTION 018000, "PART 2 – ALLOWANCE SUPPLEMENT" FOR PURCHASE OF THE BUILDING AUTOMATION SYSTEMS AND CONTROLS.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.2 ACTION SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
 - 1. Schematic flow diagrams.
 - 2. Power, signal, and control wiring diagrams.
 - 3. Details of control panel faces.
 - 4. Damper schedule.
 - 5. Valve schedule.
 - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 7. Control System Software: Schematic diagrams, written descriptions, and points list.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

- A. Manufacturers:
 - 1. Trane; Tracer Synchrony.
 - 2. Schneider Electric; EcoStruxure.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- D. Network communications shall be BACnet over IP protocol. Static IP addresses are no longer permitted by DOIM. DHCP (Dynamic Host Configuration Protocol), or equal, must be used. Operator navigation shall be via a graphical floor plan penetration using hyperlinks plus equipment/subsystem selection from tables and/or tree directories.

2.3 DDC EQUIPMENT

- A. Operator Workstation: A MSARNG owned PC based desktop computer shall be furnished to serve as the BAS building operator workstation. The computer will meet or exceed hardware and software requirements of the U.S. Army Golden Master Program for commonly used computing environment within the Army Enterprise Infrastructure. This PC is typically assigned to the Readiness NCO for the facility and will not be dedicated exclusively as a BAS building operator workstation.

- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 3. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

2.5 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.6 TIME CLOCKS

- A. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

- B. Solid-state, programmable time control with 4 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.7 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Accuracy: Plus or minus 0.5 deg F (0.3 deg C at calibration point).
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 - 4. Averaging Elements in Ducts: 18 inches (460 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
 - 6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 7. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:
 - 1. Accuracy: Plus or minus 0.2 percent at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 - 4. Averaging Elements in Ducts: 18 inches (460 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
 - 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- D. Humidity Sensors: Bulk polymer sensor element.
 - 1. Accuracy: 5 percent full range with linear output.
 - 2. Room Sensor Range: 20 to 80 percent relative humidity.
 - 3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - 4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 - 5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F (0 to 50 deg C).

6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- E. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
 - d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

2.8 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.9 GAS DETECTION EQUIPMENT

- A. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F (0 to 40 deg C); with 2 factory-calibrated alarm levels at 50 and 100 ppm.
- B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting.
- C. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.10 THERMOSTATS

- A. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 - 5. Short-cycle protection.
 - 6. Programming based on weekday, Saturday, and Sunday.
 - 7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
 - 8. Battery replacement without program loss.
 - 9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
- C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.

2. Bulbs in air ducts with flanges and shields.
 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- E. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F (24 deg C) above normal maximum operating temperature, and the following:
1. Reset: Manual.
 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- F. Room thermostat accessories include the following:
1. Insulating Bases: For thermostats located on exterior walls.
 2. Adjusting Key: As required for calibration and cover screws.
 3. Set-Point Adjustment: 1/2-inch- (13-mm-) diameter, adjustment knob.
- G. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- H. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- I. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet (6 m).
 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- J. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet (6 m).
 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- K. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

2.11 HUMIDISTATS

- A. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.12 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. (49.6 kg-cm/sq. m) of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
 - e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
 3. Coupling: V-bolt and V-shaped, toothed cradle.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 6. Power Requirements (Two-Position Spring Return): 24-V ac.
 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 9. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
 10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
 11. Run Time: 12 seconds open, 5 seconds closed.

2.13 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system globe valves shall have the following characteristics:
 - 1. NPS 2 (DN 50) and Smaller: Class 250 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 - 2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 - 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 - 4. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 - 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- C. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 - 1. Body Style: Lug.
 - 2. Disc Type: Nickel-plated ductile iron.
 - 3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
- D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
 - 2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
 - 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
- E. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.

F. Advanced Water Meters

1. 1/2" to 2 1/2" Pipe

The flow sensor shall be an in line type with a nonmagnetic, spinning impeller (paddle wheel) as the only moving part. The electronics housing shall be glass filled PPS. The impeller shall be glass-filled nylon or Tefzel® with a UHMWPE or Tefzel sleeve bearing. The shaft material shall be tungsten carbide. The electronics housing shall have two ethylene-propylene O-Rings and shall be easily removed from the meter body. The sensor will have all electronics epoxy-sealed with a 2-conductor, shielded cable extending from the top of the sensor. The sensor shall operate in line pressures up to 400 psi and liquid temperatures up to 220° F, and operate in flows of 1/2 foot per second to 15 feet per second with linearity of ± 1% and repeatability of ± 1%. The meter body shall be cast 85-5-5 bronze, available in 1/2", 3/4", 1", 1 1/4", and 1 1/2" female iron pipe thread sizes. This flow sensor shall be Badger Model 250B.

2. 2" to 30" Pipe

The flow sensor shall be an insertion type with a nonmagnetic, spinning impeller (paddle wheel) as the only moving part. The sensor sleeve will be brass with the sensor housing being glass-filled PPS. The impeller shall be glass-filled nylon or Tefzel with a UHMWPE or Tefzel® sleeve bearing. The shaft material shall be tungsten carbide. The flow sensor shall be supplied with a 2" full bore gate valve in brass and a nipple threaded for a 2" NPT connection. A bleed valve and three ethylene-polypropylene O-Rings shall be supplied with the 2" NPT adapter portion of the sensor. A removable installation tool shall be attachable to the sensor for insertion or removal of the flow sensor from the pipe. The sensor will have all electronics epoxy-sealed with a 2-conductor, shielded cable extending out through a 1/2" conduit connection on the top of the sensor. Insertion of the sensor into any pipe size shall be a fixed 1 1/2" depth from the inside wall to the end of the sensor housing. The sensor shall operate in line pressures up to 200 psi and liquid temperatures up to 220° F, and operate in flows of 1 foot per second to 30 feet per second in pipes of 3" diameter up to 40" diameter with linearity of ± 1% and repeatability of ± 1%. This sensor shall be Badger Model 225. The detachable installation tool shall be Model HTT.

G. Advanced Electric Meter

- A. The Energy Meter shall consist of digital electronic circuitry.
- B. The Energy Meter shall conform to ANSI C12.1 metering accuracy standards.
- C. The Energy Meter system shall consist of a meter and included CT(s) calibrated together as a system.
- D. The Energy Meter's system accuracy shall be +/- 1% from 2 % to 100 % of the rated current over a temperature range of 0-50° C.
- E. The Energy Meter shall require no annual recalibration by users in the field.
- F. The Energy Meter shall derive operating power from its metering connections, and shall not require a separate control power connection.
- G. The Energy Meter electronics shall automatically correct for CT phase reversal.
- H. The Energy Meter CTs shall be factory assembled.
- I. The Energy Meter shall have a backlit LCD display measuring 1.2" X 3.8" that is direct read without the need for multipliers.
- J. The Energy Meter LCD display shall show accumulated kWh on the top half of the display while the bottom half of the display scrolls through Amps, Voltage, PF, KVAR, KVA, KW Real Power, as stated in point Q below.
- K. The Energy Meter shall meet UL and cUL specifications as listed in 3111-1.
- L. The Energy Meter shall directly accept any voltage input from 120-480 VAC.
- M. The Energy Meter shall be internally isolated to 2500 VAC.
- N. The Energy Meter series shall have models available for amperage ranges of 100-2400 Amps.

- O. The Energy Meter shall have a N.O. pulse output with selectable pulse output rates of 0.10, 0.25, 0.50, or 1.00 kWh per pulse.
- P. The Energy Meter shall have a N.C. phase-loss alarm output operating at 100mA @ 24VAC/DC.
- Q. Using the optional Communications Board, the Energy Meter shall be networkable via an RS485 connection to a BACNet MS/TP network.
- R. The information and capabilities provided by the Energy Meter shall include the following:
 - a. Current, per phase & three-phase total
 - b. Voltage, per phase & three-phase total, phase-to-phase & phase-neutral
 - c. Real Power (kW), per phase & three-phase total
 - d. Reactive Power (kVAR), three phase total
 - e. Apparent Power (kVA), three phase total
 - f. Power Factor, per-phase & three-phase total
 - g. Real Energy (kWh), three phase total
- S. The Energy Meter shall be Model PM820 by Schneider Electric. The PM820 will receive pulse input from advanced gas and water meters and in turn will temporarily store all interval data and then transmit data over the MSARNG Network to a centralized Metering Data Management System (MDMS). The MDMS is a secured headend server that will receive interval metering data from all MSARNG sites. A software package residing on the MDMS will store, analyze, and report advanced metering data on a statewide basis. The MDMS is not part of this construction project.

H. Advanced Gas Meters

Gas meter shall have Thermal Gas Mass Flowmeter and Temperature Transmitter. The meter shall measure gas flow rate in standard units without the need for temperature or pressure compensation. It shall provide isolated 4 to 20 mA and pulse outputs for flow rate and a 4 to 20 mA output for process gas temperature. User shall choose the flow rate and temperature engineering units. An optional on-board 2 x 16 characters, backlit display is available to view flow rate, total, elapse time, process gas temperature, and alarms. The display shall also be used in conjunction with the Configuration Panel to configure flowmeter settings such as 4 mA and 20 mA for flow rate and temperature, pulse output frequency scaling, pipe area, zero flow cutoff, filtering (dampening), display configurations, diagnostics and high or low alarm limits. The meter shall be available in insertion and in-line models. The insertion meter is easily installed by drilling a 3/4" hole in the pipe and welding on a 3/4" NPT coupling. A compressing fitting secures the probe in place. The in-line model shall be available in 1/4-inch to 6-inch sizes and include built in flow conditioners that eliminate the need for long, straight pipe runs. The meter can be ordered with flange or NPT end connections. Both models are supplied with 316 stainless steel wetted materials standard or Hastelloy C-276 as an option. Common Gases: Air, ammonia, argon, biogas, butane, chlorine, compressed air, carbon monoxide, carbon dioxide, digester gas, ethane, ethylene, helium, hydrogen, methane, mixed gases, natural gas, nitrogen, oxygen, propane, and many more. Device shall be The Fox Model FT2 or equal.

2.14 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
 - 1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.15 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches (1530 mm) above the floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- B. Install guards on thermostats in the following locations:
 1. Entrances.
 2. Public areas.
 3. Where indicated.
- C. Install automatic dampers according to Section 233300 "Air Duct Accessories."
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- F. Install hydronic instrument wells, valves, and other accessories according to Section 232113 "Hydronic Piping."
- G. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."
- H. Install duct volume-control dampers according to Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- I. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 6. Check temperature instruments and material and length of sensing elements.
 7. Check control valves. Verify that they are in correct direction.
 8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."

PART 4: SEQUENCE OF OPERATION

4.1 Sequence of Operation – 100% OA (OAHU)

A. Building Automation System Interface

The Building Automation System (BAS) shall send the factory mounted BACNet MSTP controller an Occupied and or Unoccupied command. The BAS shall monitor the points from the factory mounted controls indicated in the points list. If communication is lost with the BAS, the controller shall operate based on last command. All programming described in this sequence shall be setup and tested by the equipment manufacturer. A unit graphic shall be provided.

B. Occupied

During occupied periods, the supply fan shall run continuously, and the outside air damper shall open fully before the fan starts. All exhaust fans to be commanded on.

When the outdoor air dry-bulb temperature is greater than 52.0 deg. F, the unit DX factory mounted controls shall modulate to maintain the cooling coil discharge air temperature at 52.0 deg. F and the unit factory mounted modulating hot gas reheat controls shall raise unit discharge air temperature to 70.0 deg. F.

When the outdoor air dry-bulb temperature is between 48 and 52.0 deg. F, unit cooling and heating shall be disabled.

When the outdoor air dry-bulb temperature is less than 48.0 deg. F, the unit factory mounted modulated gas heating controls shall modulate to maintain unit discharge air temperature to 75.0 deg. F.

C. Occupied Heat/Cool Mode

If space temperature at common area sensor on 1st, 2nd, or 3rd floors increases above unoccupied setpoint of 88.0 deg. F (adj.), the supply fan shall start, the outside air damper shall open, the unit DX factory mounted controls shall modulate to maintain the cooling coil discharge air temperature at 55.0 deg. F (adj.). Mode shall terminate when unoccupied cooling is no longer requested by the BAS.

If space temperature at common area sensor on 1st, 2nd, or 3rd floors falls below unoccupied setpoint of 45.0 deg. F (adj.), the supply fan shall start, the outside air damper shall open, the unit factory mounted gas heating controls shall modulate to maintain the unit discharge air temperature at 95.0 deg. F (adj.). Mode shall terminate when unoccupied heating is no longer requested by the BAS.

D. Occupied Humidity Control

If humidity level at sensor on 1st, 2nd, or 3rd floors increases above occupied setpoint of 60% RH (adj), an alarm shall be generated.

E. Unoccupied

During unoccupied periods, the supply fan shall be disabled, the outside air damper shall close, cooling shall be disabled, and heating shall be disabled. All exhaust fans shall be commanded off.

F. Unoccupied Heat/Cool Mode

If space temperature at common area sensor on 1st, 2nd, or 3rd floors increases above unoccupied setpoint of 88.0 deg. F (adj.), the supply fan shall start, the outside air damper shall open, the unit DX factory mounted controls shall modulate to maintain the cooling coil discharge air temperature at 55.0 deg. F (adj.). Mode shall terminate when unoccupied cooling is no longer requested by the BAS.

If space temperature at common area sensor on 1st, 2nd, or 3rd floors falls below unoccupied setpoint of 45.0 deg. F (adj.), the supply fan shall start, the outside air damper shall open, the unit factory mounted gas heating controls shall modulate to maintain the unit discharge air temperature at 95.0 deg. F (adj.). Mode shall terminate when unoccupied heating is no longer requested by the BAS.

G. Unoccupied Humidity Control

If humidity level at sensor on 1st, 2nd, or 3rd floors increases above unoccupied setpoint of 65% RH (adj), the supply fan shall start, the outside air damper shall open, the unit DX factory mounted controls shall modulate to maintain the cooling coil discharge air temperature at 51.0 deg. F (adj.), and the modulating hot gas reheat shall modulate to maintain the unit discharge air temperature at 55.0 deg. F (adj.). Mode shall terminate when dehumidification is no longer requested by the BAS.

4.2 VRF System Integration

- A. The building FMS shall communicate with the VRF system through BACnet communication. VRF controller to be provided with BACnet communication card.
- B. VRF controllers shall be enabled or disabled by signal from BAS schedule. Units will maintain space temperature with sensors and VRF controllers. Provide BACnet control from VRF controllers to BAS front end.

4.3 Exhaust Fans

- A. Exhaust fans shall be commanded on or off by the BMS schedule.

END OF SECTION

SECTION 238129

VARIABLE REFRIGERANT FLOW – MULTI-INDOOR UNITS

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system or equal.

The variable refrigerant HVAC system shall consist of an outdoor unit, Branch Controller, multiple indoor units, and Direct Digital Controls. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.

1.02 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
- E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendation.

1.04 CONTROLS

- A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- B. System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.

- C. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
- D. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
- E. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.
- F. System shall be capable of email generation for remote alarm annunciation.
- G. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in Mitsubishi Electric controls system configuration and operation. The representative shall provide proof of certification for Mitsubishi Electric Controls Applications Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

PART 2 – WARRANTY

- 2.01** The units shall be covered by the manufacturer's limited warranty for a period of five (5) years for parts and labor and five (5) years compressor parts and labor warranty to the original owner from date of substantial completion.
- 2.02** Manufacturer shall have a minimum of ten (10) years of HVAC experience in the U.S. market.
- 2.03** All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.

2.04 INSTALLATION

- A. The VRF HVAC system and controls shall be installed by a licensed mechanical contractor that has been factory trained and certified by the VRF equipment manufacturer. Contractor must have a minimum of five years of documented experience installing VRF systems.
- B. A person who received factory training and is certified by the manufacturer of the VRF system must be on site at all times during installation of the VRF system.
- C. Evidence of manufacturer's training and certification of the installer(s) is required and must be provided as part of the submittal documents.
- D. Installed system is to be inspected by equipment manufacturer's representative prior to start-up.

PART 3 – PRODUCTS

3.01 R2-SERIES OUTDOOR UNIT

A. General:

The outdoor units shall be equipped with multiple circuit boards that interface to the DDC controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

1. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s).
2. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 64 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
3. Both refrigerant lines from the outdoor unit to the Branch Controller shall be insulated in accordance with the installation manual.
4. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
5. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
6. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
7. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
8. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperatures or cooling mode down to 23°F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
9. The outdoor unit shall be capable of operating in cooling mode down to -10°F with optional manufacturer supplied low ambient kit.
10. Manufacturer supplied low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.
11. Manufacturer supplied low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
12. Manufacturer supplied low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

13. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
14. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.
15. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.

B. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

C. Fan:

1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

D. Refrigerant

1. R410A refrigerant shall be required for outdoor unit systems.
2. Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

E. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

F. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

G. Controls:

1. The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system

H. Electrical:

1. The outdoor unit electrical power shall be 208 volts, 3-phase, 60 hertz or as scheduled.
2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

I. Electrical:

1. The outdoor unit electrical power shall be 208 volts, 3-phase, 60 hertz.
2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 414-506 volts.
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

3.02 BRANCH CIRCUIT (BC) CONTROLLERS FOR R2-SERIES SYSTEMS

A. General

The Branch Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.

The Branch Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of rated capacity. The Controller shall be suitable for use in plenums in accordance with UL1995 ed 4.

B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.
2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers.

C. Refrigerant

1. R410A refrigerant shall be required.

D. Refrigerant Branches

1. All BC Controller refrigerant pipe connections shall be brazed or flared.

E. Refrigerant valves:

1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
2. Each branch shall have multiple two-position valves to control refrigerant flow.
3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

F. Future Use

1. Each VRF system shall include at least two (2) unused branches or branch devices for future use. Branches shall be fully installed & wired in central location with capped service shutoff valve & service port.

G. Integral Drain Pan:

1. An Integral resin drain pan and drain shall be provided

H. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
3. The Controller shall be controlled by integral microprocessors
4. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

3.03 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNIT

A. General

1. The four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be space-saving ceiling-recessed cassette.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Branch ducting shall be allowed from cabinet.
4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space.
6. Provide multi-function casement to receive a high efficiency filter.

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.

6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
 7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
- D. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.

Filter:

A. General

- A.1 Air filters shall be high efficiency MERV 9 ASHRAE panel filter consisting of dual layered polyester media, a crossed wire grid, spot welded on one inch centers, and a 28 point high wet-strength beverage board enclosing frame.
- A.2 Sizes shall be noted on drawings or other supporting materials.
- A.3 Contractor shall provide two (2) sets of filters at substantial completion. One set in the equipment and one (1) replacement set of filters.

B. Construction

- B.1 Filter media shall be a dual layered polyester media, lofted to a uniform depth of 0.11", and formed into a uniform radial pleat
- B.2 A welded wire grid, spot-welded on centers and treated for corrosion resistance, shall be bonded to the downstream side of the media to maintain the radial pleat and prevent media oscillation.
- B.3 An enclosing frame, of a 28 point high wet-strength beverage board that is bonded to the media shall provide a rigid and durable enclosure.
- B.4 Filters shall be made into high capacity pleat densities of 16 pleats per linear foot, 15 and 11 for 1", 2" and 4" depths respectively.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
7. Both refrigerant lines to the indoor units shall be insulated in accordance with the installation manual.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. This unit shall use controls provided by the equipment manufacturer to perform functions necessary to operate the system.
2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

3.04 CEILING-CONCEALED DUCTED INDOOR UNIT

A. General:

The ceiling-concealed ducted indoor fan coil design that mounts above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The unit shall be used with the outdoor unit and Branch Controller. The units shall support individual control using DDC controllers. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

B. Indoor Unit.

The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The unit shall be, ceiling-concealed, ducted.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

D. Fan:

1. Units shall feature external static pressure settings from 0.14 to 0.60 in. WG.
2. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.

3. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
4. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function
5. The indoor unit shall have a ducted air outlet system and ducted return air system.

E. Filter:

A. General

- A.1 Air filters shall be high efficiency MERV 9 ASHRAE panel filter consisting of dual layered polyester media, a crossed wire grid, spot welded on one inch centers, and a 28 point high wet-strength beverage board enclosing frame.
- A.2 Sizes shall be noted on drawings or other supporting materials.
- A.3 Contractor shall provide two (2) sets of filters at substantial completion. One set in the equipment and one (1) replacement set of filters.

B. Construction

- B.1 Filter media shall be a dual layered polyester media, lofted to a uniform depth of 0.11", and formed into a uniform radial pleat
- B.2 A welded wire grid, spot-welded on centers and treated for corrosion resistance, shall be bonded to the downstream side of the media to maintain the radial pleat and prevent media oscillation.
- B.3 An enclosing frame, of a 28 point high wet-strength beverage board that is bonded to the media shall provide a rigid and durable enclosure.
- B.4 Filters shall be made into high capacity pleat densities of 16 pleats per linear foot, 15 and 11 for 1", 2" and 4" depths respectively.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The condensate shall be gravity drained from the fan coil.
7. Both refrigerant lines to the indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls:

1. This unit shall use controls provided by the equipment manufacturer to perform functions necessary to operate the system. Please refer to Part 5 of this guide specification for details on controllers and other control options.
2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

PART 4 – CONTROLS

4.01 OVERVIEW

A. General:

The Controls Network (CN) shall be capable of supporting remote controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet®.

4.02 ELECTRICAL CHARACTERISTICS

A. General:

The CMCN shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.

B. Wiring:

1. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the Branch controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
2. Control wiring for the Simple MA remote controllers shall be from the remote controller (receiver) to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration.
3. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.
4. The centralized controller shall be capable of being networked with other centralized controllers for centralized control.

C. Wiring type:

1. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire.
2. Network wiring shall be CAT-5 with RJ-45 connection.

4.03 CONTROLS NETWORK

The Controls Network (CN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using BACnet® interface.

A. CN: Remote Controllers Remote Controller

The Backlit Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). The Remote Controller shall be compact in size, approximately 3" x 5" and have limited user functionality. The Controller supports temperature display selection of Fahrenheit or Celsius. The Remote Controller shall allow the user to change on/off, mode (cool, heat, auto), dry, setback and fan), temperature setting, and fan speed setting and airflow direction. The Remote Controller shall be able to limit the set temperature range. The Remote controller shall be capable of night setback control with upper and lower set temperature settings. The room temperature shall be sensed at either the Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Remote Controller shall display a four-digit error code in the event of system abnormality/error.

The Remote Controller shall require no addressing. The Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The Controller shall require cross-over wiring for grouping across indoor units.

Remote Controller			
Item	Description	Operation	Display
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. A separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group

Remote Controller			
Item	Description	Operation	Display
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. The display for test run mode will be the same as for normal start/stop (does not display "test run").	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group

4.04 INPUT/OUTPUT (I/O) BOARDS

A. Advanced HVAC Controller (AHC)

The AHC shall be capable of providing programmable binary and analog inputs and outputs to control general equipment in conjunction with indoor unit functions and states. Input and output states and values shall be monitored through the Remote controller. The remote controller shall be able to adjust temperature and humidity set points for equipment controlled by the AHC. In addition to analog and binary inputs the AHC can monitor M-NET equipment states and sensor values. Available inputs include room temperature, room humidity, occupancy, brightness, outdoor temperature, inlet/outlet water temperature, on/off state, mode, ventilation on/off, error status. In addition to programmable analog and binary outputs, the AHC can control indoor unit on/off, mode, temperature set point, fan speed, on/off and fan speed.

B. Digital Input Digital Output (DIDO) Board

The DIDO board shall be capable of providing On/Off control for non-Mitsubishi Electric equipment via the Centralized Controller's licensed web browser functions, the touch screen of the Centralized Controller, the interlock function of the software. Each DIDO board shall have two digital inputs and two digital outputs. Each digital output shall be capable of supporting an independent schedule via the Centralized Controller's web browser functions and the software. Status indication of the On/Off state of the non-Mitsubishi Electric equipment shall be either via the On/Off status of the digital output or by receipt of a digital input to the DIDO board.

The DIDO board shall be capable of receiving a digital input for interlock settings with the indoor units or digital outputs on the DIDO board. Based on the digital input status the DIDO board shall be capable of setting the following parameter on the indoor unit On/Off, Mode, and Set Temperature to predefined settings. The DIDO board shall also be capable of interlocking the On/Off state of a digital output on the DIDO board based on an onboard channel digital input status or a free contact input status from system indoor units.

C. Analog Input (AI) Board

The AI board shall be capable of monitoring temperature or humidity via the Centralized Controller's web browser functions and the software. Each AI board shall have two analog inputs. Each input shall be capable of receiving a 4/20mA, 0/10 VDC, or 1/5 VDC signal for monitoring temperature or humidity. The AI board shall be capable of monitoring the temperature or humidity input and shall be capable of displaying graphical trending of the temperature or humidity values via the Centralized Controller's web browser functions and the software. Notification of user adjustable high and low level alarms shall be capable of being emailed to distribution list or outputted via a digital output.

The AI board shall be capable of setting the following parameters on the indoor unit On/Off, Mode, and Set Temperature to predefined settings based on the input value of the temperature or humidity. The AI board shall also be capable of interlocking the On/Off state of a digital output on the input value of the temperature or humidity.

4.05 CENTRALIZED CONTROLLER (WEB-ENABLED)

A. Centralized Controller

The Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple outdoor units with the use of three (3) AE-50A expansion controllers. The Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto), dry, setback (and fan),

temperature setting, fan speed setting, and airflow direction setting. Since the provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Centralized Controller			
Item	Description	Operation	Display
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group

Centralized Controller			
Item	Description	Operation	Display
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *1. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can be scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU

Centralized Controller			
Item	Description	Operation	Display
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.	Each Group	Each Group
Multiple Language	English	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: “Batch start/stop”, “Batch emergency stop” By pulse: “batch start/stop”, “Enable/disable remote controller” Output: “start/stop”, “error/Normal” *5.	*5 Collective	*5 Collective

All Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three AE-50A expansion controllers for display of up to two hundred (200) indoor units on the main interface.

The Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

Standard software functions shall be available so that the building manager can securely log into each via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Tenant Billing shall be available but are not included. The Tenant Billing function shall require Integrated System software in conjunction with the Centralized Controllers.

B. Controller Expansion

The Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface. Up to three (3) expansion controllers can be connected to the via a local IP network (and their IP addresses assigned on the) to allow for up to two hundred (200) indoor units to be monitored and controlled from the interface.

The expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected and configured to display their units on the main controller, the individual indoor units connected can still be monitored and controlled from the interface. The last command entered will take precedence, whether at the wall controller, the Centralized Controller.

4.06 CENTRAL CONTROLLER (NON-WEB)

A. Touch Controller

The Touch Controller features a 5 inch wide color LCD touch panel. The settings for air conditioning units can be changed by touching the corresponding icons on the display. There are 3 buttons on the panel; ON/OFF, SET BACK and HOLD enabling simple and quick batch operation. One controller can control up to 24 groups/units of air conditioners. Operation status is displayed on easy-to-read LCD. The group currently operating can be seen at a glance with the operation status display. The controller can perform functions such as ON/OFF, Operation mode changeover, temperature setting and prohibit operation by local remote controller. Up to 12 patterns of weekly schedule can be set. "ON/OFF", "Operation mode", "Set Temperature", "Fan speed", "Air flow direction" and "Permit / Prohibit local operation" can be scheduled with up to 16 settings in one pattern. Up to 5 patterns of today's schedule can be set. Independent operation is possible. Automatic ventilation, Normal ventilation and Ventilation with heat exchanger can be switched from the system controller. The controller is equipped with a system changeover function which an operation mode can be switched to an optimal mode depending on indoor temperature setting and target temperature of each group or a representative indoor unit.

Touch Controller			
Item	Description	Operation	Display
ON/OFF	ON and OFF operation for the air conditioner units. Even when only a single indoor unit connected to the group remote controller will operate and collective ON/OFF lamp will light up.	Group or Collective	Group or Collective
Operation Mode Switching	Switches between Cool / Dry / Auto / Fan / Heat / Setback. Operation modes vary depending on the air conditioner unit.	Group or Collective	Group or Collective
Temperature Setting	Set temperature from 57° F - 87° F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.	Group or Collective	Group or Collective
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Group or Collective	Group or Collective

Touch Controller			
Item	Description	Operation	Display
Air Flow Direction Setting	Air flow direction angles 4-angle or 5-angle, Swing, Auto Louver ON/OFF * Air flow direction settings vary depending on the indoor unit model.	Group or Collective	Group or Collective
Hold	Hold Prohibits the scheduled operation from being executed. a. ON/OFF timer b. Auto-OFF timer c. Weekly timer d. Automatic return to the preset temperature * While an operation is prohibited by Hold function, the operation icon lights up.	Group or Collective	Group or Collective
Permit / Prohibit	When set as the master, the ON/OFF, operation mode, setting temperature and filter sign reset operations using the local remote controllers can be prohibited. Only ON/OFF and filter reset can be prohibited for the group.	Group or Collective	Group or Collective
Operation Lock	(ON/OFF, operation mode, setting temperature, fan speed, Air flow direction)	Group or Collective	Group or Collective
Room Temp Display	The room temperature can be displayed.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed. * When an error occurs, the "ON/OFF" LED flashes. The operation monitor screen show abnormal icon over the unit. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection.	N/A	Each Unit, Group, or Collective
Schedule Operation	Weekly schedule setting up to 12 patterns is available. In one pattern, up to 16 setting of "ON/OFF", "Operation mode", "Set Temperature", "Fan speed", "Air flow direction" and "Permit / Prohibit local operation" can be scheduled. Today's schedule setting up to 5 pattern in available. *Time setting unit: 5 minute /unit	Each Group	Each Group
Ventilation Operation (Independent)	Group operation of only the free plan is possible. The operation mode of these groups is automatic ventilation, ventilation with heat exchanger and normal ventilation.	Group or Collective	Group or Collective

Touch Controller			
Item	Description	Operation	Display
Ventilation Operation (Interlocked)	The controller will run in interlock with the operation of indoor unit. The mode cannot be changed. The LED will turn ON during operation after interlocking.	Group or Collective	Group or Collective
Set Temperature Range Limit	Room Temperature setting can be limited by the initial setting. The lowest limit temperature can be made higher than the usual (67°F) in cool/dry mode, while the upper limit temperature lower than the usual (83°F) in heat mode.	Group or Collective	Group or Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: "Batch start/stop", "Batch emergency stop" By pulse: "Batch start/stop", "Enable/disable remote controller" Output: "Start/Stop", "Error/Normal"	*5 Collective	*5 Collective

4.07 GRAPHICAL USER WORKSTATION SOFTWARE

The Graphical User Workstation Software shall require a field supplied PC.

A. Software

The Integrated System Software shall enable the user to control multiple centralized controllers and shall provide additional functions such as tenant billing from a single, dedicated network PC configured with the software. The configured computer shall be capable of controlling up to forty Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The software shall be required if the user wants to simultaneously control more than 1 Centralized Controllers from a single PC using a single software session. Licensing per function, per Centralized Controller shall be required for the software.

Integrated System Software	
Item	Details
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model.

Integrated System Software	
Item	Details
	Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)
Interlocked Unit ON/OFF	If there is an interlocked unit, then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)
Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportionment Charging	A RS-485 watt-hour meter (WHM) is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Two charging rates can be applied per day. ***OPTIONAL TENANT BILLING SOFTWARE (SW-CHARGE) REQUIRED
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the TG-2000 and is limited to some limited operation items.)
Operation Time Monitor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display Mask	The filter sign display at the remote controllers can be disabled.

Integrated System Software	
Item	Details
Set Temperature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

4.08 CMCN: SYSTEM INTEGRATION

The CMCN shall be capable of supporting integration with Building Management Systems (BMS).

A. BACnet® Interface

- 4.09 The BACnet® interface shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2004) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address. Power Supply

The power supply shall supply 24VDC (TB3) for the centralized controller and 30VDC (TB2) voltage for the central control transmission.

PART 1 GENERAL

1.1 MECHANICAL GENERAL PROVISIONS

- A. This contractor shall conform to the General and Supplementary Conditions Provisions under Division 1 of the Specifications.
- B. This contractor shall conform to the Specifications Section 23 05 00: Mechanical General Provisions.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Supplied But Not Installed Under This Section:
 1. Control valves.
 2. Flow switches.
 3. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
 4. Automatic control dampers, where not supplied with equipment.
 5. Airflow measuring stations.
 6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
 7. Variable Frequency Drives. (This does not include VFDs integral to machinery such as chillers or boilers)

- B. Products Installed But Not Supplied Under This Section:
 - 1. None.
- C. Products Not Furnished or Installed But Integrated with the Work of This Section:
 - 1. Chiller Control Systems.
 - 2. Boiler Control Systems.
 - 3. Pump Control Packages.
 - 4. In-line Meters (gas, water, power).
 - 5. Refrigerant Monitors.
 - 6. Chemical Water Treatment.
 - 7. Smoke Detectors (through alarm relay contacts).
- D. Work Required Under Division 16 Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 SUMMARY

- A. The Facility Management and Control System (FMCS) shall be comprised of System Network Controller or Controllers (SNC) within each facility. The SNC shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each SNC shall communicate to Mitsubishi Electric Central Controllers, LonMark/LonTalk (IDC) and/or BACnet (IBC) controllers, and other open and legacy protocol systems/devices provided under Division 23.
- B. The Facility Management and Control System (FMCS) as provided in this Division shall be based on the Niagara Framework (or "Niagara"), a Java-based framework developed by Tridium. Niagara provides an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time over the Internet using a standard Web browser. Systems not developed on the Niagara Framework platform are unacceptable.
- C. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate with the Mitsubishi Electric Diamond Controller.
 - 1. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet, and Modbus.
 - 2. System architecture shall provide secure Web access using MS Internet Explorer from any computer on the owner's LAN.
 - 3. Any control vendor that must provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara AX™ Framework shall satisfy the requirements of this section.

4. The BMS server shall host all graphic files for the control system.

D. Approved Manufacturers: Mitsubishi Electric Heating and Cooling

1.4 AGENCY AND CODE APPROVALS

- A. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
 1. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices
 2. FCC, Part 15, Subpart J, Class A Computing Devices
 3. UL 504 - Industrial Control Equipment
 4. UL 506 - Specialty Transformers
 5. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces
 6. UL 916 - Energy Management Systems All
 7. UL 1449 – Transient Voltage Suppression
 8. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts
 9. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange
 10. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices
 11. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits
 12. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems
 - a. NEMA 250 - Enclosures for Electrical Equipment
 13. NEMA ICS 1 - Industrial Controls and Systems
 14. NEMA ST 1 - Specialty Transformers
 15. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.

1.5 SOFTWARE OWNERSHIP

- A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.7 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.8 QUALITY ASSURANCE

- A. The manufacturer of the BMS digital controllers shall, if requested, provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing).
- B. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

PART 2 MATERIALS

2.1 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming, and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing various communication protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system.
- C. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the existing Operating System Server currently located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.
- D. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 BAS SERVER HARDWARE

- A. Minimum Computer Configuration (Hardware Independent)
 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
 2. 2 GHz, P4 or higher CPU – Dual Processor
 3. 2 Gb of RAM minimum.
 4. 80 gigabyte hard disk, SVGA Card with 1024 x 768, 24-bit True Color, Back-up system 24X CD Rom Drive, 19" Flat Screen Color Monitor, Keyboard and mouse
 5. Operating system for the server shall be Microsoft Windows XP, 7 or RedHat Linux 6.0.
 6. Internet Explorer 8.0 or later
 7. 10/100Base-T Ethernet Port
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (8.0 or later) running on Microsoft 98, 2000, NT, XP, or 7. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.4 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC), and advanced unitary controllers (AUC), and central controllers (CC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers must be fully programmable to meet the unique requirements of the facility it must control.
- C. The controllers must be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara AX, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall be capable of executing application control programs to provide:
 1. Calendar functions

2. Scheduling
 3. Trending
 4. Alarm monitoring and routing
 5. Time synchronization
 6. Integration of LonWorks, BACnet, and ModBus controller data
 7. Network management functions for all SNC, PEC and ASC based devices
- F. The SNC must provide the following hardware features as a minimum:
1. One Ethernet Port-10/100 Mdps
 2. One RS-232/485 port
 3. Battery Backup
 4. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 5. Direct network communication to VRF equipment using VRF manufacturer's native network communication structure. Translation to an additional protocol or language is not acceptable.
- G. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- H. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- I. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm,
 - b. Return to normal,
 - c. To default.
 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text,
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date
 - b. Equipment (air handler #, auditorium, etc.)
 - c. Acknowledge time, date, and user who issued acknowledgement.
- J. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

2.5 CENTRAL CONTROLLER (CC)

- A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- B. System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.
- C. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
- D. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
- E. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.
- F. System shall be capable of email generation for remote alarm annunciation.
- G. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in Mitsubishi Electric controls system configuration and operation. The representative shall provide proof of certification for Mitsubishi Electric CMCN Essentials Training and/or CMCN Hands-On Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

PART 3 BAS SERVER & WEB BROWSER GUI

3.1 SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP/IP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support Microsoft and Netscape Navigator browsers (6.0 or later versions), and Windows as well as non-Windows operating systems. No special software, other than free public domain programs such as "JAVA VIRTUAL MACHINE" shall be required to be installed on PC's used to access the BAS via a web browser.

- C. The BAS server software must support at least the following server platforms (Windows, and/or Linux). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and must offer and be configured with the following features as a minimum:
1. Trending
 2. Scheduling
 3. Electrical demand limiting
 4. Duty Cycling
 5. Downloading Memory to field devices
 6. Real time 'live' Graphic Programs
 7. Tree Navigation
 8. Parameter change of properties
 9. Setpoint Adjustments
 10. Alarm / Event information
 11. Configuration of operators
 12. Execution of global commands
 13. Add, delete, and modify graphics and displayed data
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project .BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface
 2. System Configuration Utilities for future modifications to the system, and controllers.
 3. Graphical Programming Tools
 4. Direct Digital Control software
 5. Application Software
 6. Any required third party software
 7. If licensing credits are required provide a minimum of 10% additional to as built control system requires.
- F. BAS Server Database: The BAS server software shall utilize a Java DataBase Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Database Open Connectivity: The BAS server database shall allow real time access of data via the following standard mechanisms:
1. Open protocol standard like SOAP
 2. OLE/OPC (for Microsoft Client's/Server platform only)
 3. Import/Export of the database from or to XML (eXtensible Mark-up Language)
- H. Communication Protocol(s): The native protocol for the BAS server software shall be TCP/IP over Ethernet.

- I. Thin Client – Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
 - 1. Web Browser's for PC's: Only a 5.5 or later browser (Explorer/Navigator) will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 - 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

3.2 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on or by selecting dynamic links to other system graphics. Both the navigation and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the corresponding graphic. The navigation shall as a minimum provide the following views: Geographic, Principal Systems, Users, Trends and Alarms.
 - 1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
- D. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
 - 1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color 3D building floor-plans, equipment drawings, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh.
 - 2. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, Setback, Alarm Settings, Set Temperature Range Limits, Schedule options, Equipment error codes, Wall Controller lock outs, and any other valid data required for setup.
 - 3. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy or site specific schedules.
 - 4. Alarms: Shall be used to view alarm information, acknowledge alarms, sort alarms by category, actions and verify reporting actions.

5. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated .gifs or .jpg, vector scalable, active setpoint graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in 1900 by 1200 pixels 24 bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective setpoints. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit
 - b. Each building
 - c. Each floor and zone controlled
- F. Hierarchical Schedules: Utilizing the Navigation page displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation page. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation page shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the following features:
 - a. Types of schedule shall be Normal, Holiday or Override
 - b. A specific date,
 - c. A range of dates,
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any)
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the

operator shall be able to define an 'individual tenant' group – who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'

4. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).

G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Alarms' view.

Alarms, and reporting actions shall have the following capabilities:

1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report, and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
2. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
3. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
4. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement, and total number of Alarms in the BAS Server database.
5. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
6. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
 - d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.

- H. Trends: Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 7. Copy/Paste. The operator must have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Password. Access to different areas of the BAS system shall be defined in terms of Roles, Privileges and geographic area of responsibility as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print, and Alarm/Event Maintenance.
 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

3.3 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and

drop method of graphical icon programming shall not be accepted. All systems shall use a GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors, etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence must be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming must be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 - 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 - 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 - 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 - 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 - 5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 - 6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
 - 7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
 - 8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
 - 9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.

10. Live Graphical Programs: The Graphic Programming software must support a 'live' mode, where all input/output data, calculated data, and setpoints shall be displayed in a 'live' real-time mode.

PART 4 INSTALLATION

4.1 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

4.2 WIRING

- A. All electrical control wiring = to the control panels shall be the responsibility of the Installing Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.

PART 5 PROJECT CLOSEOUT

5.1 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

5.2 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide comprehensive training for system orientation, product maintenance and troubleshooting, programming and engineering, if not provided under a previous contract at the site using the same brand and type of controllers within the previous 3 years.
- C. The Control System Contractor shall provide instruction to the owner's designated personnel on the operation of the BMS and describe its intended use with respect to the programmed functions specified. Operator orientation of the BMS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation

5.3 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Installing Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Installing Contractor shall maintain all *software during the warranty period*. In addition, all factory or sub-vendor upgrades to software shall be added to the systems, when they become available, at no additional cost. New products are not considered upgrades in this context.
- D. Maintenance of Control Hardware: The Installing Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Installing Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all software is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

5.4 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
 - 1. As-built control drawings for all equipment.
 - 2. As-built Network Communications Diagram.
 - 3. General description and specifications for all components.
 - 4. Completed Performance Verification sheets.

5. Completed Controller Checkout/Calibration Sheets.

END OF SECTION