US Army Corps
of Engineers
Huntsville Center

MODULAR STORAGE MAGAZINE, BOX-TYPE STD 421-80-07 WITH 10'-8" DOOR (REVISION 1)

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	Removed Hasps, Modified ILD Door Details, Implemented Lessons Learned, Electrical Updates	JAN. 2024

DESIGNED BY: J. UMPHREY
DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: TES MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND
SUPPORT CENTER,
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

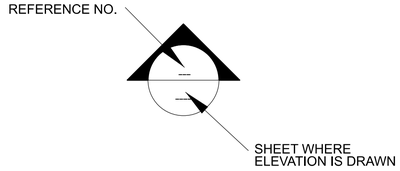
COVER SHEET

SHEET ID
G-001

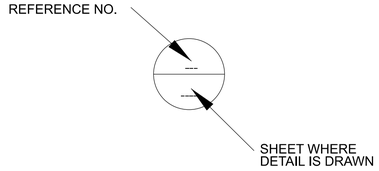
Sheet 1 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

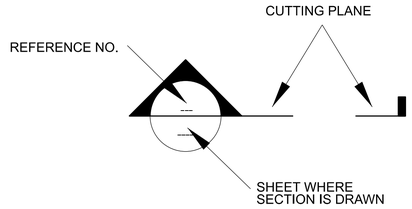
DRAWING SYMBOLS



ELEVATION REFERENCE



DETAIL REFERENCE



SECTION CUT

GENERAL ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR
ALUM	ALUMINUM
APPROX	APPROXIMATELY
BLDG	BUILDING
BOTT	BOTTOM
BRG	BEARING
CIP	CAST-IN-PLACE
CJ	CONTROL JOINT
CL	CENTER LINE
CMU	CONCRETE MASONRY UNIT
CP	CENTER POINT
COL	COLUMN
COORD	COORDINATE
CONC	CONCRETE
CONT	CONTINUE, CONTINUOUS
DIA	DIAMETER
DIAG	DIAGONAL
DIM	DIMENSION
EA	EACH
ELEV	ELEVATION
EF	EACH FACE
EJ	EXPANSION JOINT
EQ	EQUAL
E.W.	EACH WAY
(E) OR EXIST	EXISTING
EXT	EXTERIOR
FTG	FOOTING
FV	FIELD VERIFY
GALV	GALVANIZED
HD	HEADED
HT	HEIGHT
INT	INTERIOR
ID	INSIDE DIAMETER
LLH	LONG-LEG HORIZONTAL
LLV	LONG-LEG VERTICAL
MIN	MINIMUM
MANF	MANUFACTURER
NTS	NOT TO SCALE
O.C.	ON CENTER
OD	OUTSIDE DIAMETER
OH	OPPOSITE HAND
R	RADIUS
REINF	REINFORCEMENT
REQ'D	REQUIRED
SF	SQUARE FEET
SHT	SHEET
SIM	SIMILAR
SOG	SLAB-ON-GRADE
STIFF	STIFFENER
TYP	TYPICAL
UNO	UNLESS OTHERWISE NOTED
VIF	VERIFY IN FIELD
WWF	WELDED WIRE FABRIC
WWR	WELDED WIRE REINFORCEMENT
W/	WITH
WP	WORKING POINT

DRAWING INDEX

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	S-102	6	ROOF FRAMING PLAN	
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	E-201-A	24	GROUNDING AND LIGHTNING PROTECTION DETAILS	SHEET ADDED
	E-202-A	25	GROUNDING AND BONDING DETAILS	SHEET ADDED
	E-301-A	26	ROLLING SPHERE METHOD ANALYSIS	SHEET ADDED

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INDEX, SYMBOLS, & ABBREVIATIONS

SHEET ID
G-002
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STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

1.0 DESIGN CRITERIA:

A. BUILDING CODES AND SPECIFICATIONS:

1. INTERNATIONAL BUILDING CODE 2018 (IBC) AS MODIFIED BY UFC 1-200-01
2. AMERICAN CONCRETE INSTITUTE (ACI 318-14)
3. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC 13th ED.)
4. AMERICAN WELDING SOCIETY, A.W.S.

B. LIVE LOADS

ROOF----------100 PSF
FLOOR----------500 PSF

SNOW LOAD:

GROUND SNOW LOAD (Pg) = 60 PSF
IMPORTANCE FACTOR (I) = 1.1
EXPOSURE CATEGORY (Ce) = 1.0
THERMAL CATEGORY (Ct) = 1.2

C. WIND LOAD:

BASIC WIND SPEED: 180 MPH
IMPORTANCE FACTOR (I): 1.0
EXPOSURE CATEGORY: C
ENCLOSURE CLASSIFICATION: ENCLOSED

D. EARTHQUAKE:

OCCUPANCY CATEGORY=III
Ie= 1.25
Ss= 0.65
Sds= 0.49
S1= 0.18
Sd1= 0.19
SITE CLASS: C
BASIC SEISMIC-FORCE RESISTING SYSTEM= INTERMEDIATE PRECAST SHEAR WALLS
SEISMIC DESIGN CATEGORY= C
ANALYSIS PROCEDURE = EQUIVALENT LATERAL FORCE PROCEDURE

E. SOILS

SOIL DENSITY (γ): 120 PCF
ANGLE OF INTERNAL FRICTION OF THE SOIL (ϕ) : 30 DEGREES
EQUIVALENT FLUID PRESSURE (EFP): 60 PSF PER FOOT OF DEPTH

2.0 GENERAL

2.1 CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND SITE CONDITIONS PRIOR TO CONSTRUCTION/FABRICATION. CONTRACTOR SHALL NOTIFY CONTRACTING OFFICER OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION.

2.2 THE STRUCTURE (MEMBERS AND CONNECTIONS) HAS BEEN DESIGNED TO SUPPORT IN-PLACE DESIGN LOADS ONLY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LIMITING CONSTRUCTION LOADS SUCH THAT THESE LOADS DO NOT EXCEED THE DESIGN LOADS NOTED ABOVE.

2.3 IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE CONSTRUCTION METHODS, PROCEDURES, AND SEQUENCES TO ENSURE STABILITY AND SAFETY DURING CONSTRUCTION. THE CONTRACTOR SHALL TAKE NECESSARY PRECAUTIONS TO PROTECT AND MAINTAIN THE STRUCTURAL INTEGRITY OF ALL NEW AND EXISTING CONSTRUCTION AT ALL STAGES.

2.4 SECTIONS AND DETAILS SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE CONSIDERED TYPICAL FOR SIMILAR CONDITIONS THAT DO NOT HAVE A SPECIFIC SECTION INDICATED.

2.5 THE CONTRACTOR SHALL COORDINATE STANDARD DRAWINGS WITH THE VENDOR/MANF. SHOP DRAWINGS TO VERIFY SIZES AND LOCATIONS OF OPENINGS, SLEEVES, INSERTS, DEPRESSIONS, FINISHES, SLOPES, ETC. ANY DISCREPANCY SHALL BE BROUGHT TO THE ATTENTION OF THE CONTRACTING OFFICER.

2.6 SEE CIVIL SITE LAYOUT DRAWINGS (PART OF SITE ADAPTATION) FOR ACTUAL FINISHED FLOOR ELEVATIONS (F.F.E.) FOR ALL BUILDINGS. ELEVATIONS SHOWN IN STRUCTURAL DOCUMENTS WILL BE BASED ON REFERENCED F.F.E. EQUAL TO 0'-0", U.O.N.

2.7 ANY DISCREPANCIES BETWEEN DRAWINGS, SPECIFICATIONS, REFERENCE STANDARDS, OR GOVERNING CODE, THE MORE STRINGENT REQUIREMENTS SHALL GOVERN. CONTRACTOR SHALL NOTIFY THE CONTRACTING OFFICER OF DISCREPANCIES AND OBTAIN DIRECTION PRIOR TO PROCEEDING.

2.8 CONTRACTOR SHALL PROVIDE TEMPORARY SHORING AND BRACING OF ALL STRUCTURAL WORK, AND SOIL EXCAVATION AS REQUIRED. SHORING AND BRACING SHALL NOT BE REMOVED UNTIL ALL FINAL CONNECTIONS HAVE BEEN COMPLETED IN ACCORDANCE WITH THE DRAWINGS, AND MATERIALS HAVE ACHIEVED DESIGN STRENGTH.

3.0 FOUNDATIONS

3.1 SEE CIVIL DRAWINGS AND SPECIFICATIONS (PART OF SITE ADAPTATION) FOR EARTHWORK PREPARATION OF FOUNDATIONS INCLUDING THE REMOVAL OF ORGANIC MATERIALS, COMPACTING SOILS BENEATH STRUCTURES, BACK FILL REQUIREMENTS FOR OVER EXCAVATION AND REMOVAL OF UNSUITABLE MATERIALS.

3.2 MAXIMUM ASSUMED NET SOIL BEARING PRESSURE USED FOR DESIGN: 3000 PSF.

3.3 ASSUMED UNIT WEIGHT OF SOIL USED FOR DESIGN: 120 PCF

3.4 ALL FOUNDATION BEARING SURFACES SHALL BE REVIEWED BY THE GEOTECHNICAL ENGINEER PRIOR TO PLACING CONCRETE TO ENSURE THEIR COMPLIANCE WITH THE PRESSURES NOTE ABOVE.

3.5 ALL FOOTINGS SHALL PROJECT AT LEAST 1'-6" INTO UNDISTURBED NATURAL SOIL OR COMPACTED ENGINEERED FILL HAVING A SOIL BEARING PRESSURE THAT MEETS OR EXCEEDS THAT SPECIFIED ABOVE.

3.6 ALL DISTURBED EARTH UNDER FOOTINGS SHALL BE REPLACED WITH LEAN CONCRETE.

3.7 CONCRETE SHALL NOT BE PLACED OVER FROZEN SOIL OR FOOTING EXCAVATIONS SUBJECTED TO WATER.

4.0 CONCRETE

4.1 ALL CONCRETE WORK INCLUDING DETAILING, FABRICATION, PLACEMENT OF REINFORCING, MIXING, HANDLING,PLACING, FINISHING, AND CURING SHALL CONFORM TO THE FOLLOWING DOCUMENTS:

ACI 301----------"STANDARD SPECIFICATIONS FOR STRUCTURAL CONCRETE"
ACI 315----------"MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES"
ACI 318----------"BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE"

4.2 ALL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS, U.O.N. ALL CONCRETE SHALL CONFORM TO ASTM C94.

4.3 REINFORCING BARS SHALL BE DEFORMED TYPE CONFORMING TO ASTM A615 GRADE 60 U.O.N.

4.4 WELDED WIRE REINFORCEMENT SHALL CONFORM TO ASTM A185. MINIMUM LAP AND EMBEDMENT TO BE THE GREATER OF ONE CROSS WIRE SPACING PLUS 2" OR 6", WHICHEVER IS GREATER.

4.5 FABRICATE AND PROVIDE BAR SUPPORTING ACCESSORIES IN ACCORDANCE WITH ACI MANUAL OF STANDARD PRACTICE AND C.R.S.I. SPECIFICATIONS. REINFORCING SHALL NOT BE WELDED IN ANY MANNER U.O.N. IN CONSTRUCTION DOCUMENTS.

4.6 REINFORCING SHALL BE CONTINUOUS WITH CLASS "B" TENSION LAP SPLICES, U.O.N.

4.7 CONCRETE COVERAGE OF REINFORCEMENT U.ON.:

CONCRETE CAST AGAINST EARTH:.....3 INCHES
FORMED CONCRETE EXPOSED TO EARTH OR WEATHER;
NO. 6 BAR AND LARGER.....2 INCHES
NO. 5 BAR AND SMALLER.....1 1/2 INCHES
CONCRETE NOT EXPOSED TO WEATHER:
SLABS, WALLS, JOISTS.....1 INCHES
BEAMS AND COLUMNS.....1 1/2 INCHES
SLAB ON GRADE.....MID-DEPTH OF SLAB

4.8 PROVIDE REINFORCING BARS IN CONCRETE FOOTINGS TO MATCH THE SIZE AND SPACING OF THE HORIZONTAL REINFORCING AT ALL CORNERS AND INTERSECTIONS OF STRIP FOOTINGS. PROVIDE LEG LENGTH EQUIVALENTTO CLASS "A" TENSION LAP SPLICE U.O.N.

4.9 PROVIDE DOWEL TO FOUNDATION WITH 90 DEGREE HOOK TO MATCH SIZE AND SPACING OF VERTICAL REINFORCING AT ALL PEDESTALS, WALLS, AND COLUMNS.

4.10 FOOTINGS AND SLABS SHALL HAVE NO HORIZONTAL JOINTS (POURED TO THEIR FULL DEPTHS IN ONE OPERATION). ANY STOP IN CONCRETE WORK SHALL BE BULKHEAD AND KEYED, U.O.N.

4.11 REINFORCEMENT SHALL NOT BE BENT OR STRAIGHTENED IN A MANNER THAT WILL DAMAGE THE MATERIAL. BARS WITH KINKS OR IMPROPER BENDS SHALL NOT BE USED.

4.12 REINFORCEMENT SHALL BE CONTINUOUS THROUGH ALL CONSTRUCTION JOINTS, BUT DISCONTINUOU THROUGH ALL CONTROL JOINTS, U.O.N..

4.13 A CLASS C FINISH IS REQUIRED FOR EXPOSED FORMED SURFACES OF PRECAST PANELS. A CLASS D FINISH IS REQUIRED FOR SURFACES WHICH WILL BE BELOW GRADE OR NOT EXPOSED TO VIEW AFTER FINAL ASSEMBLY.

4.14 REFER TO GEOTECHNICAL REPORT FOR RECOMMENDATIONS RELATIVE TO SUBGRADE PREPARATION FOR SLAB ON GRADE WORK.

5.0 STRUCTURAL STEEL

5.1 STRUCTURAL STEEL FABRICATION, ERECTION, AND CONNECTION DESIGN SHALL CONFORM TO A.I.S.C.'S "SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS."

5.2 STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING ASTM DESIGNATIONS:

W SHAPES.....ASTM A992
STEEL CHANNELS, ANGLES, PLATES AND BARS: .....ASTM A992 OR ASTM A572 GRADE 50
RECTANGULAR, SQUARE, AND ROUND HSS.....ASTM A500, GRADE C
STEEL PIPE (HSS).....ASTM A53, GRADE B

DOORS FABRICATED FROM ASTM A572 GRADE 50 STRUCTURAL STEEL SHALL NOT EXCEED 60 KSI FOR THE YIELD STRESS (Fy). TO ENSURE SATISFACTION OF THIS REQUIREMENT, THE DOOR FABRICATOR SHALL SUBMIT CERTIFIED MANUFACTURER'S MILL REPORT FOR ALL STRUCTURAL STEEL USED IN THE DOORS.

5.3 STRUCTURAL FASTENERS SHALL CONFORM TO THE FOLLOWING ASTM DESIGNATIONS:

ANCHOR BOLTS.....ASTM 1554
THREADED RODS.....ASTM A36
HEADED STUDS.....ASTM A108, GRADES 1015 TO 1020 (60 KSI TENSILE STRENGTH)

5.4 BOLTED CONNECTIONS SHALL CONFORM TO RCSC'S "SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS". ALL BOLTS SHALL BE 3/4" DIAMETER UNLESS OTHERWISE NOTED.

5.5 WELDED CONNECTIONS SHALL CONFORM TO AWS D1.1 "STRUCTURAL WELDING CODE-STEEL". MINIMUM SIZE FILLET WELDS SHALL BE 3/16" UNLESS OTHERWISE NOTED AND ELECTRODES SHALL BE E70xx. WELDERS SHALL BE QUALIFIED IN ACCORDANCE WITH AWS.

5.6 ALL EXTERIOR STEEL EXPOSED TO THE WEATHER SHALL BE HOT DIPPED GALVANIZED OR COATED WITH A HIGH PERFORMANCE COATING SYSTEM (HPCS). MEMBERS NOT REQUIRED FOR CORROSION PROTECTION SHALL RECEIVE ONE COAT OF STANDARD PRIMER PAINT. DO NOT PRIME OR PAINT SURFACES WHICH ARE TO RECEIVE FIELD WELDED HEADED SHEAR STUDS. PROVIDE 3" MINIMUM CONCRETE COVER FOR ALL STEEL BELOW GRADE AND PAINT WITH 2 COATS OF COAL TAR EPOXY. EPOXY SHALL MEET THE REQUIREMENTS OF PAINT SPECIFICATION SSPC-PAINT 16.

5.7 ALL STIFFENERS AND GUSSETS PLATES SHALL BE MINIMUM 3/8" THICK, UNLESS OTHERWISE NOTED.

6.0 STRUCTURAL PRECAST CONCRETE

6.1 ALL PRECAST ELEMENTS NOT DETAILED ON DRAWINGS SHALL BE DESIGNED FOR THE SPAN AND CONCRETE AND CONSTRUCTION LOADING CONDITIONS SHOWN ON THE DRAWINGS BY A LICENSED STRUCTURAL ENGINEER. ALL DESIGN CALCULATIONS, INCLUDING THE DESIGN OF ALL STRUCTURAL ELEMENTS AND LIFTING POINTS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR REVIEW PRIOR TO THE START OF FABRICATION.

6.2 THE PRECAST MANUFACTURER SHALL BE RESPONSIBLE FOR COORDINATION OF ALL DISCIPLINES AS THEY EFFECT THE PRECAST ELEMENTS.

6.3 THERE SHALL BE NO FIELD CUTTING OF PRECAST ELEMENTS WITHOUT THE APPROVAL OF THE CONTRACTING OFFICER.

6.4 CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH AT TWENTY- EIGHT DAYS OF 4000 PSI.

6.5 ALL GROUT SHALL BE NON -SHRINK, NON- METALLIC WITH F'c = 5000 PSI.

7.0 ELECTRICAL BONDING AND GROUNDING

7.1 ALL METAL PARTS, TO INCLUDE LOUVERS, VENTILATORS, DOORS AND DOOR FRAME MUST BE MADE ELECTRICALLY BONDED TO THE MAGAZINE REINFORCING CAGE.

7.2 THE REINFORCING CAGE MUST BE ELECTRICALLY BONDED BY WIRE TIES AT AMINIMUM OF 4'-0" O.C. IN EACH DIRECTION. REFER TO ELECTRICAL DRAWINGS FOR ADDITIONAL DETAILS AND INFORMATION.

7.3 ELECTRICAL CONTINUITY SHALL BE PROVIDED ACROSS FLOOR EXPANSION AND ISOLATION JOINTS TO CONCRETE FOUNDATION WALLS, BETWEEN PRECAST WALL AND PRECAST ROOF PANELS, AND BETWEEN PRECAST WALLS AND CONCRETE PEDESTAL FOOTINGS DURING CONSTRUCTION. SEE ELECTRICAL DRAWINGS FOR ADDITIONAL INFORMATION REGARDING ELECTRICAL BONDING.

DESIGNER NOTES: TO BE REMOVED WHEN PREPARING CONSTRUCTION DRAWINGS FOR SITE ADAPTION OF THIS DESIGN.

1. THE MAGAZINE HAS BEEN ANALYZED FOR THE LOADS LISTED ON THIS SHEET AND DETERMINED TO BE ADEQUATE UNDER THESE LOADINGS. HOWEVER, THE DESIGNER SHOULD VERIFY THE STRUCTURE FOR THE SITE-SPECIFIC LOADING CRITERIA. IF SITE-SPECIFIC LOADS EXCEED THESE LISTED ON THIS SHEET, THE DESIGNER SHOULD ADDRESS ALL DEFICIENCIES THAT DONT MEET CURRENT BUILDING CODES.
2. FOUNDATIONS SHALL BE REVISED TO REFLECT SPECIFIC SITE SOIL CONDITIONS INCLUDING LOCAL SITING, TOPOGRAPHIC CONDITIONS, AND FROST PENETRATION DEPTHS.
3. STRUCTURAL COMPONENTS, WITH THE EXCEPTION OF THE FOUNDATION (FOOTINGS), SLAB-ON-GRADE, AND WING WALLS SHALL NOT BE MODIFIED WITHOUT THE APPROVAL OF THE CONTRACTING OFFICIER, WHO SHOULD CONSULT WITH THE U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE (STRUCTURAL BRANCH). STRUCTURE HAS BEEN DETERMINED TO BE ADEQUATE FOR THE DESIGN CRITERIA LISTED ON THIS SHEET.

STRUCTURAL DESIGNATION (7-BAR) NOTES:

1. ANY DEVIATION FROM THE STANDARD APPROVED DESIGN DRAWINGS FOR THE CONCRETE HEADWALL, STEEL DOOR, CONCRETE ROOF OR THEIR SUPPORTS WITHOUT WRITTEN APPROVAL FROM THE DEPARTMENT OF DEFENSE EXPLOSIVE SAFETY BOARD (DDESB) MAY REQUIRE THE MAGAZINE TO BE CONSIDERED AN UNDEFINED MAGAZINE AND MAY SEVERELY RESTRICT THE ALLOWABLE STORAGE CAPACITY.
2. IF CONSTRUCTED PER THESE DRAWINGS, FACILITY MEETS BLAST-RESISTANT DESIGN CRITERIA FOR A 7-BAR STRUCTURAL DESIGNATION PER DESR 6055.09-M. THIS DESIGNATION IN NO WAY IMPLIES VALIDATION OF THE DESIGN AGAINST OTHER LOAD CASES.

PHYSICAL SECURITY NOTE:

1. THIS DRAWING PACKAGE WAS DESIGNED TO MEET THE MINIMUM CONSTRUCTION AND SECURITY REQUIREMENTS PER DoDI 5100.76, DoDM 5100.76, DESR 6055.09, AND UFC 4-026-01/MILITARY HANDBOOK 1013/1A FOR STORING SECURITY RISK CATEGORY I AND II ITEMS SUBJECT TO A LEVEL III/MEDIUM THREAT SEVERITY LEVEL FORCED ENTRY DESIGN BASIS THREAT (DBT). UPDATES TO THIS DRAWING PACKAGE TO MAINTAIN OR EXCEED THIS MINIMUM STANDARD DESIGN SHALL BE CONDUCTED BY QUALIFIED ENGINEERS AND TRAINED PHYSICAL SECURITY SPECIALIST PRIOR TO DESIGN, CONTRACT AWARD, AND ACCEPTANCE FOR NEW CONSTRUCTION TO ENSURE COMPLIANCE WITH THE CRITERIA OF DoDI 5100.76, DoDM 5100.76, DESR 6055.09, AND UFC 4-026-01/MILITARY HANDBOOK 1013/1A.

1. THIS STANDARD DESIGN DRAWING DATED JANUARY 2024; STD 421-80-07 REVISION 1, SHEETS 1-26, UPDATES AND SUPERSEDES THE STANDARD DESIGN 421-80-07 DATED DECEMBER 2011, SHEETS 1-24.

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GENERAL NOTES

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S-001
Sheet 3 of 26

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SPECIAL INSPECTION SCHEDULE/VERIFICATION

ITEM	EXTENT OF INSPECTION [1]	REFERENCE (IBC TABLE 1705.3)	COMMENTS/SCOPE
CONCRETE CONSTRUCTION			
REINFORCING STEEL PLACEMENT	P	ACI 318: Ch 20, 25.2, 25.3, 26.6.1-26.6.3	INSPECT SIZE, SPACING, COVER, POSITIONING AND GRADE OF REINFORCING STEEL. VERIFY THAT REINFORCING BARS ARE FREE OF FORM OIL OR OTHER DELETERIOUS MATERIALS. INSPECT BAR LAPS AND MECHANICAL SPLICES. VERIFY THAT BARS ARE ADEQUATELLY TIED AND SUPPORTED ON CHAIRS OR BOLSTERS
WELDING OF RIENFORCEMENT	C, P	AWS D1.4, ACI 318:26.6.4	VISUALLY INSPECT ALL REINFORCING STEEL WELDS. VERIFY WELDABILITY OF REINFORCING STEEL. INSPECT PREHEATING OF STEEL WHEN REQUIRED.
CONCRETE PLACEMENT	C	ACI 318: 26.5	INSPECT PLACEMENT OF CONCRETE. VERIFY THAT CONCRETE CONVEYANCE AND DEPOSITING AVOIDS SEGREGATION OR CONTAMINATION. VERIFY THAT CONCRETE IS PROPERLY CONSOLIDATED
SAMPLING AND TESTING OF CONCRETE	C	ASTM C 172 ASTM C 31 ACI 318: 26.5, 26.12	TEST CONCRETE COMPRESSIVE STRENGTH, SLUMP, AIR-CONTENT AND TEMPERATURE
CURING AND PROTECTION	P	ACI 318: 26.5.3-26.5.5	INSPECT CURING, COLD WEATHER PROTECTION AND HOT WEATHER PROTECTION PROCEDURES
FORMWORK	P	ACI 318: 26.11.1.2 (b)	INSPECT FORWORK FOR SHAPE, LOCATION, AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED
PRECAST CONCRETE			
PLANT CERTIFICATION/QUALITY CONTROL PROCEDURES	S		REVIEW OF PLANT OPERATIONS AND QUALITY CONTROL PROCEDURES
MIX DESIGN	S		INSPECT CONCRETE BATCHING OPERATIONS AND VERIFY COMPLIANCE WITH APPROVED MIX DESIGN
MATERICAL CERTIFICATION	S		REVIEW FOR CONFORMANCE TO ACI 318
REINFORCEMENT INSTALLATION	P		INSPECT SIZE, SPACING, POSITION AND GRADE OF REINFORCING STEEL
CONNECTIONS/EMBEDDED ITEMS	P		INSPECT INTERFACE CONNECTIONS INCLUDING END AND EDGE DOWELING. INSPECT EMBEDMENTS FOR PROPER LOCATION AND WELDING OF CONNECTIONS
CONCRETE PLACEMENT	C	ACI 318: 26.5	INSPECT PLACEMENT OF CONCRETE. VERIFY THAT CONCRETE CONVEYANCE AND DEPOSITING AVOIDS SEGREGATION OR CONTAMINATION. VERIFY THAT CONCRETE IS PROPERLY CONSOLIDATED
SAMPLING AND TESTING	C		
CURING AND PROTECTION	P		
ERECTED PRECAST ELEMENTS	C	ACI 318: Ch. 26.9	INSPECT ERECTION OF PRECAST CONCRETE INCLUDING MEMBER CONFIGURATION, CONNECTIONS, WELDING AND GROUTING
DOOR CONSTRUCTION			
FABRICATOR CERTIFICATION/QUALITY CONTROL PROCEDURES	S		REVIEW OF FABRICATOR'S QUALITY CONTROL PROCEDURES OR AISC CERTIFICATION
FABRICATOR INSPECTION	P		INSPECT IN-PLANT FABRICATION, OR REVIEW FABRICATOR'S APPROVED INDEPENDENT INSPECTION AGENCY'S REPORTS
SPECIAL ITEMS RELATED TO THE OTHER EXPLOSIVES SAFETY RELATED ITEMS			
REBAR FARADAY-SHIELD	P	DWGS E-101/A; E-201/A; E-202/A UFC 4-420-01,3-8.5; 3-9	INSPECT REINFORCING STEEL TO ENSURE ELECTRICAL CONTINUITY BETWEEN THE CAP, WALLS, SLAB AND FOUNDATION THROUGH BONDING WELDS. DOCUMENT BONDS WITH PHOTOS AND CONTINUITY TEST.
GROUNDING ELECTRODE SYSTEM AND SUBSYSTEMS	P/S	DWGS E-101/A; E-201/A; E-202/A; DA PAM 385-64,17-28; NFPA 780,8.10; UFC 4-420-01,3-8.4,5	VISUALLY INSPECT GROUNDING ELECTRODE SYSTEM, INCLUDING BONDING CONNECTIONS, GROUNDING ELECTRODES, COUNTERPOISE CABLE, BONDING CABLES AND SUBSURFACE BONDING CABLES PRIOR TO BURIAL. DOCUMENT INSPECTION WITH REPORT AND PHOTOGRAPHS FOR SUBMISSION TO THE GOVERNMENT. DAMAGED, FRAYED, OR CORROSIVE COMPONENTS SHALL BE REPLACED.
GROUNDING ELECTRODE SYSTEM TESTS	P/S	DA PAM 385-64,17-28; NFPA 780,8.10; UFC 4-420-01,3-8.4	TEST THE GROUNDING ELECTRODE SYSTEM AFTER INSPECTION. DOCUMENT TEST RESULTS IN REPORT TO THE GOVERNMENT.
LIGHTNING PROTECTION BONDING INSPECTION AND TESTING	P/S	DWGS E-101/A; E-201/A; E-202/A; DA PAM 385-64,17-28; NFPA 780,8.10; UFC 4-420-01,3-8.4,5,6	INSPECT AND TEST 100% OF LPS BONDS PRIOR TO PROJECT COMPLETION. DOCUMENT TEST RESULTS FOR SUBMISSION TO THE GOVERNMENT. PROVIDE PHOTOGRAPHIC RECORDS OF SUBSURFACE BONDS.
LPS COMPONENTS	P	DWGS E-101/A; NFPA 780,8.10; DA PAM 385-64,17-27	INSPECT LPS COMPONENTS FOR SECURE MOUNTING AND PROTECTION AGAINST ACCIDENTAL MECHANICAL DISPLACEMENT.
SURGE PROTECTION (IF APPLICABLE)	S	NFPA 780,8.6 DA PAM 385-64,17-26 UFC 3-575-01,3-4	CONFIRM SURGE PROTECTIVE DEVICE(S) (SPD) ARE INSTALLED AT THE SERVICE ENTRANCE EQUIPMENT FOR POWER, COMM. AND IDS SYSTEMS, IF SYSTEMS ARE INSTALLED (NOT SHOWN IN STANDARD DESIGN).
EARTH COVER	P	DWGS S-301-302	INSPECT DEPTH GAUGES ON ROOF PRIOR TO EARTH COVER PLACEMENT FOR SIZE AND STABILITY. INSPECT EARTH COVER DEPTH AND SLOPE TO ENSURE A 2' MIN. IS PROVIDED ABOVE STRUCTURE
DOOR LAPS	C	DWG S-701	INSPECT DOOR LAPS AT TOP AND BOTTOM OF DOOR FRAME

SPECIAL INSPECTION NOTES:

1 INSPECTION INTERVALS ARE AS FOLLOWS:
C - Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed

P - Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

S - Submittal

2 STRUCTURAL TEST AND SPECIAL INSPECTIONS ARE BASED ON CHAPTER 17 OF THE IBC 2018 EDITION

3 CONTRACTOR SHALL HIRE A QUALIFIED INSPECTION AND TESTING AGENCY TO PERFORM SPECIAL INSPECTIONS AND TESTING IN ACCORDANCE WITH THE IBC. SUBMIT INSPECTION REPORTS TO THE CONTRACTING OFFICER FOR EACH DAY SPECIAL INSPECTIONS AND TESTING IS PERFORMED.

DESIGNER NOTES: TO BE REMOVED WHEN PREPARING CONSTRUCTION DRAWINGS FOR SITE ADAPTION OF THIS DESIGN.

1. SPECIAL INSPECTION SCHEDULE SHALL BE REVISED TO REFLECT SPECIFIC PROJECT REQUIREMENTS IN ACCORDANCE WITH CHAPTER 17 OF THE INTERNATIONAL BUILDING CODE AND UFC 3-301-01; HOWEVER, AT A MINIMUM EDIT UFGS 01 45 35 "SPECIAL INSPECTIONS" TO INCORPORATE THE SPECIAL ITEMS RELATED TO THE 'OTHER EXPLOSIVES SAFETY RELATED ITEMS' FOR INSPECTION AS SHOWN ON THIS SCHEDULE.

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	Removed Hasps, Modified ILD Door Details, Implemented Lessons Learned, Electrical Updates	JAN. 2024

DESIGNED BY: J. UMPHREY
DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: JESS MOX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER,
HUNTSVILLE, ALABAMA

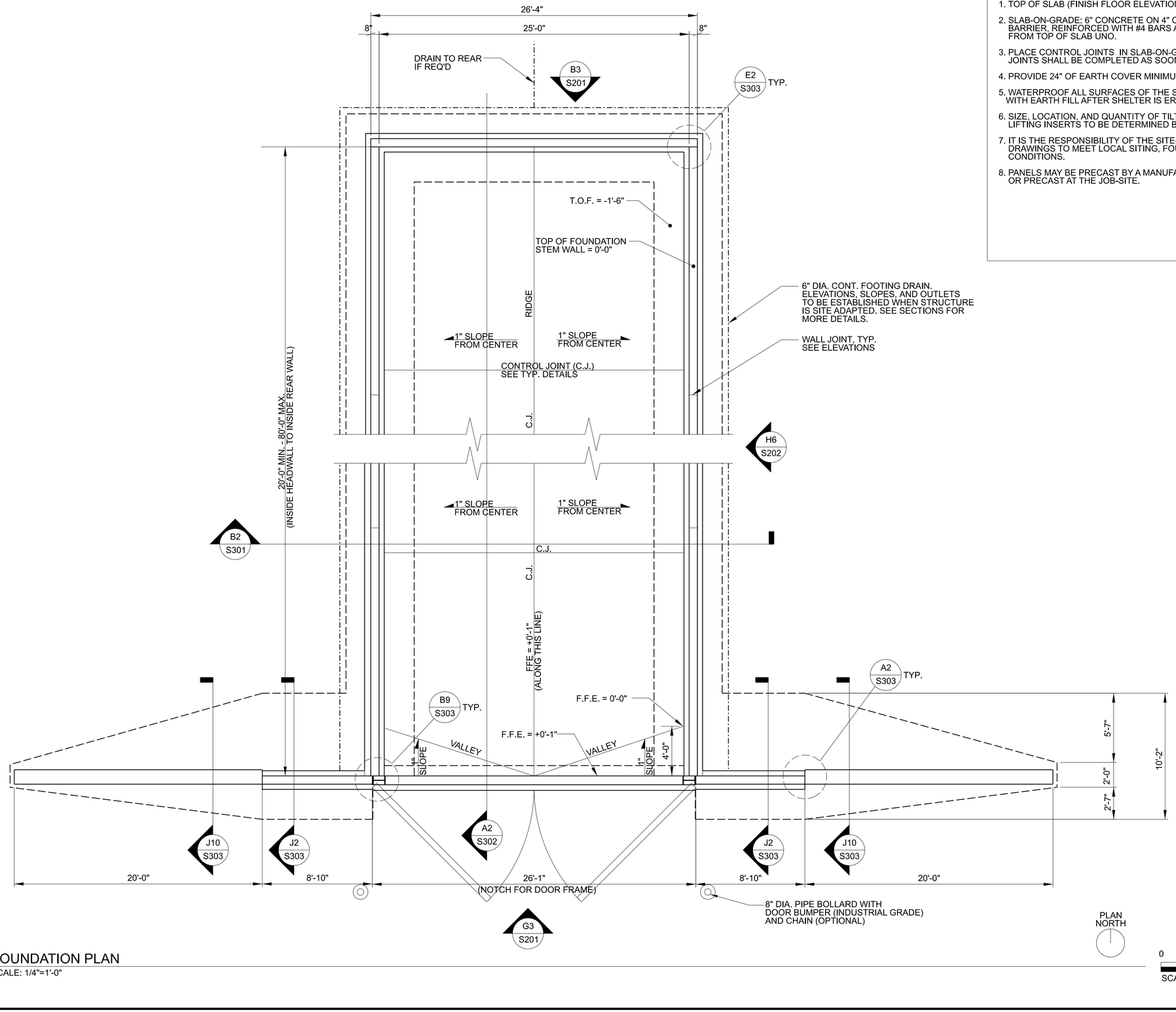
MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)
SPECIAL INSPECTIONS

SHEET ID
S-002
Sheet 4 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL NOTES

1. TOP OF SLAB (FINISH FLOOR ELEVATION) = 0'-0" U.O.N.
2. SLAB-ON-GRADE: 6" CONCRETE ON 4" CAPILLARY WATER BARRIER AND VAPOR BARRIER, REINFORCED WITH #4 BARS AT 12" O.C. EACH WAY SUPPORTED 1 1/2" FROM TOP OF SLAB UNO.
3. PLACE CONTROL JOINTS IN SLAB-ON-GRADE AT 18'-0" O.C. (MAX.). CONTROL JOINTS SHALL BE COMPLETED AS SOON AS POSSIBLE.
4. PROVIDE 24" OF EARTH COVER MINIMUM ON ROOF.
5. WATERPROOF ALL SURFACES OF THE SHELTER WHICH WILL BE IN CONTACT WITH EARTH FILL AFTER SHELTER IS ERECTED.
6. SIZE, LOCATION, AND QUANTITY OF TILT-UP BRACE ATTACHMENT POINTS AND LIFTING INSERTS TO BE DETERMINED BY CONTRACTOR/PRECAST MANF..
7. IT IS THE RESPONSIBILITY OF THE SITE-ADAPT ENGINEER TO MODIFY THESE DRAWINGS TO MEET LOCAL SITING, FOUNDATION, AND TOPOGRAPHIC CONDITIONS.
8. PANELS MAY BE PRECAST BY A MANUFACTURER SPECIALIZING IN PRECAST OR PRECAST AT THE JOB-SITE.



A2 FOUNDATION PLAN
SCALE: 1/4"=1'-0"

0 3' 6' 12'
SCALE 1/4" = 1'-0"

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	Removed Hasps. Modified ILD Door Details, Implemented Lessons Learned. Electrical Updates	JAN. 2024

DESIGNED BY: J. UMPHREY
DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: JESS MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

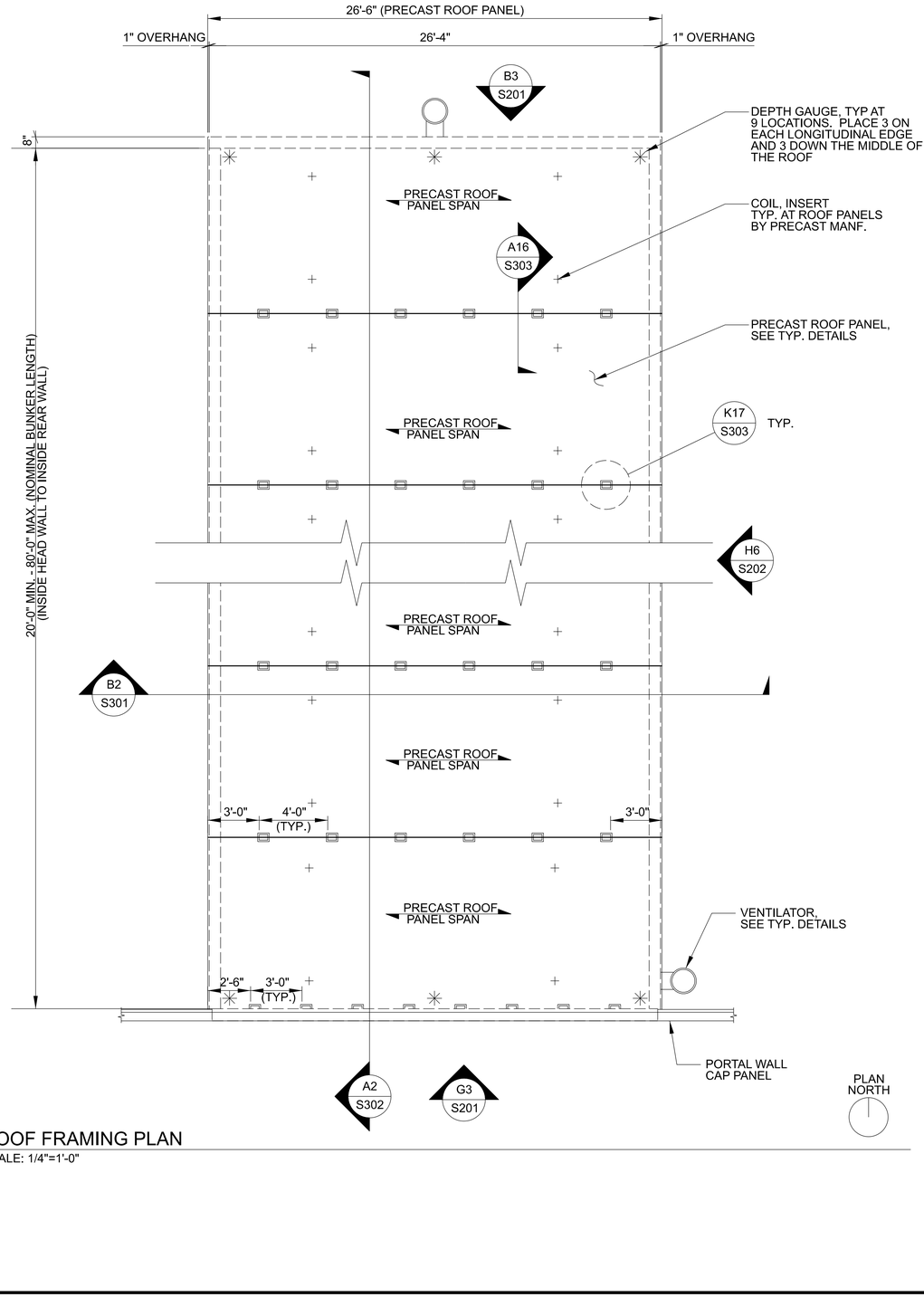
FOUNDATION PLAN

SHEET ID
S-101
Sheet 5 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL NOTES

1. PROVIDE 24" OF EARTH COVER MINIMUM ON ROOF.
2. WATERPROOF ALL SURFACES OF THE SHELTER WHICH WILL BE IN CONTACT WITH EARTH FILL AFTER SHELTER IS ERECTED.
3. SIZE, LOCATION, AND QUANTITY OF TILT-UP BRACE ATTACHMENT POINTS AND LIFTING INSERTS TO BE DETERMINED BY CONTRACTOR/PRECAST MANF..
4. IT IS THE RESPONSIBILITY OF THE SITE-ADAPT ENGINEER TO MODIFY THESE DRAWINGS TO MEET LOCAL SITING, FOUNDATION, AND TOPOGRAPHIC CONDITIONS.
5. PANELS MAY BE PRECAST BY A MANUFACTURER SPECIALIZING IN PRECAST OR PRECAST AT THE JOB-SITE.
6. PROVIDE ELECTRICAL CONTINUITY WITHIN THE PRECAST ROOF PANELS BY BONDING AT 4'-0" O.C. ACROSS TOP OF STIRRUPS TO END ANGLES IN ONE DIRECTION. IN THE OTHER DIRECTION, ELECTRICALLY BOND #4 BAR FROM BOTTOM PLATE TO #4 REINF.



B4 ROOF FRAMING PLAN
SCALE: 1/4"=1'-0"

0 3' 6' 12'
SCALE 1/4" = 1'-0"

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ISSUE DATE: JANUARY 2024
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DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: JESS MCX
SIZE: ANSI D

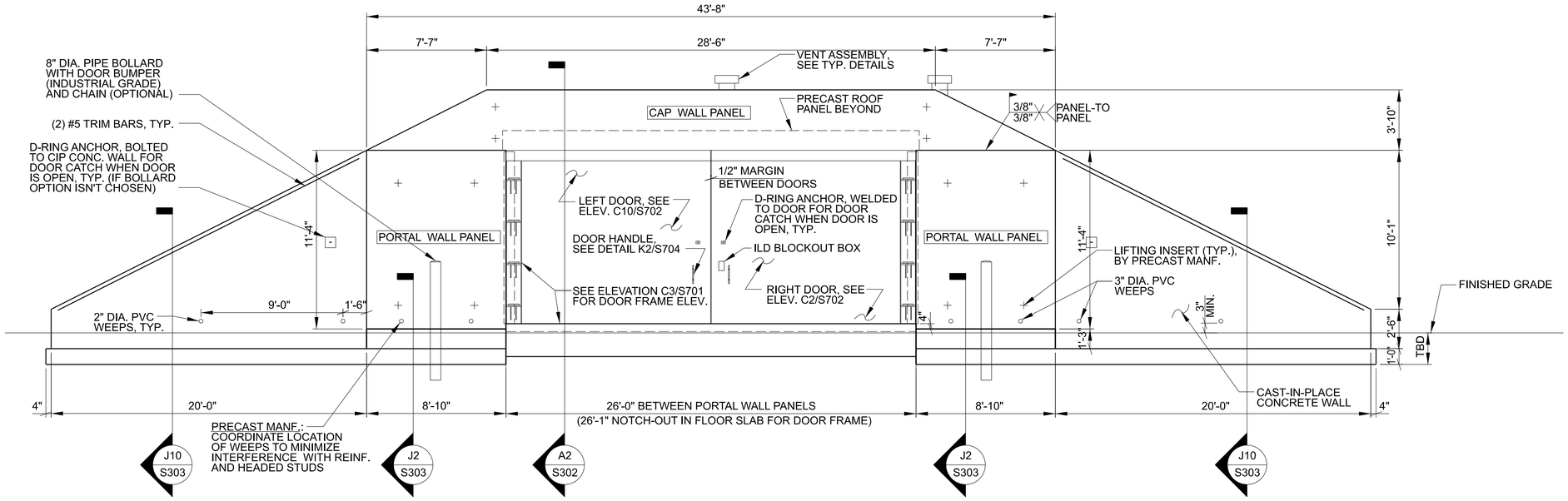
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

ROOF FRAMING PLAN

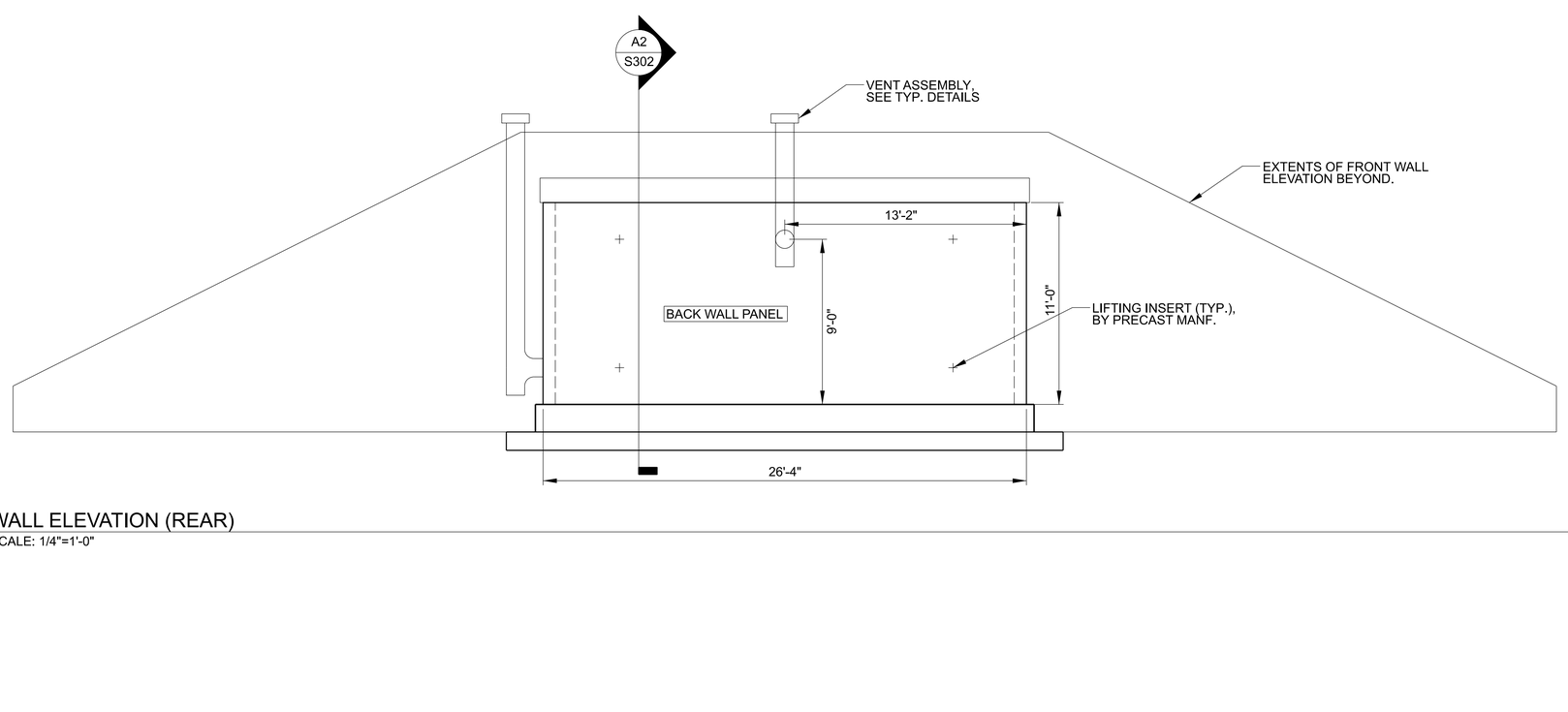
SHEET ID
S-102
Sheet 6 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



G3 WALL ELEVATION (FRONT)

SCALE: 1/4"=1'-0"



B3 WALL ELEVATION (REAR)

SCALE: 1/4"=1'-0"

0 3' 6' 12'

SCALE 1/4" = 1'-0"

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DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: TES MCX
SIZE: ANSI D
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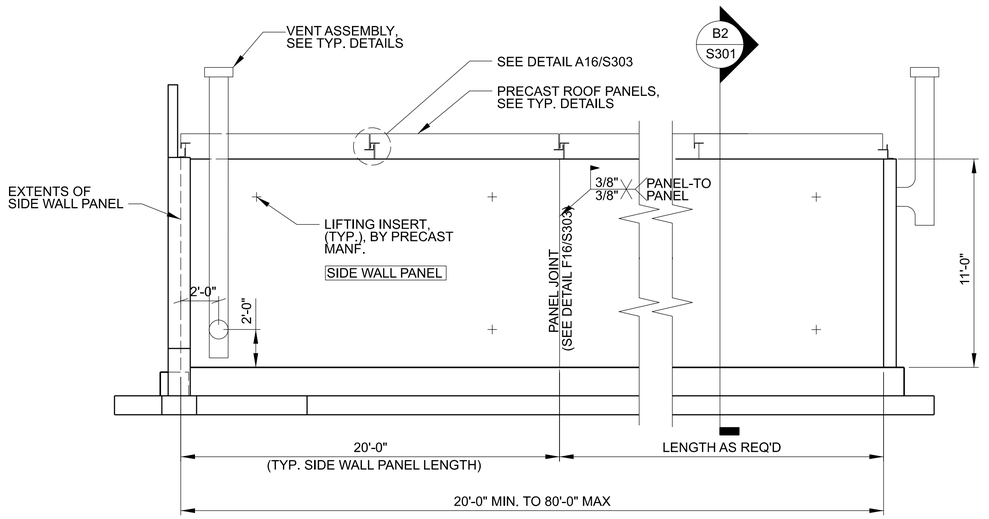
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

ELEVATIONS

SHEET ID
S-201
Sheet 7 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



H6 WALL ELEVATION (SIDE)

SCALE: 1/4"=1'-0"

0 3' 6' 12'

SCALE 1/4" = 1'-0"

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DRAWN BY: J. UMPHREY
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SUBMITTED BY: JESS MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
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U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

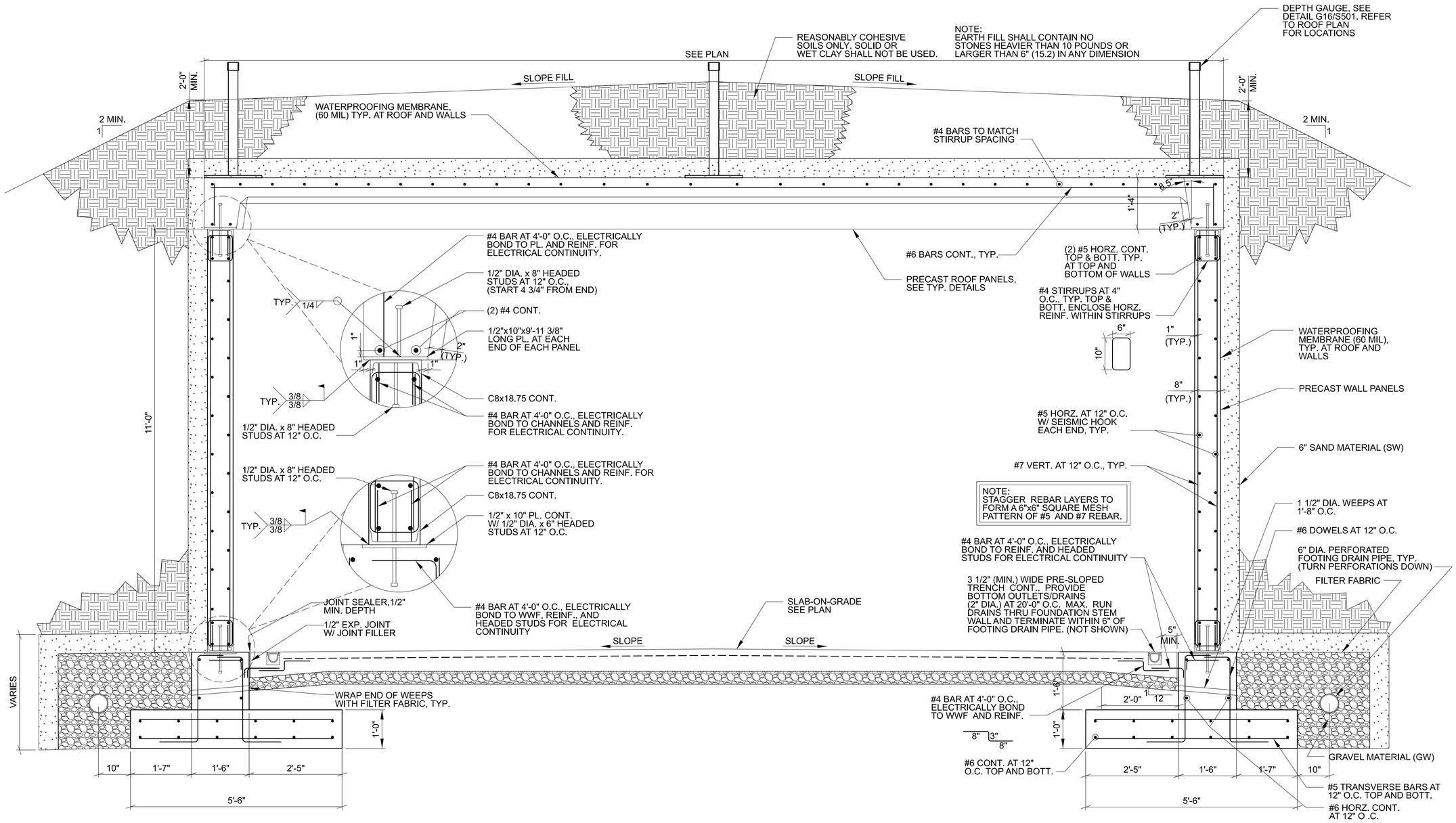
MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

ELEVATIONS

SHEET ID
S-202

Sheet 8 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



B2 TRANSVERSE SECTION

SCALE: 3/4"=1'-0"

0 1' 2' 4'

SCALE 3/4" = 1'-0"

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MARK	DESCRIPTION	DATE
1	Removed Hasps, Modified ILD Door Details, Implemented Lessons Learned, Electrical Updates	JAN. 2024

DESIGNED BY: J. LIMPHREY
DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: JES MCCX
SIZE: ANSI D

ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

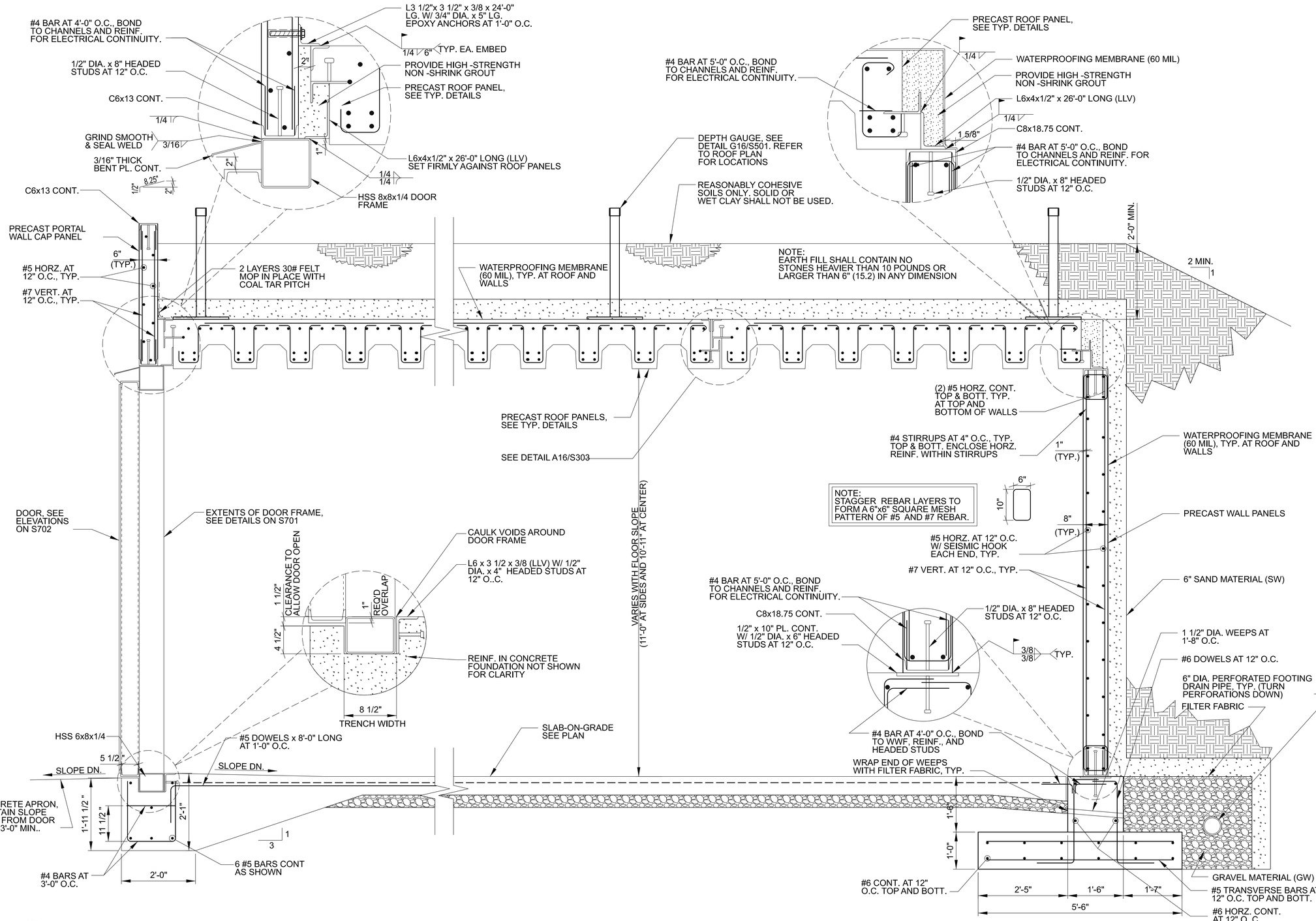
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

BUILDING SECTION

SHEET ID
S-301
Sheet 9 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



A2 FOUNDATION PLAN

SCALE: 3/4"=1'-0"

0 1' 2' 4'

SCALE 3/4" = 1'-0"

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SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

U.S. ARMY CORPS OF ENGINEERS ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV. 1)

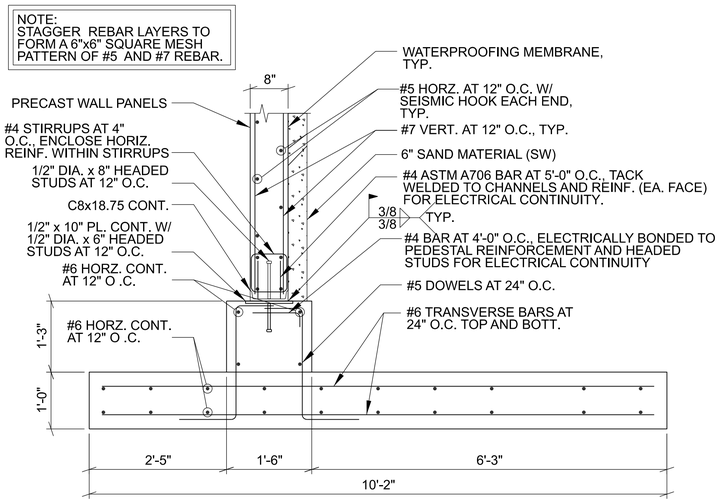
BUILDING SECTION

SHEET ID

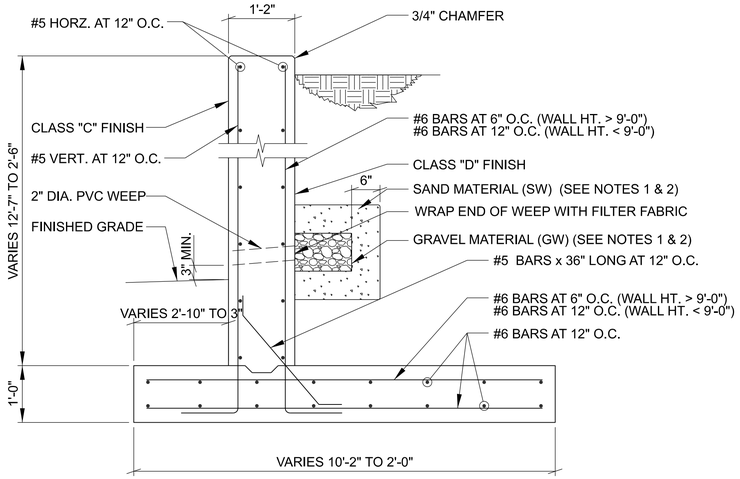
S-302

Sheet 10 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



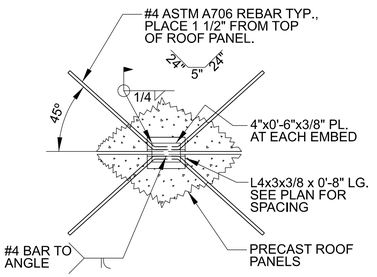
J2 SECTION
SCALE: 3/4"=1'-0"



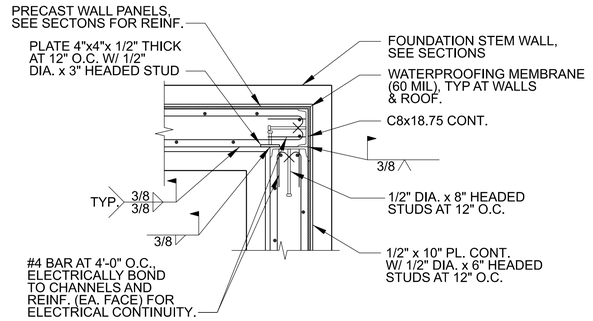
J10 SECTION
SCALE: 3/4"=1'-0"

NOTES:

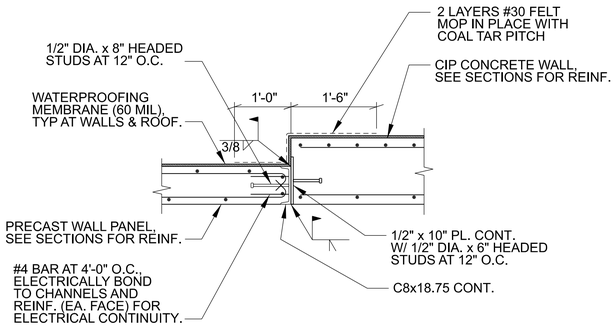
1. THE SAND AND GRAVEL MATERIALS SHOWN IN THE SECTIONAL VIEW THROUGH WING WALL SHOULD BE TERMINATED AT THE POINT WHERE THE WING WALL HEIGHT IS INSUFFICIENT TO MAINTAIN THE 2'-3' COHESIONLESS FILL MATERIAL. PLACE COVER OVER AT LEAST 6" OF SAND MATERIAL. PAST THIS POINT, AN ADDITIONAL 6" OF SAND MATERIAL SHOULD BE ADDED TO "CLOSE IN" THE END OF GRAVEL MATERIAL.
2. AS AN OPTION, DEPENDING ON THE SITE SPECIFIC CONDITIONS, THE WEEPHOLES THROUGH THE WING WALLS MAY BE REPLACED WITH PERFORATED PIPE DRAINS PLACED IN THE GRAVEL MATERIAL RUNNING LATERALLY BEHIND THE WING WALLS AND PORTAL WALL PANELS AND CONNECTED TO THE PERIMETER FOOTING DRAIN.



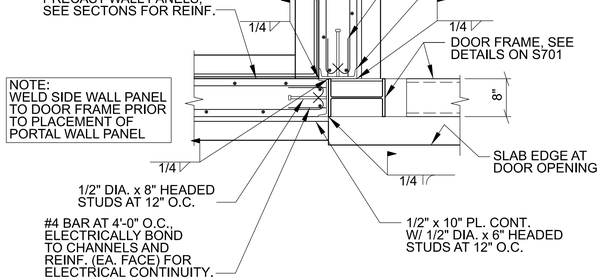
K17 DETAIL
SCALE: 3/4"=1'-0"



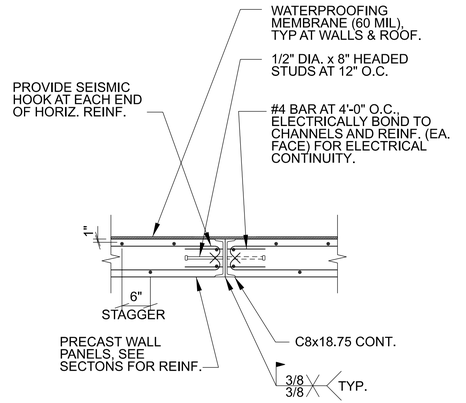
E2 DETAIL
SCALE: 3/4"=1'-0"



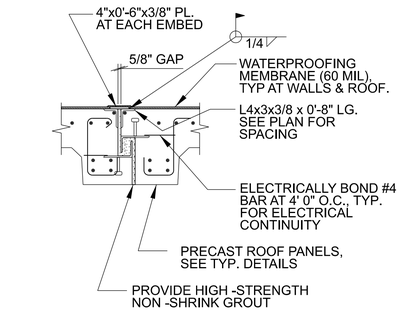
A2 DETAIL
SCALE: 3/4"=1'-0"



B9 DETAIL
SCALE: 3/4"=1'-0"



F16 DETAIL
SCALE: 3/4"=1'-0"



REFER TO DETAIL K17/S303 FOR PLAN VIEW

A16 DETAIL
SCALE: 3/4"=1'-0"

0 1' 2' 4'
SCALE 3/4" = 1'-0"

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SUBMITTED BY: JESS MCKY
SIZE: ANSI D

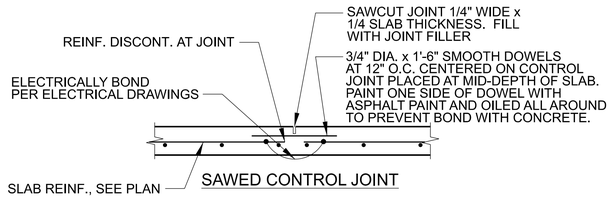
U.S. ARMY CORPS OF ENGINEERS ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV. 1)

SECTIONS

SHEET ID
S-303
Sheet 11 of 26

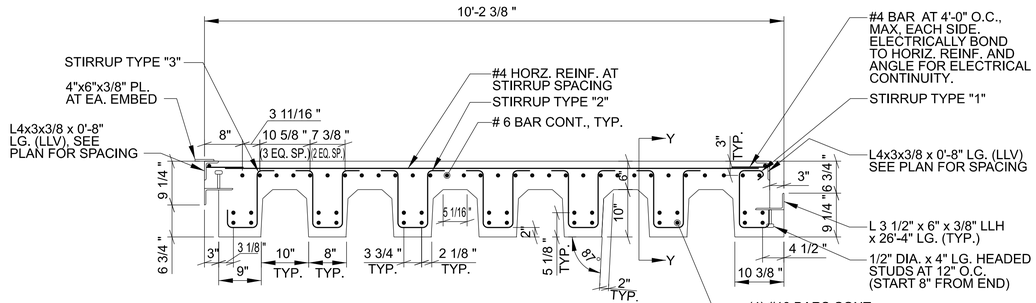
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



K3 SLAB CONTROL JOINT DETAIL

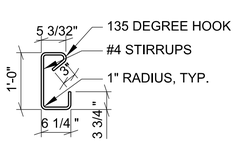
SCALE: 3/4"=1'-0"

USE EITHER AT CONTRACTOR'S OPTION
SAWCUT JOINTS AS EARLY AS ALLOWED
HAND- TOOL AREAS INACCESSIBLE BY SAW



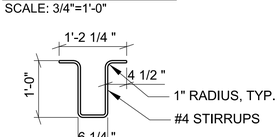
CROSS SECTION

SCALE: 3/4"=1'-0"



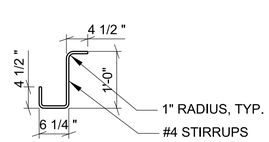
STIRRUP TYPE "1"

SCALE: 3/4"=1'-0"



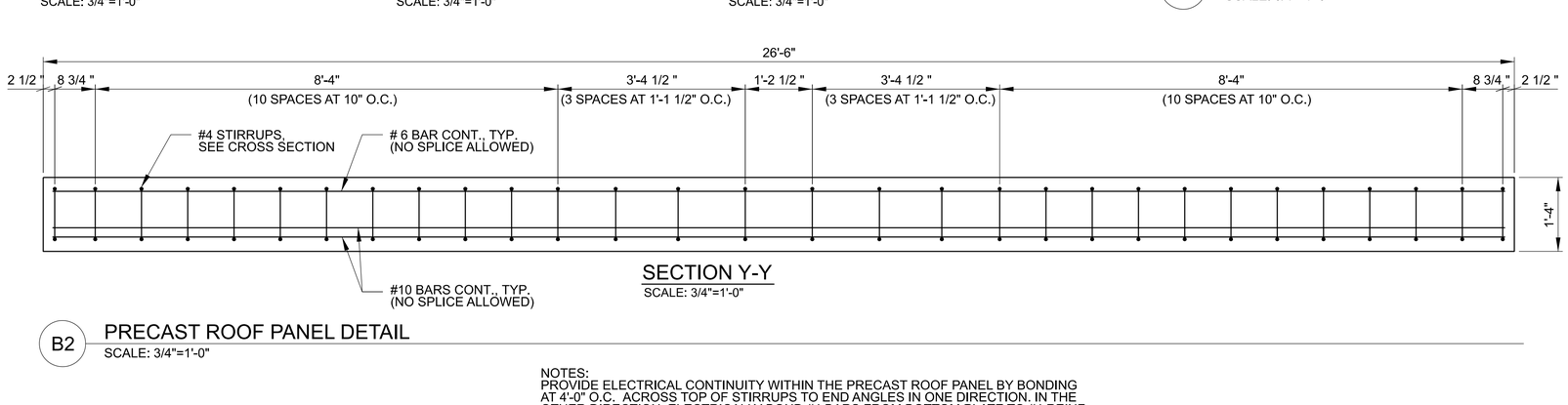
STIRRUP TYPE "2"

SCALE: 3/4"=1'-0"



STIRRUP TYPE "3"

SCALE: 3/4"=1'-0"



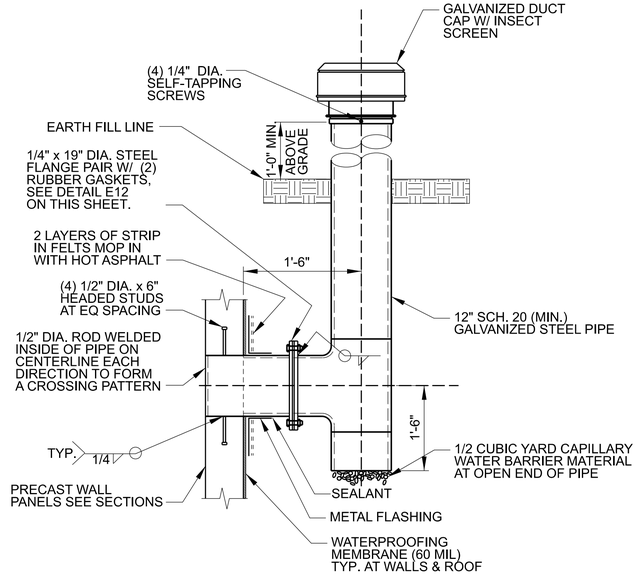
SECTION Y-Y

SCALE: 3/4"=1'-0"

B2 PRECAST ROOF PANEL DETAIL

SCALE: 3/4"=1'-0"

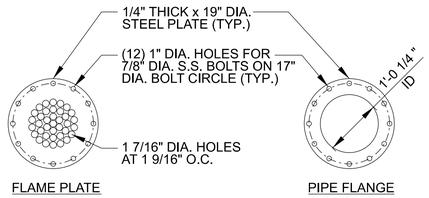
NOTES:
PROVIDE ELECTRICAL CONTINUITY WITHIN THE PRECAST ROOF PANEL BY BONDING AT 4'-0" O.C. ACROSS TOP OF STIRRUPS TO END ANGLES IN ONE DIRECTION. IN THE OTHER DIRECTION, ELECTRICALLY BOND #4 BARS FROM BOTTOM PLATE TO #4 REINF.



J11 TYPICAL VENT DETAIL

SCALE: 3/4"=1'-0"

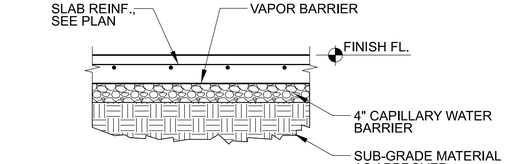
NOTE:
PROVIDE ELECTRICAL CONTINUITY BY BONDING VERTICAL AND HORZ. REINFORCEMENT TO VENT PIPE



NOTE:
CLASS 150 FORGED FLANGES MAY BE SUBSTITUTED FOR FABRICATED PLATE FLANGES

E12 VENTILATOR FLAME PLATE DETAIL

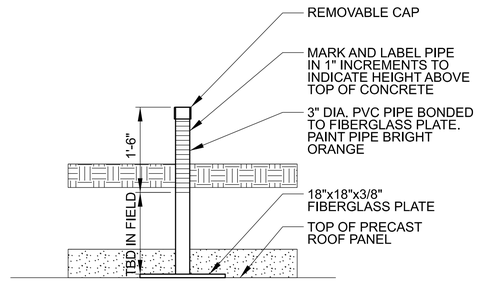
SCALE: 3/4"=1'-0"



M17 SLAB-ON-GRADE DETAIL

SCALE: 3/4"=1'-0"

NOTES:
REFER TO GEOTECHNICAL REPORT FOR THE SUBGRADE PREPARATION AND EARTHWORK RECOMMENDATIONS.



G16 DEPTH GAUGE DETAIL

SCALE: 3/4"=1'-0"

SPLICE LENGTHS					DEVELOPMENT LENGTHS	
BAR SIZE	f_c= 4000 PSI				f_c= 4000 PSI	
	TOP BARS		OTHER BARS		TOP BARS	OTHER BARS
NO.	A	B	A	B		
#3	19"	24"	15"	19"	19"	15"
#4	25"	32"	19"	25"	25"	19"
#5	31"	40"	24"	31"	31"	24"
#6	37"	48"	29"	37"	37"	29"
#7	54"	70"	42"	54"	54"	42"
#8	62"	80"	48"	60"	62"	48"
#9	78"	101"	60"	78"	70"	54"
#10	85"	111"	66"	85"	79"	61"

TOP BARS ARE HORIZONTAL REINF. WITH MORE THAN 12" ON CONCRETE CAST BELOW THE REINF.

CONCRETE LAP LENGTHS SHALL BE INCREASED 20 PERCENT WHERE EPOXY COATING IS USED.

WHEN LAPPING TWO DIFFERENT SIZE BARS, USE THE LARGER OF THE LAP SPLICE DIMENSION OF THE SMALLER BAR OR THE DEVELOPMENT LENGTH OF THE LARGER BARS

0 1' 2' 4'

SCALE 3/4" = 1'-0"

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	Removed Hasps, Modified ILD Door Details, Implemented Lessons Learned, Electrical Updates	JAN. 2024

DESIGNED BY: J. UMPHREY
DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: TES MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

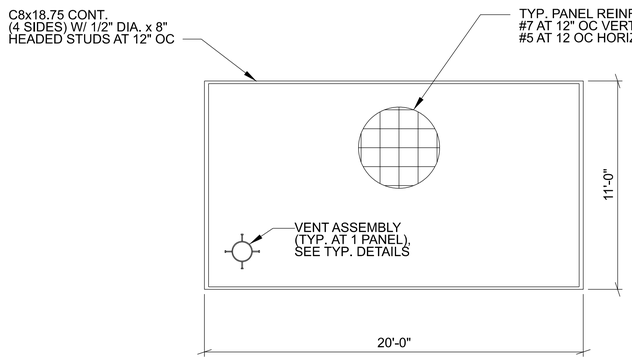
U.S. ARMY CORPS OF ENGINEERS ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV. 1)

TYPICAL DETAILS

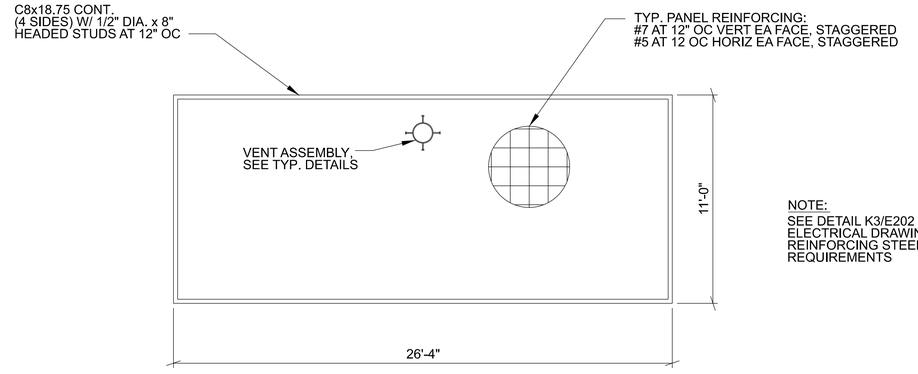
SHEET ID
S-501
Sheet 12 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



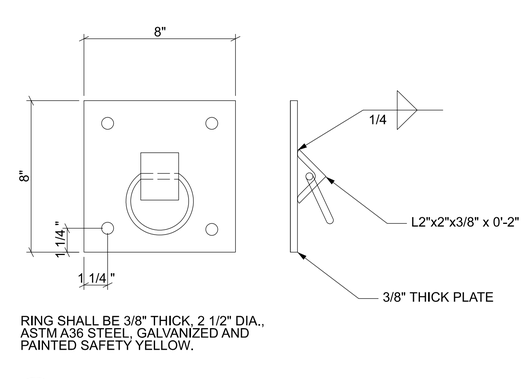
NOTE:
SEE DETAIL K3/E202 OF ELECTRICAL DRAWINGS FOR REINFORCING STEEL BONDING REQUIREMENTS

J4 SIDE WALL PANEL ELEVATION
SCALE: 1/4"=1'-0"



NOTE:
SEE DETAIL K3/E202 OF ELECTRICAL DRAWINGS FOR REINFORCING STEEL BONDING REQUIREMENTS

J14 BACK WALL PANEL ELEVATION
SCALE: 1/4"=1'-0"



RING SHALL BE 3/8" THICK, 2 1/2" DIA., ASTM A36 STEEL, GALVANIZED AND PAINTED SAFETY YELLOW.

C15 D-RING DETAIL
SCALE: 3"=1'-0"

0 0'6" 1'0"
SCALE 3" = 1'-0"

0 3' 6' 12'
SCALE 1/4" = 1'-0"

US Army Corps of Engineers®

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SUBMITTED BY: E. MCX
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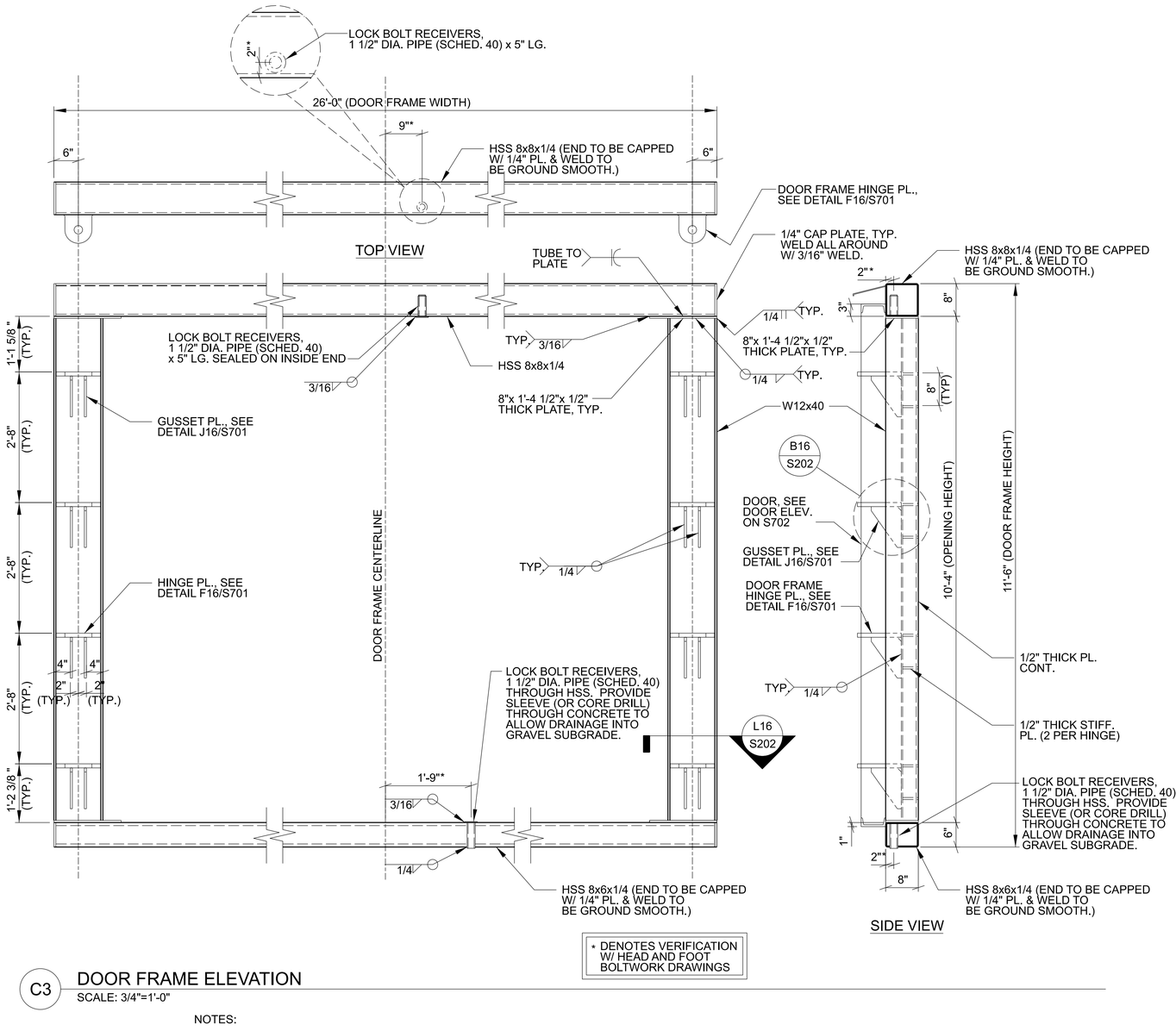
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND
SUPPORT CENTER,
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

TYPICAL WALL DETAILS

SHEET ID
S-502
Sheet 13 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

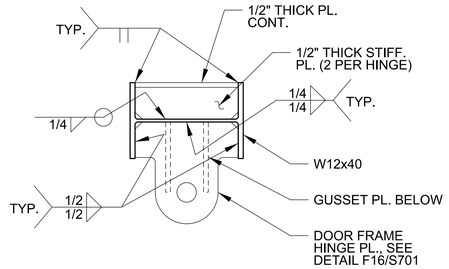


C3 DOOR FRAME ELEVATION

SCALE: 3/4"=1'-0"

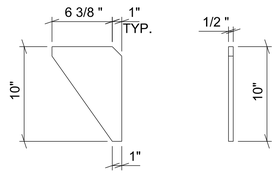
NOTES:

1. THE 3" AND 1" DOOR OVERLAP AT THE TOP AND BOTTOM OF THE DOOR FRAME, RESPECTIVELY SHALL NOT BE REDUCED AS THIS IS IMPERATIVE TO CARRY OUT THE DESIGN INTENT.
2. PROVIDE HEAVY DUTY WEATHER STRIPPING/SEALING AROUND INSIDE PERIMETER OF DOOR GAPS.
3. DOOR FRAME AND BLAST DOORS SHALL BE FACTORY PAINTED WITH HIGH PERFORMANCE COATING SYSTEM.



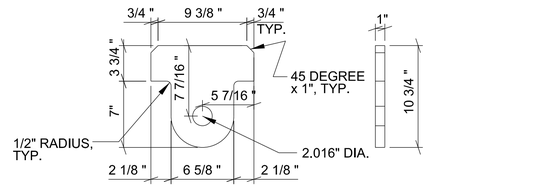
L16 SECTION

SCALE: 1 1/2"=1'-0"



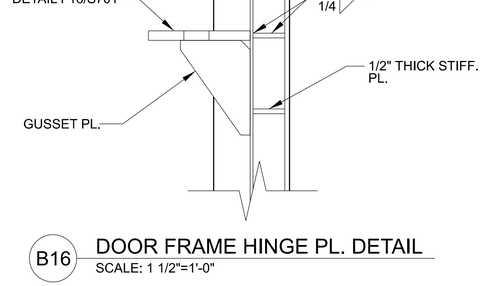
J16 GUSSET PL. DETAIL

SCALE: 1 1/2"=1'-0"



F16 DOOR FRAME HINGE PL. DETAIL

SCALE: 1 1/2"=1'-0"



B16 DOOR FRAME HINGE PL. DETAIL

SCALE: 1 1/2"=1'-0"

0 1' 2' 4'
SCALE 3/4" = 1'-0"

0 0'6" 1 2
SCALE 1 1/2" = 1'-0"

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
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ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
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DESIGNED BY: J. UMPHREY
DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY:
SPEC. MCX
SIZE: ANSI D

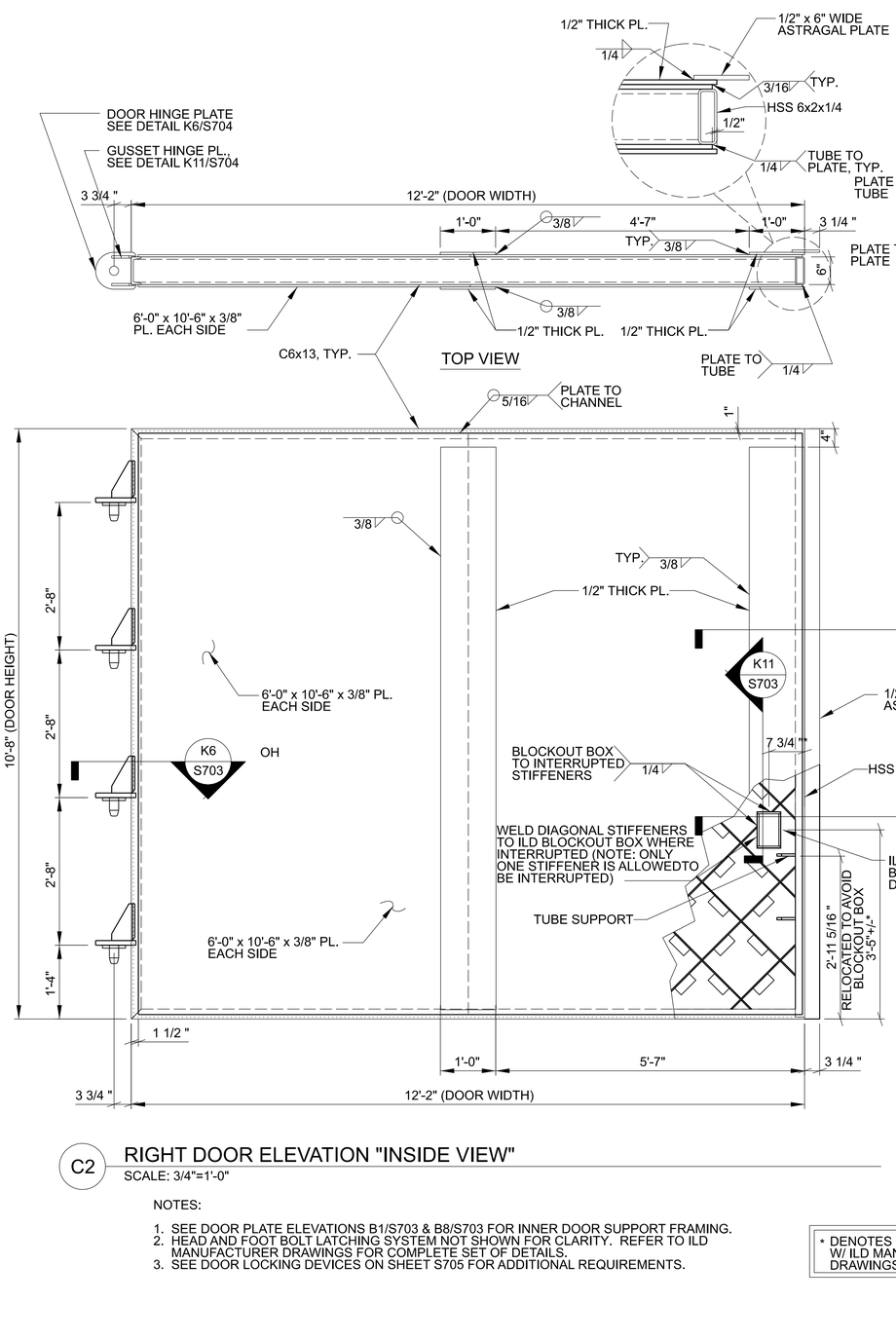
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND
SUPPORT CENTER,
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

DOOR FRAME ELEVATIONS
AND DETAILS

SHEET ID
S-701
Sheet 14 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



C2 RIGHT DOOR ELEVATION "INSIDE VIEW"

SCALE: 3/4"=1'-0"

NOTES:

1. SEE DOOR PLATE ELEVATIONS B1/S703 & B8/S703 FOR INNER DOOR SUPPORT FRAMING.
2. HEAD AND FOOT BOLT LATCHING SYSTEM NOT SHOWN FOR CLARITY. REFER TO ILD MANUFACTURER DRAWINGS FOR COMPLETE SET OF DETAILS.
3. SEE DOOR LOCKING DEVICES ON SHEET S705 FOR ADDITIONAL REQUIREMENTS.

* DENOTES VERIFICATION W/ ILD MANUFACTURER DRAWINGS

C10 LEFT DOOR ELEVATION "INSIDE VIEW"

SCALE: 3/4"=1'-0"

NOTES:

1. SEE DOOR PLATE ELEVATIONS B1/S703 & B8/S703 FOR INNER DOOR SUPPORT FRAMING.
2. SEE DOOR LOCKING DEVICES ON SHEET S705 FOR ADDITIONAL REQUIREMENTS.

0 1' 2' 4'

SCALE 3/4" = 1'-0"

US Army Corps of Engineers®

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DRAWN BY:	J. UMPHREY
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SUBMITTED BY:	TES. MCX
SIZE:	ANSI D
ISSUE DATE:	JANUARY 2024
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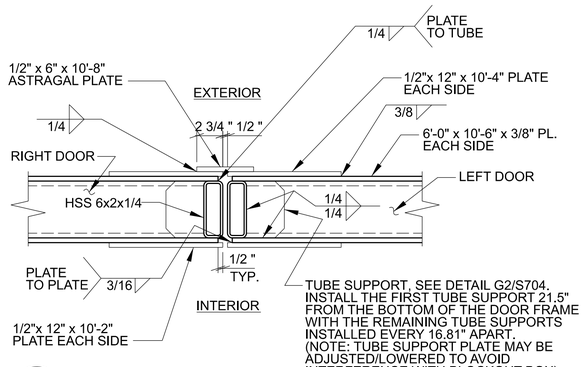
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

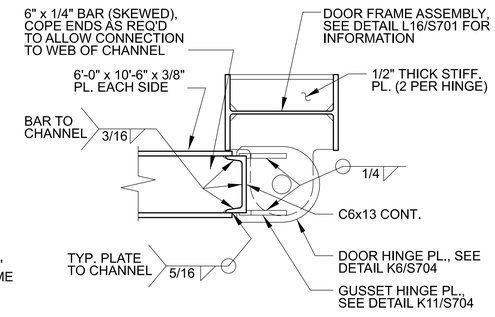
DOOR ELEVATIONS

SHEET ID
S-702
Sheet 15 of 26

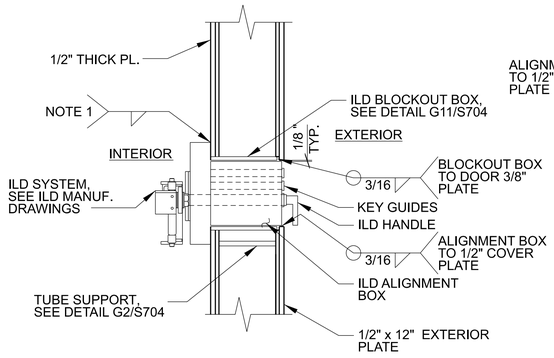
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



K1 SECTION
SCALE: 1 1/2"=1'-0"

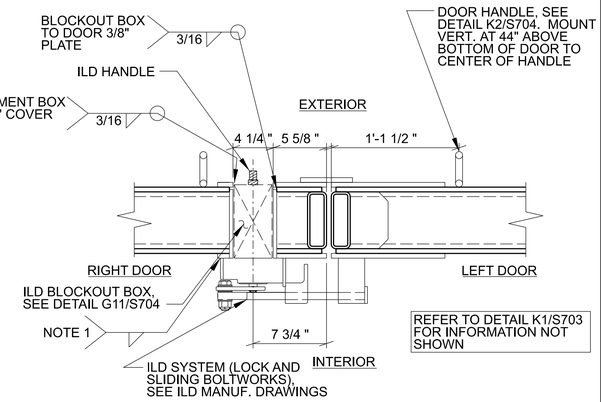


K6 SECTION
SCALE: 1 1/2"=1'-0"



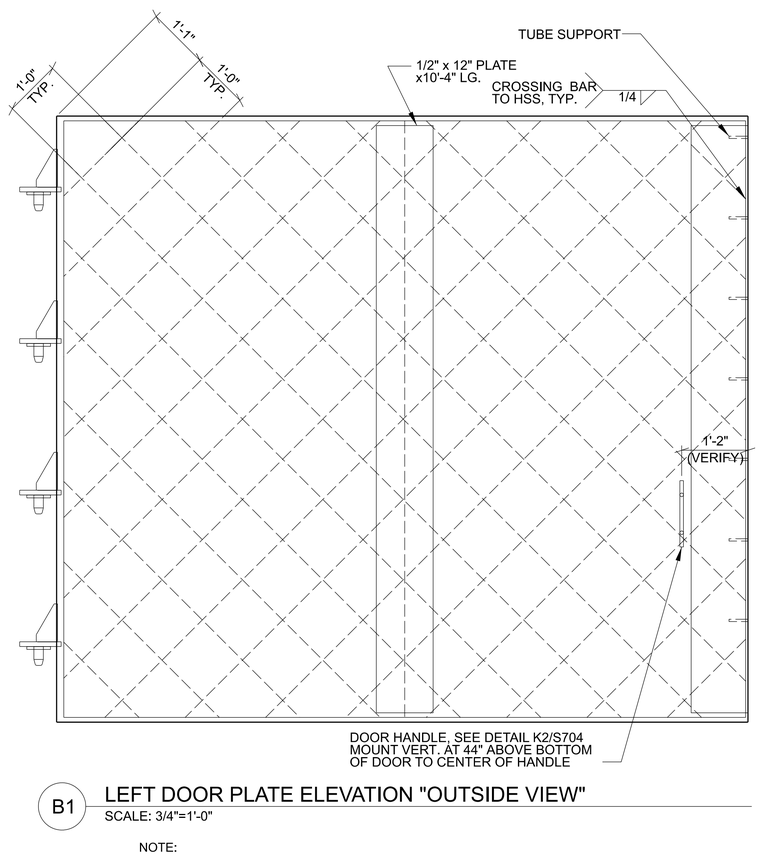
K11 SECTION
SCALE: 1 1/2"=1'-0"

NOTE 1:
WELD AT ILD BOLTWORKS TO DOOR PER ILD DRAWINGS



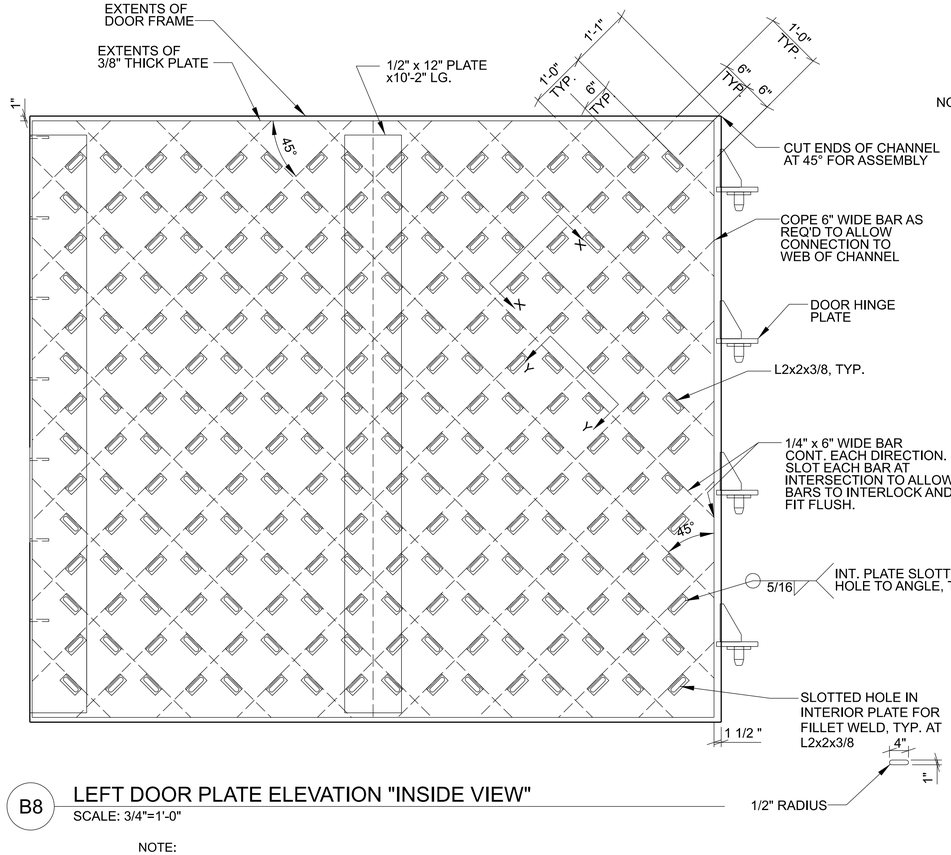
K16 SECTION
SCALE: 1 1/2"=1'-0"

NOTE 1:
WELD AT ILD BOLTWORKS TO DOOR PER ILD DRAWINGS



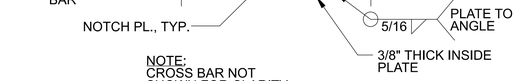
B1 LEFT DOOR PLATE ELEVATION "OUTSIDE VIEW"
SCALE: 3/4"=1'-0"

NOTE:
1. RIGHT DOOR PLATE ELEVATION IS SIMILAR EXCEPT FOR ILD BLOCKOUT



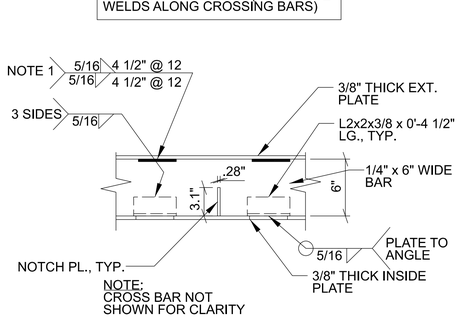
B8 LEFT DOOR PLATE ELEVATION "INSIDE VIEW"
SCALE: 3/4"=1'-0"

NOTE:
1. RIGHT DOOR PLATE ELEVATION IS SIMILAR EXCEPT FOR ILD BLOCKOUT
2. SEE S-705 FOR ILD DOOR LATCH COMPONENTS NOT SHOWN HERE FOR CLARITY.



SECTION X-X
SCALE: 1 1/2"=1'-0"

NOTE 1:
PLATE TO CROSS BAR (ALTERNATE WELDS ALONG CROSSING BARS)



SECTION Y-Y
SCALE: 1 1/2"=1'-0"

0 1' 2' 4'
SCALE 3/4" = 1'-0"

0 0'6" 1' 2'
SCALE 1 1/2" = 1'-0"

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	Removed Hasps. Modified ILD Door Details, Implemented Lessons Learned. Electrical Updates	JAN. 2024

DESIGNED BY: J. UMPHREY
DRAWN BY: J. UMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: J. MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
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CONTRACT NO.:

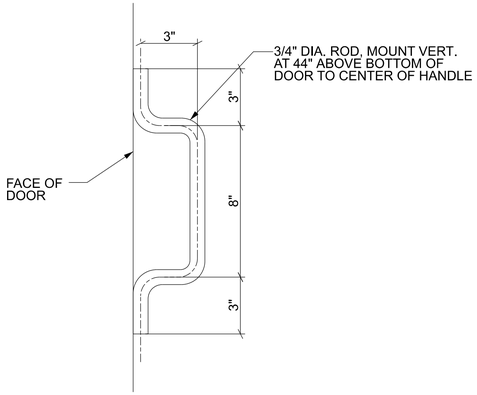
U.S. ARMY CORPS OF ENGINEERS ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV. 1)

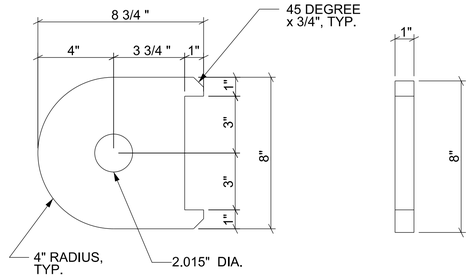
DOOR SECTIONS

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

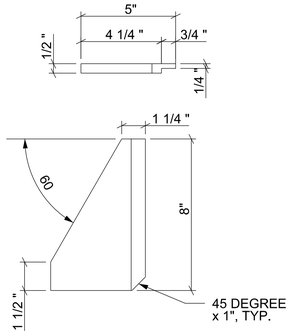
SHEET ID
S-703
Sheet 16 of 26



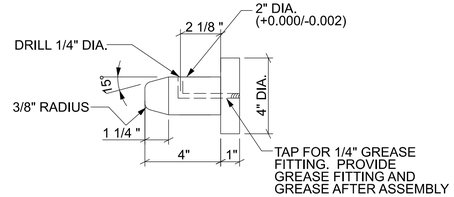
K2 HANDLE DETAIL
SCALE: 3"=1'-0"



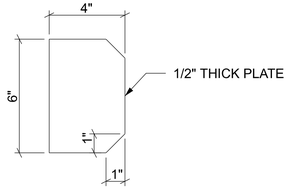
K6 DOOR HINGE PL. DETAIL
SCALE: 3"=1'-0"



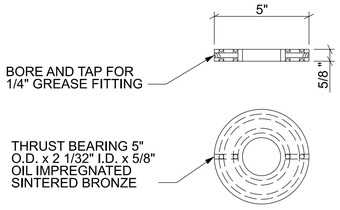
K11 GUSSET HINGE PL. DETAIL
SCALE: 3"=1'-0"



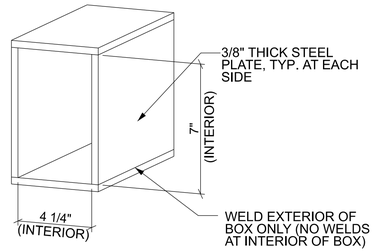
K15 HINGE PIN DETAIL
SCALE: 3"=1'-0"



G2 TUBE SUPPORT PL. DETAIL
SCALE: 3"=1'-0"



G6 THRUST BEARING DETAIL
SCALE: 3"=1'-0"



G11 ILD BLOCKOUT BOX DETAIL
SCALE: 3"=1'-0"

0 0'3" 0'6" 1'
SCALE 3" = 1'-0"

US Army Corps of Engineers®

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U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

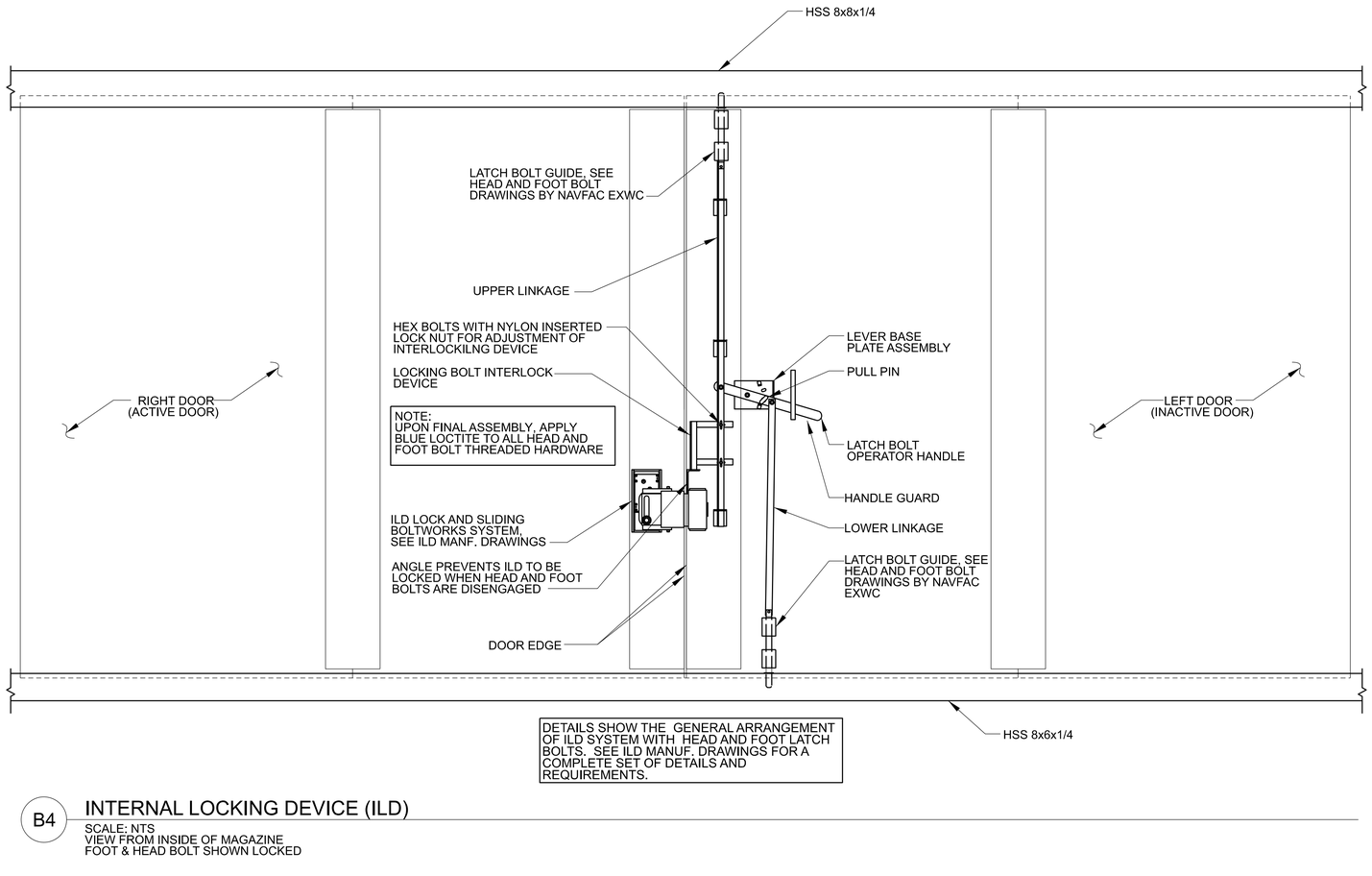
DOOR DETAILS

SHEET ID
S-704
Sheet 17 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL NOTES

1. THE INTERNAL LOCKING DEVICE (ILD), THE SLIDING BOLTWORKS, AND HEAD AND FOOT BOLT DRAWINGS ARE A U.S. GOVERNMENT DESIGNED AND PATENTED LOCKING SYSTEM. THE SLIDING BOLTWORKS AND HEAD AND FOOT BOLT DRAWINGS SHALL BE OBTAINED THROUGH THE GOVERNMENT FROM THE NAVAL FACILITIES ENGINEERING AND EXPEDITIONARY WARFARE CENTER (NAVFAC-EXWC), SECURITY ENGINEERING DIVISION, DOD LOCK PROGRAM. THE GOVERNMENT INSTALLATION AGENCY IS RESPONSIBLE FOR PURCHASING THE (ILD) LOCK DIRECTLY FROM NAVFAC-EXWC. CONTACT CAN BE MADE VIA PHONE BY CALLING 805-982-1212 OR THEIR WEBSITE (https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_nfesc_pp/locks/) FOR ORDERING INFORMATION.
2. THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLATION OF ALL COMPONENTS RELATED TO THE MAGAZINE DOOR OPERATING SYSTEM, INCLUDING THE SLIDING LOCKING BOLTWORKS AND HEAD AND FOOT BOLT LOCKING SYSTEM.
3. NO MODIFICATIONS AND/OR DEVIATIONS TO THE DOOR CONSTRUCTION SHOWN IN THE STANDARD DRAWINGS ARE PERMITTED TO ACCOMMODATE THE ILD UNLESS APPROVED BY THE U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE (STRUCTURAL BRANCH).
4. DOOR MANUFACTURER WILL COORDINATE WITH THE GOVERNMENT ON INSTALLATION AND ATTACHMENT DETAILS OF THE ILD AND PROVIDE THE NECESSARY STIFFENERS AND ADDITIONAL FRAMING (IF REQUIRED) TO ACCOMMODATE THE ILD.
5. SEE NAVFAC-EXWC SLIDING BOLTWORKS AND HEAD AND FOOT BOLT DRAWINGS FOR ADDITIONAL INFORMATION NOT SHOWN IN THESE DRAWINGS.
6. SEE DOOR FRAME AND DOOR DETAILS ON SHEETS S701 - S704.
7. UPON COMPLETION OF THE MAGAZINE PROJECT, THE GOVERNMENT INSTALLATION AGENCY SHALL CONTACT NAVFAC-EXWC DOD LOCK PROGRAM FOR PROCUREMENT AND COORDINATE THE INSTALLATION OF THE ILD LOCK.



B4 INTERNAL LOCKING DEVICE (ILD)

SCALE: NTS
VIEW FROM INSIDE OF MAGAZINE
FOOT & HEAD BOLT SHOWN LOCKED

US Army Corps of Engineers®

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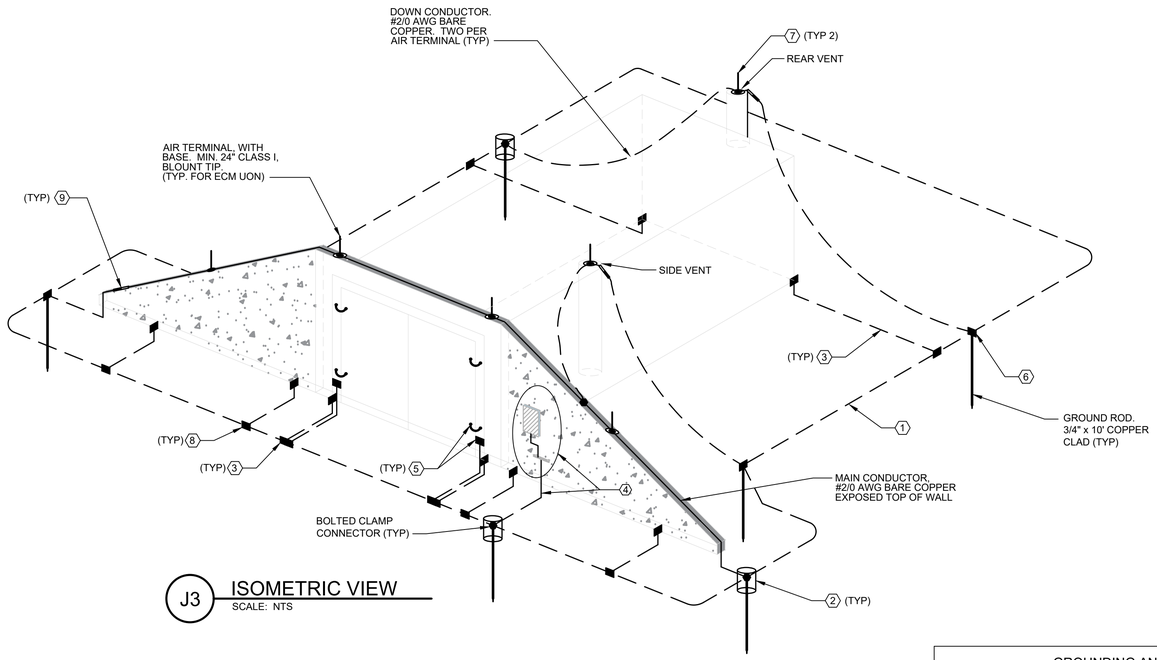
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

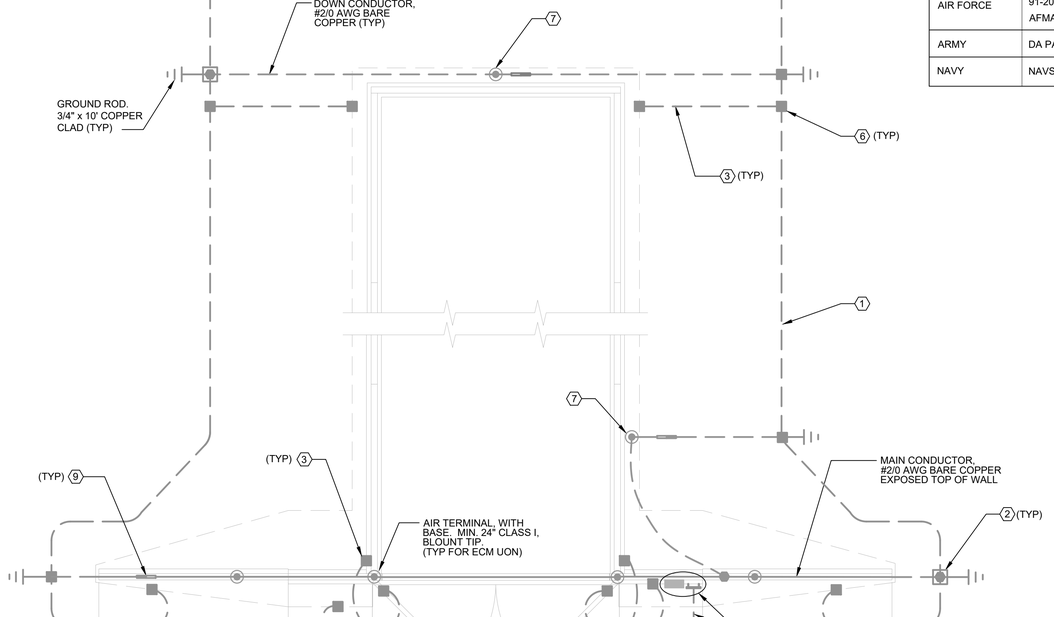
INTERNAL LOCKING DEVICES

SHEET ID
S-705
Sheet 18 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



J3 ISOMETRIC VIEW
SCALE: NTS



A3 GROUNDING AND LIGHTNING PROTECTION PLAN VIEW
SCALE: NTS

LEGEND:

EXPOSED	———
DIRECT BURIED	— — — — —

ABBREVIATIONS:

AHJ	AUTHORITY HAVING JURISDICTION
AWG	AMERICAN WIRE GAUGE
DOD	DEPARTMENT OF DEFENSE
DWG	DRAWING
ECM	EARTH COVERED MAGAZINE
G.E.S.	GROUNDING ELECTRODE SYSTEM
LPS	LIGHTNING PROTECTION SYSTEM
M	METER
MIN	MINIMUM
mm	MILLIMETERS
NTE	NOT TO EXCEED
NTS	NOT TO SCALE
QTY	QUANTITY
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED

GENERAL NOTES:

1. THIS DRAWING SET REPRESENTS THE ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, (CEHNC) STANDARD GUIDANCE FOR LIGHTNING PROTECTION SYSTEM (LPS) DESIGN APPLICABLE TO EARTH COVERED MAGAZINES (ECM). THIS STANDARD IS A PERFORMANCE BASED DESIGN. DESIGNER SHALL ADAPT THE STANDARDS TO SPECIFIC SITE CONDITIONS AND CONSULT GOVERNING CRITERIA TO ENSURE A COMPLETE AND FUNCTIONAL LPS DESIGN.
2. AT ARMY INSTALLATIONS THE COMPLETED LPS SHALL RECEIVE AN UNDERWRITER'S LABORATORY (UL) MASTER LABEL CERTIFICATE IN COMPLIANCE WITH APPLICABLE GOVERNING CRITERIA. OTHER THAN ARMY, CERTIFICATION SHALL BE ACCORDING TO THE AHJ.
3. LPS COMPONENTS SHALL BEAR THE UL LISTING OR LABEL WHEN AVAILABLE (OR LOCAL EQUIVALENT).
4. THE LPS DESIGN MUST PROVIDE A ZONE-OF-PROTECTION BASED ON A 100' RADIUS STRIKING DISTANCE (ds) USING THE ROLLING SPHERE METHOD (RSM) ANALYSIS. SEE DRAWINGS E-301 FOR A TYPICAL RSM ANALYSIS. AIR TERMINALS ALONG THE LENGTH OF THE ECM OR BETWEEN THE HEADWALL AND THE REAR VENT ARE OPTIONAL WHERE A MINIMUM OF 2' EARTH COVER IS MAINTAINED (NOT SHOWN WITHIN THIS STANDARD).
5. REINFORCING STEEL IN WALLS, FLOOR SLAB, ROOF PANELS OR BOX STRUCTURES MUST BE ELECTRICALLY CONTINUOUS THROUGH BONDING AND HAVE A SOLID, DIRECT CONNECTION TO THE PRIMARY GROUNDING ELECTRODE SYSTEM. MINIMUM REBAR OVERLAP IS 20 x DIAMETER (20D). METAL VENTILATORS, STEEL DOORS AND FRAMES SHALL BE BONDED TO THE PRIMARY GROUNDING ELECTRODE SYSTEM. PHOTO DOCUMENTATION OF THE BONDING AND GROUNDING WORKS IS MANDATORY BEFORE CONCEALING. REFERENCE STRUCTURAL DRAWINGS FOR ADDITIONAL BONDING INFORMATION.
6. INCOMING POWER AND COMMUNICATION CONDUCTORS MUST RUN UNDERGROUND AT LEAST 50' BEFORE ENTERING THE FACILITY. CONDUCTORS MUST BE INSTALLED IN METALLIC CONDUIT THAT IS BONDED TO THE PRIMARY GROUNDING ELECTRODE SYSTEM AT THE POINT OF ENTRY.
7. INTERIOR ELECTRICAL SYSTEMS ARE NOT INCLUDED IN THIS STANDARD SET. IF REQUIRED, INTERIOR ELECTRICAL SYSTEMS SHALL BE DESIGNED BASED ON USER REQUIREMENTS. HAZARDOUS CLASSIFICATIONS BASED ON NFPA 70, ARTICLE 500 SHALL BE DETERMINED BY THE DESIGNER DURING THE DESIGN PROCESS BASED ON INTENDED FACILITY USE.
8. WHEN ELECTRICAL SYSTEMS ARE PRESENT, PROVIDE SURGE PROTECTION DEVICES (SPD) FOR CONDUCTIVE MEDIA AT THE SERVICE ENTRANCE EQUIPMENT. SPDs SHALL BE COMPLIANT WITH NFPA 780.
9. STATIC GROUND BUS BAR NOT DEPICTED IN THE PLAN VIEW. IF REQUIRED, SEE DA PAM 385-64, SECTION II, AND UFC 3-575-01, CHAPTER 2 FOR MORE INFORMATION AND DETAIL ON SHEET E-201. LOCATION TBD IN FIELD.
10. CONSIDER METALLIC MASSES FOR SIDE FLASH POTENTIAL. METALLIC MASSES WITHIN SIDE FLASH DISTANCE SHALL BE BONDED TO THE LPS, OR BE MOVED OUTSIDE THE SIDE FLASH SEPARATION DISTANCE.
11. UNDERGROUND CONNECTIONS TO THE GROUNDING ELECTRODE SYSTEM SHALL BE WITH EXOTHERMIC WELDS. WITHIN GROUND TEST WELLS USE BOLTED CONNECTORS, ONLY.
12. USE ONLY COPPER CONDUCTORS. PROVIDE BI-METALLIC CONNECTORS, PLATING AND ACCEPTABLY COATED MATERIALS AS REQUIRED TO PREVENT CORROSION DUE TO DISSIMILAR METALS CONTACT. SEE ANSI/UL 96 SUGGESTED COMPATIBLE METALS ON SHEET E-201.
13. TWO VENTILATORS ARE STANDARD. IF OTHER VENTILATORS ARE REQUIRED, PROVIDE AIR TERMINALS, GROUNDING AND BONDING TYPICAL AS SHOWN. ALL OTHER LPS COMPONENTS AND DESIGN ASPECTS REMAIN UNCHANGED. SIDE VENTILATOR LOCATION IS APPROXIMATE. LOCATION SHOWN FOR CLARITY.
14. APPLY THE MOST STRINGENT CRITERIA WHERE CONFLICTS ARISE BETWEEN U.S. STANDARDS AND LOCAL STANDARDS. SEE CRITERIA TABLE THIS DRAWING.
15. LPS CONDUCTORS SHALL BE SIZED PER NFPA 780 TABLE 4.1.1.1.1 (CLASS I) OR TABLE 4.1.1.1.2 (CLASS II) AS NOTED. LPS CONDUCTORS FOR ECMs SHALL BE MINIMUM MAIN-SIZE CLASS II, UON. REFER TO TABLE THIS SHEET FOR CORRESPONDING AWG SIZES TO MAIN-SIZE LPS CONDUCTORS WHERE BARE AWG CONDUCTORS ARE NOT "LISTED FOR THE PURPOSE" FOR LIGHTNING PROTECTION BY A LISTING AUTHORITY.
16. REFER TO THE SPECIAL INSTRUCTIONS SCHEDULE ON SHEET S-002 FOR VERIFICATION PROCEDURES DURING CONSTRUCTION.

GROUNDING AND LPS CRITERIA PER DOD AGENCY

DOD (APPLICABLE ALL AGENCIES)	NFPA 780	STANDARD FOR THE INSTALLATION OF LIGHTNING PROTECTION SYSTEMS
	DESR 6055.09	DEFENSE EXPLOSIVES SAFETY REGULATION
	UFC 4-420-01	AMMUNITION AND EXPLOSIVES STORAGE MAGAZINES
	UFC 3-575-01	LIGHTNING AND STATIC ELECTRICITY PROTECTION SYSTEMS
AIR FORCE	DESR 6055.09_AFMAN 91-201	EXPLOSIVES SAFETY STANDARDS
	AFMAN 32-1065	GROUNDING AND ELECTRICAL SYSTEMS
ARMY	DA PAM 385-64	EXPLOSIVES SAFETY STANDARDS
NAVY	NAVSEA OP 5	AMMUNITION AND EXPLOSIVES SAFETY ASHORE

LIGHTNING PROTECTION CONDUCTORS AND CORRESPONDING AWG SIZES

(NFPA 780 TABLE A.4.1.1.1)

LIGHTNING CONDUCTORS	AREA (CIR. MILS)
• CLASS I MAIN-SIZE COPPER	57,400
• #2 AWG	66,360
• CLASS II MAIN-SIZE COPPER	115,000
• #2/0 AWG	133,100
• LIGHTNING BONDING COPPER	26,240
• #6 AWG	26,240

SIZES SHOWN ON SHEETS FOR THIS STANDARD ARE INDICATED IN MINIMUM AWG SIZE. ALUMINUM CONDUCTORS NOT PERMITTED FOR ECM CONSTRUCTION. SEE GENERAL NOTE 15.

KEYED NOTES:

1. #4/0 AWG BARE COPPER CONDUCTOR AND THE GROUNDING ELECTRODE SYSTEM (GES). INSTALL IN DIRECT CONTACT WITH EARTH 3' - 8' FROM EDGE OF EARTH COVER AND MIN. 30" BELOW GRADE. BENDS SHALL NOT BE LESS THAN 90 DEGREES.
2. GROUND TEST WELL WITH 3/4" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQUIRED. PROVIDE TRAFFIC RATED COVER. ONLY BOLTED CLAMP CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL ON SHEET E-201.
3. BOND FOUNDATION REBAR TO THE GES USING #4/0 AWG. TYPICAL EACH CORNER AND AT DISTANCES NOT TO EXCEED 60'. SEE DETAIL ON SHEET E-202.
4. WHEN REQUIRED, PROVIDE POWER PANEL AND FIELD LOCATE PER USER REQUIREMENTS. MAY BE LOCATED OUTSIDE OR INSIDE MAGAZINE (OUTSIDE SHOWN). ELECTRICAL SERVICE GROUNDING SHALL BE INSTALLED PER NFPA 70 OR MORE STRINGENT LOCAL CODE. PROVIDE SURGE PROTECTION AT POWER PANEL. PROVIDE SINGLE POINT GROUND BAR FOR GROUNDING CONNECTIONS. SEE DETAIL ON SHEET E-202 FOR SINGLE POINT GROUND BAR.
5. BOND DOOR FRAME TO GES WITH #2/0 AWG, TWO PLACES. BOND DOOR TO DOOR FRAME USING BRAIDED COPPER STRAP EQUAL TO #1/0 AWG. TOP AND BOTTOM EACH DOOR (SHOWN IN ISOMETRIC VIEW).
6. EXOTHERMIC WELD BONDING CONNECTION. PROVIDE APPLICABLE TYPE MOLD AS REQUIRED.
7. VENT MOUNTED AIR TERMINAL. PROVIDE AIR TERMINAL BASE COMPATIBLE WITH VENT MATERIAL TO PREVENT CORROSION RESULTING FROM DISSIMILAR METALS. AIR TERMINAL SHALL HAVE TWO PATHS TO GROUND.
8. BOND WING-WALL REBAR TO THE GES USING #4/0 AWG. MINIMUM TWO PLACES PER WING-WALL. SEE DETAIL ON SHEET E-202.
9. OPTIONAL PER USER REQUIREMENTS. PROVIDE A 4-BOLT INLINE CONNECTOR, OR EQUIVALENT OF MIN. 2 " SURFACE CONTACT EACH CONDUCTOR, AT DOWN CONDUCTORS EXTENDING FROM THE AIR TERMINAL SYSTEM IN ORDER TO DISCONNECT BELOW GRADE CONDUCTORS FROM ABOVE GRADE CONDUCTORS TO FACILITATE TESTING OF GROUNDING SYSTEMS (NOT NECESSARY WHERE DISCONNECT CAN BE MADE AT TEST WELLS). INSTALL EXPOSED AND WHERE ACCESSIBLE. ALL LOCATIONS MAY NOT BE SHOWN. SEE DETAIL ON SHEET E-202.

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DESIGNED BY: J. DENTON
DRAWN BY: J. DENTON
CHECKED BY: G. SILLIVANT
SUBMITTED BY: TES MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

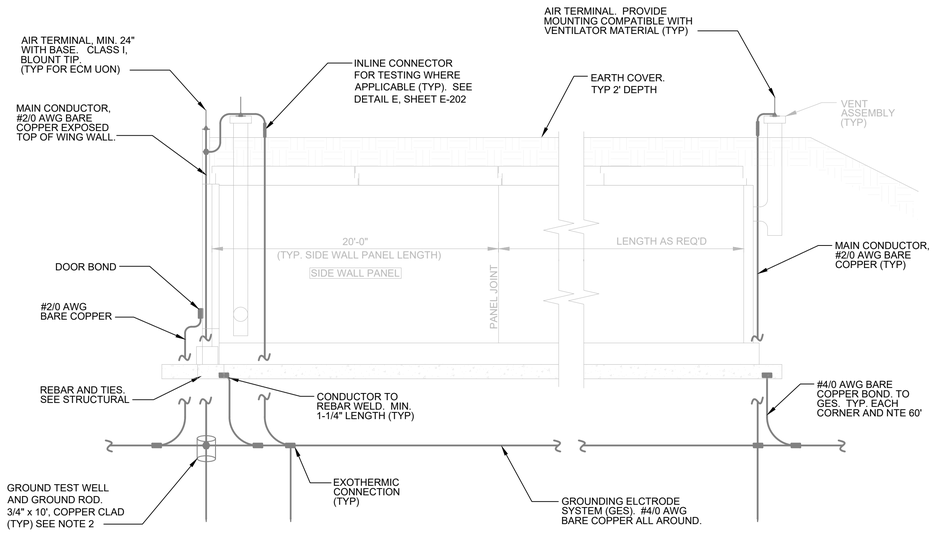
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV 1)

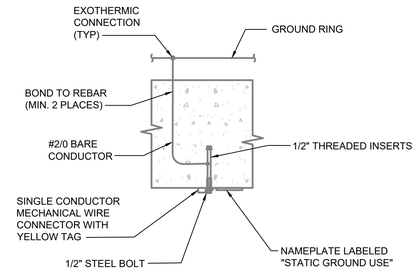
GROUNDING AND LIGHTNING PROTECTION PLAN

SHEET ID
E-101
Sheet 19 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



J4 TYPICAL ECM SECTION VIEW
SCALE: NTS



L11 OPTIONAL STATIC GROUND INSERT DETAIL
SCALE: NTS

NOTES:

A. PROVIDE A REMOVABLE YELLOW MELAMINE PLASTIC TAG THAT ATTACHES TO THE STATIC GROUND INSERT. TAG SHALL INCLUDE THE FOLLOWING INFORMATION:

"NOT IN SERVICE - NO MAINTENANCE REQUIRED.

INSTALLATION MEETS STATIC/FACILITY GROUNDING REQUIREMENTS PER DA PAM 385-64. ACTIVITY SHALL PERFORM TESTING PER DAM 385-64 AND ENACT MAINTENANCE SCHEDULE WHEN THE STATIC/FACILITY GROUND INSERT IS PLACED IN SERVICE.

RETAIN THIS TAG TO RE-ATTACH WHEN REMOVED FROM SERVICE."

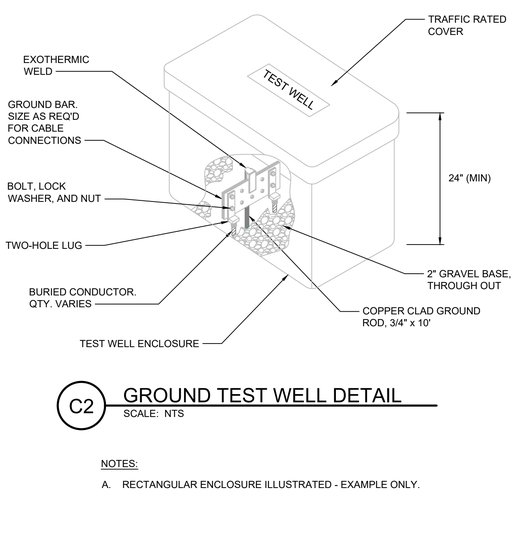
GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET E-101.
2. GROUND TEST WELL WITH 3/4" X 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQUIRED. PROVIDE TRAFFIC RATED COVERS. ONLY BOLTED-TYPE CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL THIS SHEET.
3. CONDUCTORS THIS SHEET SHALL BE COPPER, MINIMUM SIZE #2/0 AWG BARE COPPER, UON.
4. SEE STRUCTURAL SHEETS TO CONFIRM ECM DIMENSIONS AND MEASUREMENTS.

SUGGESTED COMPATIBLE METALS

CONFIRM METAL COMPATIBILITY WITH ANSI/UL 96.

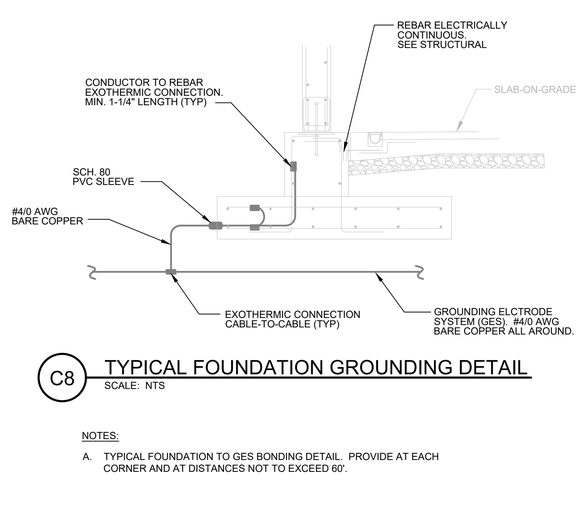
STRUCTURAL METALS	LPS METALS
AL	AL
IRON	AL or TIN PLATED CU
COPPER	CU
BRONZE	CU
STEEL (GALV.)	AL
STEEL (STAINLESS)	AL or CU
STEEL	AL
TIN	AL or CU
ZINC	AL
ABBREVIATIONS: AL - ALUMINUM CU - COPPER	GALV. - GALVANIZED



C2 GROUND TEST WELL DETAIL
SCALE: NTS

NOTES:

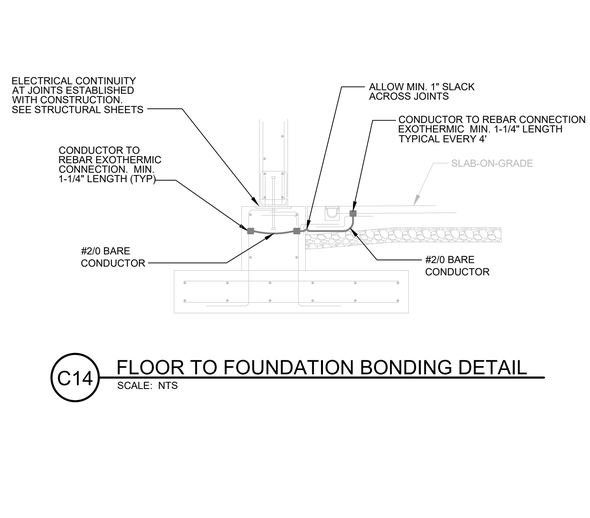
A. RECTANGULAR ENCLOSURE ILLUSTRATED - EXAMPLE ONLY.



C8 TYPICAL FOUNDATION GROUNDING DETAIL
SCALE: NTS

NOTES:

A. TYPICAL FOUNDATION TO GES BONDING DETAIL. PROVIDE AT EACH CORNER AND AT DISTANCES NOT TO EXCEED 60'.



C14 FLOOR TO FOUNDATION BONDING DETAIL
SCALE: NTS

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SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
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U.S. ARMY CORPS OF ENGINEERS
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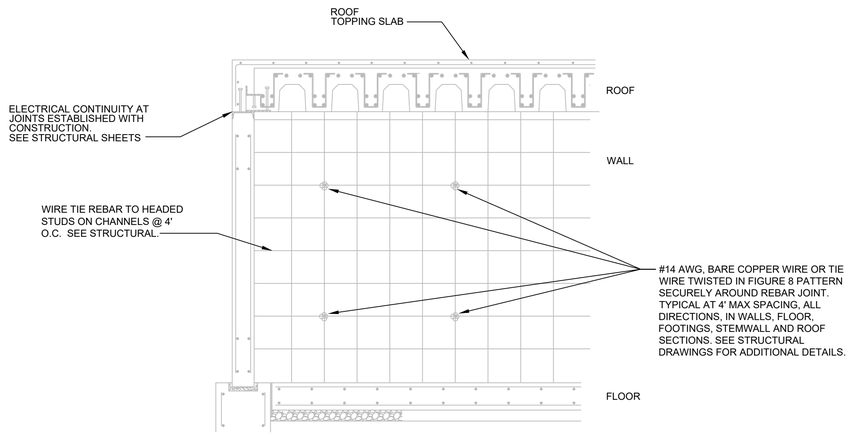
MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV 1)

GROUNDING AND LIGHTNING PROTECTION DETAILS

SHEET ID
E-201
Sheet 20 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



K3 PANEL BONDING DETAILS

SCALE: NTS

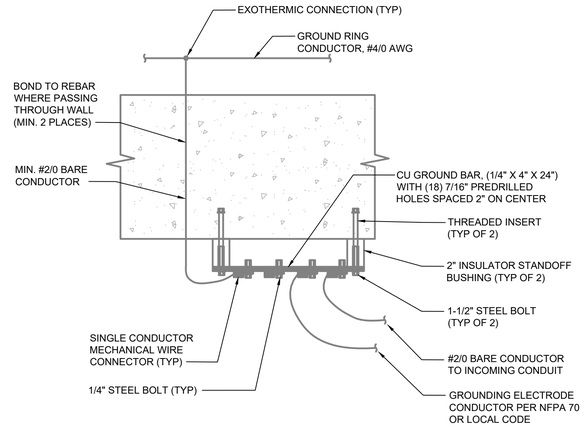
NOTES:

A. "TACK" WELDING MAY BE USED IN LIEU OF TIE WIRES FOR ELECTRICAL CONTINUITY.

B. BONDING AND GROUNDING NOTE: ELECTRICAL BONDING REQUIREMENTS INTERNAL TO PRECAST ROOF AND WALL PANELS SHALL BE PROVIDED BY THE PRECAST MANUFACTURER IN ACCORDANCE WITH THE STRUCTURAL DRAWINGS. ELECTRICAL BONDING REQUIREMENTS EXTERNAL TO PRECAST PANELS AND WITHIN CAST-IN-PLACE CONCRETE SLABS SHALL BE FIELD INSTALLED.

C. PANEL BONDING DETAIL IS GENERIC AND MAY NOT REFLECT EXACT CONSTRUCTION METHODS.

D. INSTALL SAME BONDING METHODS AT WING-WALL PANELS.



K10 SINGLE POINT GROUND BAR DETAIL

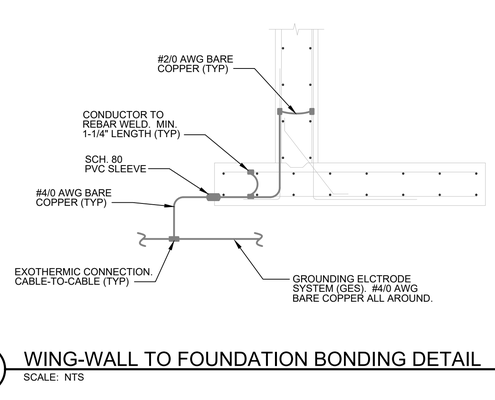
SCALE: NTS

NOTES:

A. WHERE POWER IS PROVIDED TO THE MAGAZINE, PROVIDE A SINGLE POINT GROUND BAR AS DETAILED. LOCATE ADJACENT TO POWER PANEL, MIN. 18" ABOVE GRADE. INTERIOR INSTALL SHOWN.

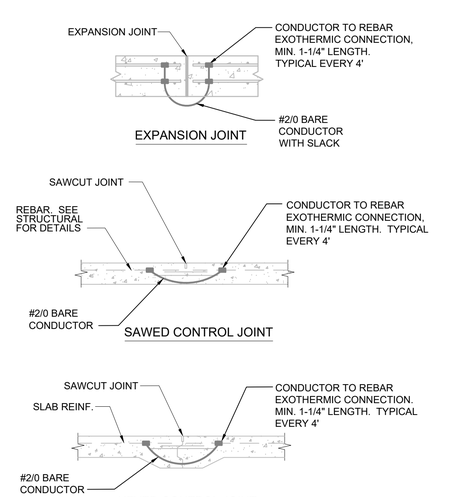
GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET E-101.
2. UNLESS OTHERWISE NOTED, BONDING AS SHOWN WITHIN THE DETAILS ON THIS SHEET SHALL BE EVERY 4' MINIMUM IN ALL DIRECTIONS.
3. CONDUCTORS THIS SHEET SHALL BE COPPER, MINIMUM SIZE #2/0 AWG BARE COPPER, UON.
4. SEE STRUCTURAL SHEETS TO CONFIRM ECM DIMENSIONS AND MEASUREMENTS.



B2 WING-WALL TO FOUNDATION BONDING DETAIL

SCALE: NTS



B9 TYPICAL BOND CONNECTION AT VARIOUS CONSTRUCTION JOINTS

SCALE: NTS

CONNECTOR SHALL PROVIDE MIN. 2" CONNECTION LENGTH EACH CONDUCTOR OR EQUIVALENT SURFACE AREA CONTACT

D15 TYPICAL INLINE CONNECTOR (DISCONNECT)

SCALE: NTS

NOTES:

A. INLINE CONNECTOR MAY BE USED TO FACILITATE TESTING OF DIFFERENT PORTIONS OF THE LIGHTNING PROTECTION AND GROUNDING SYSTEM. FOR EXAMPLE, INLINE CONNECTORS MAY BE USED TO DISCONNECT THE BELOW GRADE GROUNDING SYSTEM FROM THE ABOVE GRADE AIR TERMINALS AND MAIN CONDUCTORS. USER OPTION TO INSTALL NOT NECESSARY WHERE DISCONNECT CAN BE MADE AT A TEST WELL.

B. WHEN USED, INLINE CONNECTORS SHALL BE INSTALLED EXPOSED AND WHERE EASILY ACCESSIBLE.

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DESIGNED BY: J. DENTON
DRAWN BY: J. DENTON
CHECKED BY: G. SILLIVANT
SUBMITTED BY: TES MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

GROUNDING AND BONDING DETAILS

SHEET ID
E-202
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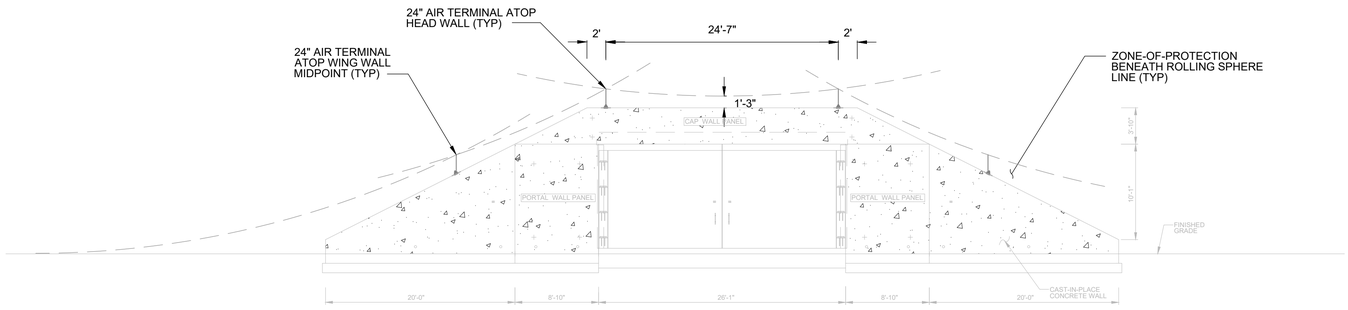
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



K6 ROLLING SPHERE ANALYSIS - HEAD WALL VIEW

SCALE: NTS

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET E-101.
2. ROLLING SPHERE METHOD (RSM) ANALYSIS DEMONSTRATES A ZONE OF PROTECTION BASED ON A 100' RADIUS STRIKING DISTANCE FOR THE HEAD WALL. A LPS TO PROTECT THE ECM STRUCTURE IS OPTIONAL IF 2' OF EARTH COVERED IS MAINTAINED OVER THE ECM.
3. VENTILATORS ARE NOT SHOWN IN THE HEAD WALL VIEW. EACH VENTILATOR MUST HAVE AN AIR TERMINAL EXTENDING 24" ABOVE THE VENTILATOR.
4. GROUNDING AND BONDING COMPONENTS / SYSTEMS ARE NOT DEPICTED IN THE RSM ANALYSIS.
5. SEE STRUCTURAL SHEETS TO CONFIRM ECM DIMENSIONS AND MEASUREMENTS.

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BOX-TYPE, STD 421-80-07 (REV 1)

ROLLING SPHERE METHOD ANALYSIS

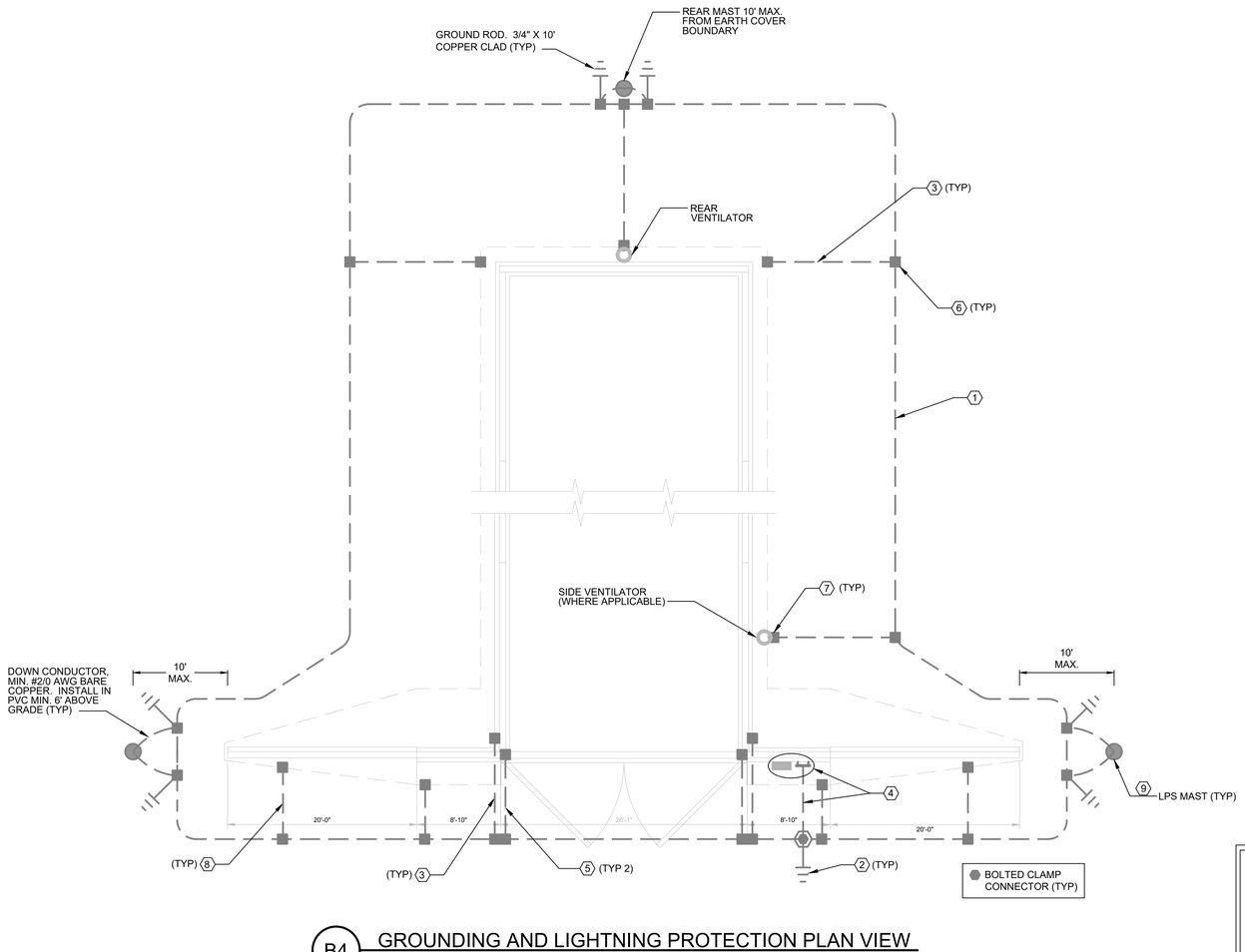
SHEET ID
E-301

Sheet 22 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GOVERNING LIGHTNING PROTECTION SYSTEM CRITERIA PER DOD AGENCY		
DOD (APPLICABLE ALL AGENCIES)	NFPA 780	STANDARD FOR THE INSTALLATION OF LIGHTNING PROTECTION SYSTEMS
	DESR 6055.09	DEFENSE EXPLOSIVES SAFETY REGULATION
	UFC 4-420-01	AMMUNITION AND EXPLOSIVES STORAGE MAGAZINES
	UFC 3-575-01	LIGHTNING AND STATIC ELECTRICITY PROTECTION SYSTEMS
AIR FORCE	DOD 6055.09_AFMAN 91-201	EXPLOSIVES SAFETY STANDARDS
	AFMAN 32-1065	GROUNDING AND ELECTRICAL SYSTEMS
ARMY	DA PAM 385-64	EXPLOSIVES SAFETY STANDARDS
NAVY	NAVSEA OP 5	AMMUNITION AND EXPLOSIVES SAFETY ASHORE

LIGHTNING PROTECTION CONDUCTORS AND CORRESPONDING AWG SIZES (NFPA 780 TABLE A.4.1.1.1)	
LIGHTNING CONDUCTORS	AREA (CIR. MILS)
• CLASS I MAIN-SIZE COPPER	57,400
• #2 AWG	66,360
• CLASS II MAIN-SIZE COPPER	115,000
• #2/0 AWG	133,100
• LIGHTNING BONDING COPPER	26,240
• #6 AWG	26,240
SIZES SHOWN ON SHEETS FOR THIS STANDARD ARE INDICATED IN MINIMUM AWG SIZE. ALUMINUM CONDUCTORS NOT PERMITTED FOR ECM CONSTRUCTION. SEE GENERAL NOTE 15.	



B4 GROUNDING AND LIGHTNING PROTECTION PLAN VIEW
SCALE: NTS

DESIGNER NOTE: TO BE REMOVED WHEN PREPARING CONSTRUCTION DRAWINGS FOR SITE ADAPTATION DESIGN

SHEETS E-101-A, E-201-A. E-202-A, AND E-301-A IDENTIFY AN ALTERNATE LIGHTNING PROTECTION SYSTEM USING A MAST-TYPE DESIGN INSTEAD OF AN INTEGRAL-TYPE DESIGN. DESIGNER SHALL CONFIRM WITH THE OWNER THE TYPE OF PROTECTION SYSTEM TO BE INSTALLED AND REMOVE THE SHEETS IDENTIFYING THE NON-APPLICABLE DESIGN FROM THE CONSTRUCTION CONTRACT DOCUMENTS.

(A) - ALTERNATE LIGHTNING PROTECTION DESIGN

ALTERNATE DESIGN GENERAL NOTES:

1. SEE GENERAL NOTES THIS SHEET.
2. USER AND OWNER HAS THE OPTION TO INSTALL EITHER TYPE OF PROTECTION SYSTEM ILLUSTRATED, INTEGRAL OR MAST-TYPE. BONDING AND GROUNDING REQUIREMENTS ARE SHOWN ON SHEETS E-101-A, E-201-A AND E-202-A.
3. ROLLING SPHERE ANALYSIS FOR THE MAST-TYPE SYSTEM IS SHOWN ON SHEET E-301-A.

LEGEND:

EXPOSED ———————

DIRECT BURIED — — — — —

ABBREVIATIONS:

AHJ	AUTHORITY HAVING JURISDICTION
AWG	AMERICAN WIRE GAUGE
DOD	DEPARTMENT OF DEFENSE
DWG	DRAWING
ECM	EARTH COVERED MAGAZINE
GES	GROUNDING ELECTRODE SYSTEM
LPS	LIGHTNING PROTECTION SYSTEM
M	METER
MIN	MINIMUM
mm	MILLIMETERS
NTE	NOT TO EXCEED
NTS	NOT TO SCALE
QTY	QUANTITY
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED

GENERAL NOTES:

1. THIS DRAWING SET REPRESENTS THE ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, (CEHNC) STANDARD GUIDANCE FOR LIGHTNING PROTECTION SYSTEM (LPS) DESIGN APPLICABLE TO EARTH COVERED MAGAZINES (ECM). THIS STANDARD IS A PERFORMANCE BASED DESIGN. DESIGNER SHALL ADAPT THE STANDARDS TO SPECIFIC SITE CONDITIONS AND CONSULT GOVERNING CRITERIA TO ENSURE A COMPLETE AND FUNCTIONAL LPS DESIGN.
2. AT ARMY INSTALLATIONS THE COMPLETED LPS SHALL RECEIVE AN UNDERWRITER'S LABORATORY (UL) MASTER LABEL CERTIFICATE IN COMPLIANCE WITH APPLICABLE GOVERNING CRITERIA. OTHER THAN ARMY, CERTIFICATION SHALL BE ACCORDING TO THE AHJ.
3. LPS COMPONENTS SHALL BEAR THE UL LISTING OR LABEL WHEN AVAILABLE (OR LOCAL EQUIVALENT).
4. THE LPS DESIGN MUST PROVIDE A ZONE-OF-PROTECTION BASED ON A 100' RADIUS STRIKING DISTANCE (ds) USING THE ROLLING SPHERE METHOD (RSM) ANALYSIS. SEE SHEETS E-301-A FOR TYPICAL RSM ANALYSIS.
5. REINFORCING STEEL IN WALLS, FLOOR SLAB, ROOF PANELS OR BOX STRUCTURES MUST BE ELECTRICALLY CONTINUOUS THROUGH BONDING AND HAVE A SOLID, DIRECT CONNECTION TO THE PRIMARY GROUNDING ELECTRODE SYSTEM. MINIMUM REBAR OVERLAP IS 20x DIAMETER (20D). METAL VENTILATORS, STEEL DOORS AND FRAMES SHALL BE BONDED TO THE PRIMARY GROUNDING ELECTRODE SYSTEM. PHOTO DOCUMENTATION OF THE BONDING AND GROUNDING WORKS IS MANDATORY BEFORE CONCEALING. REFERENCE STRUCTURAL DRAWINGS FOR ADDITIONAL BONDING INFORMATION.
6. INCOMING POWER AND COMMUNICATION CONDUCTORS MUST RUN UNDERGROUND AT LEAST 50' BEFORE ENTERING THE FACILITY. CONDUCTORS MUST BE INSTALLED IN METALLIC CONDUIT THAT IS BONDED TO THE PRIMARY GROUNDING ELECTRODE SYSTEM AT THE POINT OF ENTRY.
7. INTERIOR ELECTRICAL SYSTEMS ARE NOT INCLUDED IN THIS STANDARD SET. IF REQUIRED, INTERIOR ELECTRICAL SYSTEMS SHALL BE DESIGNED BASED ON USER REQUIREMENTS. HAZARDOUS CLASSIFICATIONS BASED ON NFPA 70, ARTICLE 500 SHALL BE DETERMINED BY THE DESIGNER DURING THE DESIGN PROCESS BASED ON INTENDED FACILITY USE.
8. WHEN ELECTRICAL SYSTEMS ARE PRESENT, PROVIDE SURGE PROTECTION DEVICES (SPD) FOR CONDUCTIVE MEDIA AT THE SERVICE ENTRANCE EQUIPMENT. SPDs SHALL BE COMPLIANT WITH NFPA 780.
9. STATIC GROUND BUS BAR NOT DEPICTED IN THE PLAN VIEW. IF REQUIRED, SEE DA PAM 385-64, SECTION II, AND UFC 3-575-01, CHAPTER 2 FOR MORE INFORMATION AND DETAIL ON SHEET E-201-A. LOCATION TBD IN FIELD.
10. CONSIDER METALLIC MASSES FOR SIDE FLASH POTENTIAL. METALLIC MASSES WITHIN SIDE FLASH DISTANCE SHALL BE BONDED TO THE LPS, OR BE MOVED OUTSIDE THE SIDE FLASH SEPARATION DISTANCE.
11. UNDERGROUND CONNECTIONS TO THE GROUNDING ELECTRODE SYSTEM SHALL BE WITH EXOTHERMIC WELDS. WITHIN GROUND TEST WELLS USE BOLTED CONNECTORS, ONLY.
12. USE ONLY COPPER CONDUCTORS. PROVIDE BI-METALLIC CONNECTORS, PLATING AND ACCEPTABLY COATED MATERIALS AS REQUIRED TO PREVENT CORROSION DUE TO DISSIMILAR METALS CONTACT. SEE ANSI/UL 96 SUGGESTED COMPATIBLE METALS ON SHEET E-201-A.
13. TWO VENTILATORS ARE STANDARD. IF OTHER VENTILATORS ARE REQUIRED, PROVIDE GROUNDING AND BONDING TYPICAL AS SHOWN. ALL OTHER LPS COMPONENTS AND DESIGN ASPECTS REMAIN UNCHANGED. SIDE VENTILATOR LOCATION IS APPROXIMATE. LOCATION SHOWN FOR CLARITY.
14. APPLY THE MOST STRINGENT CRITERIA WHERE CONFLICTS ARISE BETWEEN U.S. STANDARDS AND LOCAL STANDARDS. SEE CRITERIA TABLE THIS DRAWING.
15. LPS CONDUCTORS SHALL BE SIZED PER NFPA 780 TABLE 4.1.1.1.1 (CLASS I) OR TABLE 4.1.1.1.2 (CLASS II) AS NOTED. LPS CONDUCTORS FOR ECMs SHALL BE MINIMUM MAIN-SIZE CLASS II, UON. REFER TO TABLE THIS SHEET FOR CORRESPONDING AWG SIZES TO MAIN-SIZE LPS CONDUCTORS WHERE BARE AWG CONDUCTORS ARE NOT "LISTED FOR THE PURPOSE" FOR LIGHTNING PROTECTION BY A LISTING AUTHORITY.
16. REFER TO THE SPECIAL INSTRUCTIONS SCHEDULE ON SHEET S-002 FOR VERIFICATION PROCEDURES DURING CONSTRUCTION.
17. MAST INSTALLATION SHALL BE DESIGNED PER LOCAL CONDITIONS AND CRITERIA.

KEYED NOTES:

1. #4/0 AWG BARE COPPER CONDUCTOR AND THE GROUNDING ELECTRODE SYSTEM (GES). INSTALL IN DIRECT CONTACT WITH EARTH 3' - 8' FROM EDGE OF EARTH COVER AND MIN. 30" BELOW GRADE. BENDS SHALL NOT BE LESS THAN 90 DEGREES.
2. GROUND TEST WELL WITH 3/4" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQUIRED. PROVIDE TRAFFIC RATED COVER. ONLY BOLTED CLAMP CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL ON SHEET E-201-A.
3. BOND FOUNDATION REBAR TO THE G.E.S. USING #4/0 AWG. TYPICAL EACH CORNER AND AT DISTANCES NOT TO EXCEED 60'. SEE DETAIL ON SHEET E-202-A.
4. WHEN REQUIRED, PROVIDE POWER PANEL AND FIELD LOCATE PER USER REQUIREMENTS. PANEL MAY BE LOCATED OUTSIDE OR INSIDE MAGAZINE (OUTSIDE SHOWN). ELECTRICAL SERVICE GROUNDING SHALL BE INSTALLED PER NFPA 70 OR MORE STRINGENT LOCAL CODE. PROVIDE SURGE PROTECTION AT POWER PANEL. PROVIDE SINGLE POINT GROUND BAR FOR GROUNDING CONNECTIONS. SEE DETAIL ON SHEET E-202-A FOR SINGLE POINT GROUND BAR.
5. BOND DOOR FRAME TO THE GES WITH #2/0 AWG, TWO PLACES. BOND DOOR TO DOOR FRAME USING BRAIDED COPPER STRAP EQUAL TO #1/0 AWG. TOP AND BOTTOM EACH DOOR (SHOWN IN ISOMETRIC VIEW).
6. EXOTHERMIC WELD BONDING CONNECTION. PROVIDE APPLICABLE TYPE MOLD AS REQUIRED.
7. VENTILATOR BONDING REQUIRED. PROVIDE COMPATIBLE BONDING MATERIAL WITH VENTILATOR TO PREVENT CORROSION RESULTING FROM DISSIMILAR METALS.
8. BOND WING-WALL REBAR TO THE GES USING #4/0 AWG. MINIMUM TWO PLACES PER WING-WALL. SEE DETAIL ON SHEET E-202-A.
9. LPS MAST, WOOD OR METALLIC PER USER REQUIREMENTS. WHERE WOOD MASTS ARE USED, PROVIDE AIR TERMINAL MOUNTED AS ILLUSTRATED IN DETAIL ON SHEET E-202-A. PROVIDE TWO MAIN SIZE DOWN CONDUCTORS TO THE GES AND TERMINATED AT A GROUND ROD. WHERE METALLIC MASTS ARE USED AS THE STRIKE TERMINATION DEVICE AND DOWN CONDUCTOR, THE MAST'S WALL AND TOP MUST MEET THE MINIMUM THICKNESS REQUIREMENTS AS SPECIFIED IN NFPA 780, AND THE MAST MUST BE ELECTRICALLY CONTINUOUS. METALLIC MASTS SHALL BE BONDED TO THE GES AT TWO LOCATIONS.
10. MAST HEIGHTS AND LOCATIONS SHALL PROVIDE AN EQUIVALENT ZONE OF PROTECTION AS ILLUSTRATED IN THE ROLLING SPHERE METHOD ANALYSIS ON SHEET E-301-A.

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	LPS & Grounding Updates. Removed Air Terminals Lengthwise Along ECM. Added '-A' Sheets for Mast-Type LPS Design	JAN. 2024

DESIGNED BY: J. DENTON
DRAWN BY: J. DENTON
CHECKED BY: G. SILLIVANT
SUBMITTED BY: E. MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

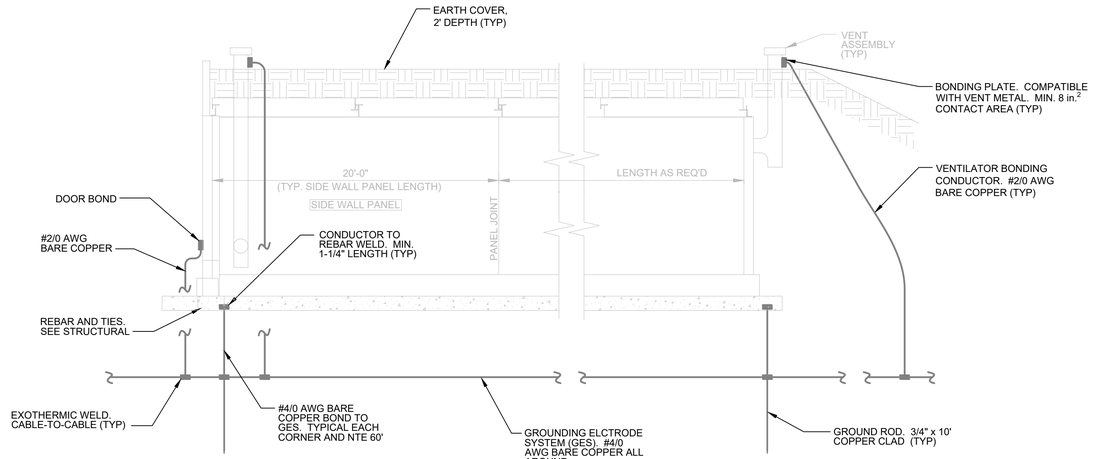
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER,
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV. 1)

GROUNDING AND LIGHTNING PROTECTION PLAN

SHEET ID
E-101-A
Sheet 23 of 26

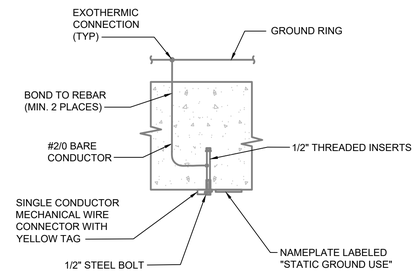
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



J3 TYPICAL ECM BONDING - CROSS SECTIONAL VIEW
SCALE: NTS

NOTES:

A. LPS MASTS NOT SHOWN.



L11 OPTICAL STATIC GROUND INSERT DETAIL
SCALE: NTS

NOTES:

A. PROVIDE A REMOVABLE YELLOW MELAMINE PLASTIC TAG THAT ATTACHES TO THE STATIC GROUND INSERT. TAG SHALL INCLUDE THE FOLLOWING INFORMATION:

"NOT IN SERVICE - NO MAINTENANCE REQUIRED.

INSTALLATION MEETS STATIC/FACILITY GROUNDING REQUIREMENTS PER DA PAM 385-64. ACTIVITY SHALL PERFORM TESTING PER DAM 385-64 AND ENACT MAINTENANCE SCHEDULE WHEN THE STATIC/FACILITY GROUND INSERT IS PLACED IN SERVICE.

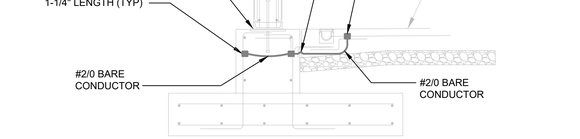
RETAIN THIS TAG TO RE-ATTACH WHEN REMOVED FROM SERVICE."

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET E-101-A.
2. IF ADDITIONAL VENTILATORS ARE PRESENT, PROVIDE GROUNDING AND BONDING TYPICAL FOR THOSE SHOWN.
3. GROUND TEST WELL WITH 3/4" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQUIRED. PROVIDE TRAFFIC RATED COVERS. USE ONLY BOLTED CLAMP CONNECTORS WITHIN GROUND TEST WELLS. SEE DETAIL THIS SHEET.
4. CONDUCTORS SHALL BE MINIMUM #2/0 AWG BARE COPPER, UON.
5. SEE STRUCTURAL SHEET TO CONFIRM ECM DIMENSIONS AND MEASUREMENTS.

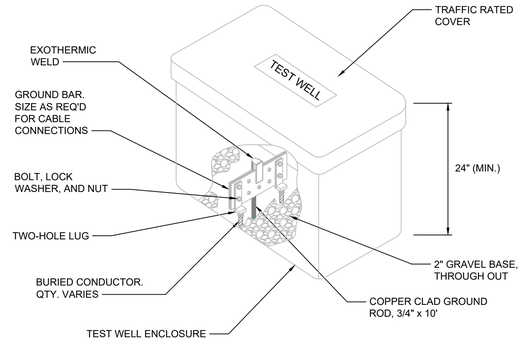
ALTERNATE DESIGN GENERAL NOTES:

1. SEE GENERAL NOTES THIS SHEET.
2. USER AND OWNER HAS THE OPTION TO INSTALL EITHER TYPE OF PROTECTION SYSTEM ILLUSTRATED, INTEGRAL OR MAST-TYPE. BONDING AND GROUNDING REQUIREMENTS ARE SHOWN ON SHEETS E-101-A, E-201-A AND E-202-A.
3. ROLLING SPHERE ANALYSIS FOR THE MAST-TYPE SYSTEM IS SHOWN ON SHEET E-301-A.



F12 FLOOR TO FOUNDATION BONDING DETAIL
SCALE: NTS

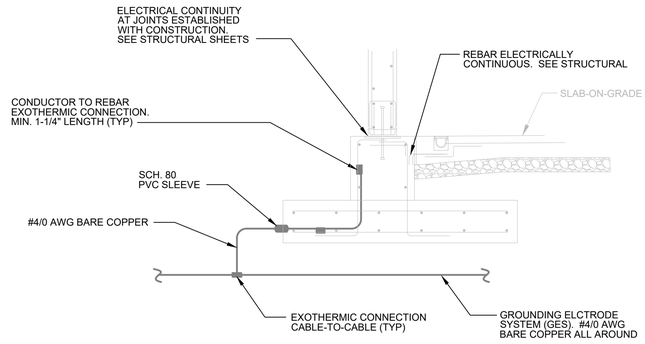
SUGGESTED COMPATIBLE METALS	
CONFIRM METAL COMPATIBILITY WITH ANSI/UL 96.	
STRUCTURAL METALS	LPS METALS
AL	AL
IRON	AL or TIN PLATED CU
COPPER	CU
BRONZE	CU
STEEL (GALV.)	AL
STEEL (STAINLESS)	AL or CU
STEEL	AL
TIN	AL or CU
ZINC	AL
ABBREVIATIONS: AL - ALUMINUM CU - COPPER	GALV. - GALVANIZED



B2 GROUND TEST WELL DETAIL
SCALE: NTS

NOTES:

A. RECTANGULAR ENCLOSURE ILLUSTRATED - EXAMPLE ONLY.



B8 TYPICAL FOUNDATION GROUNDING DETAIL
SCALE: NTS

NOTES:

A. TYPICAL FOUNDATION TO GES BONDING DETAIL. PROVIDE AT EACH CORNER AND AT DISTANCES NOT TO EXCEED 60'.

DESIGNER NOTE: TO BE REMOVED WHEN PREPARING CONSTRUCTION DRAWINGS FOR SITE ADAPTATION DESIGN

SHEETS E-101-A, E-201-A. E-202-A, E-301-A, AND E-302-A IDENTIFY AN ALTERNATE LIGHTNING PROTECTION SYSTEM USING A MAST-TYPE DESIGN INSTEAD OF AN INTEGRAL-TYPE DESIGN. DESIGNER SHALL CONFIRM WITH THE OWNER THE TYPE OF PROTECTION SYSTEM TO BE INSTALLED AND REMOVE THE SHEETS IDENTIFYING THE NON-APPLICABLE DESIGN FROM THE CONSTRUCTION CONTRACT DOCUMENTS.

(A) - ALTERNATE LIGHTNING PROTECTION DESIGN

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	LPS & Grounding Updates. Removed Air Terminals Lengthwise Along ECM. Added 'A' Sheets for Mast-Type LPS Design	JAN. 2024

ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

DESIGNED BY: J. DENTON
DRAWN BY: J. DENTON
CHECKED BY: G. SILLIVANT
SUBMITTED BY: JES MOX
SIZE: ANSI D

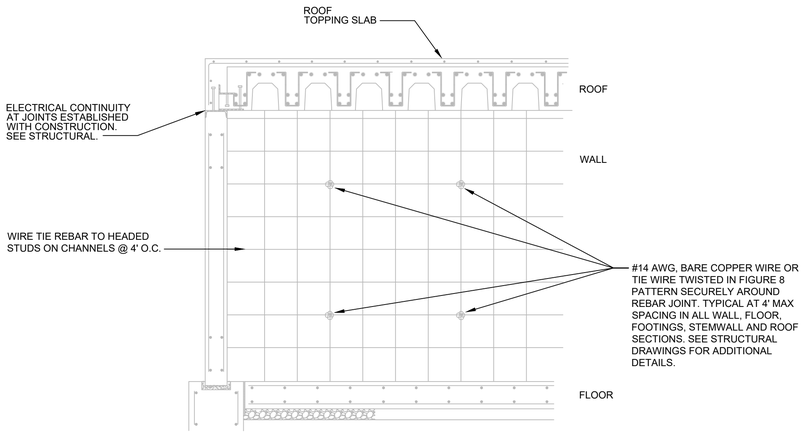
U.S. ARMY CORPS OF ENGINEERS ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE BOX-TYPE, STD 421-80-07 (REV. 1)

GROUNDING AND LIGHTNING PROTECTION DETAILS

SHEET ID
E-201-A
Sheet 24 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



K3 PANEL BONDING DETAILS

SCALE: NTS

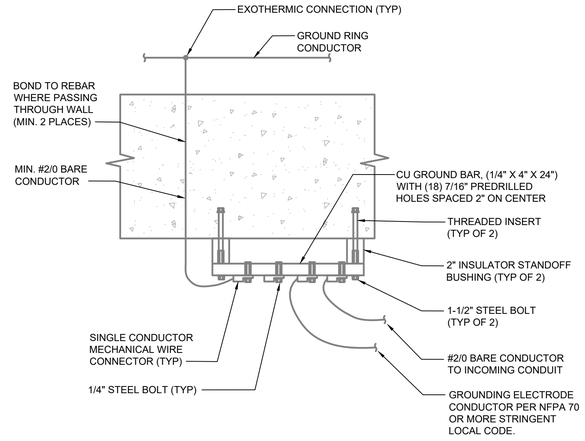
NOTES:

A. "TACK" WELDING MAY BE USED IN LIEU OF TIE WIRES FOR ELECTRICAL CONTINUITY.

B. BONDING AND GROUNDING NOTE: ELECTRICAL BONDING REQUIREMENTS INTERNAL TO PRECAST ROOF AND WALL PANELS SHALL BE PROVIDED BY THE PRECAST MANUFACTURER IN ACCORDANCE WITH THE STRUCTURAL DRAWINGS. ELECTRICAL BONDING REQUIREMENTS EXTERNAL TO PRECAST PANELS AND WITHIN CAST-IN-PLACE CONCRETE SLABS SHALL BE FIELD INSTALLED.

C. PANEL BONDING DETAIL IS GENERIC AND MAY NOT REFLECT EXACT CONSTRUCTION METHODS.

D. INSTALL SAME BONDING METHODS AT WING-WALL PANELS.



K10 SINGLE POINT GROUND BAR DETAIL

SCALE: NTS

NOTES:

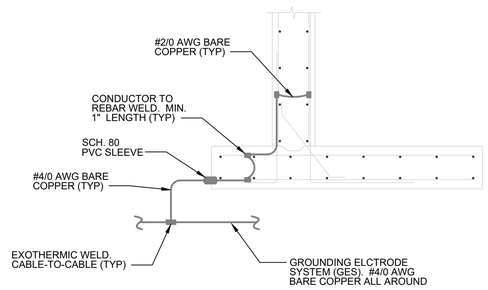
A. WHERE POWER IS PROVIDED TO THE MAGAZINE, PROVIDE A SINGLE POINT GROUND BAR AS DETAILED. LOCATE ADJACENT TO POWER PANEL, MIN. 18" ABOVE GRADE. INTERIOR INSTALL SHOWN.

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET E-101-A.
2. CONDUCTORS SHALL BE MINIMUM #2/0 AWG BARE COPPER, UON.
3. BONDING AS SHOWN WITHIN THE DETAILS OF THIS SHEET SHALL BE EVERY 4' MINIMUM IN ALL DIRECTIONS, UON.
4. SEE STRUCTURAL SHEETS TO CONFIRM ECM DIMENSIONS AND MEASUREMENTS.

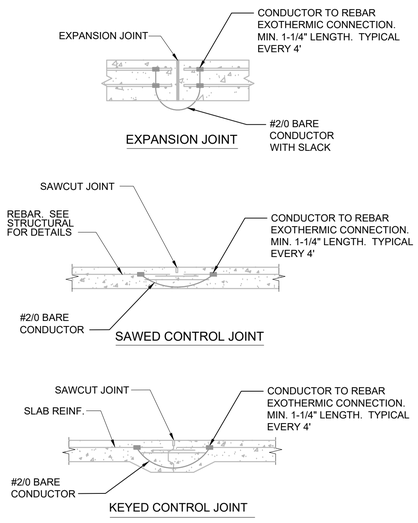
ALTERNATE DESIGN GENERAL NOTES:

1. SEE GENERAL NOTES THIS SHEET.
2. USER AND OWNER HAS THE OPTION TO INSTALL EITHER TYPE OF PROTECTION SYSTEM ILLUSTRATED, INTEGRAL OR MAST-TYPE. BONDING AND GROUNDING REQUIREMENTS ARE SHOWN ON SHEETS E-101-A, E-201-A AND E-202-A.
3. ROLLING SPHERE ANALYSIS FOR THE MAST-TYPE SYSTEM IS SHOWN ON SHEET E-301-A.



B3 WING-WALL TO FOUNDATION BONDING DETAIL

SCALE: NTS



B10 TYPICAL BOND CONNECTION AT VARIOUS CONSTRUCTION JOINTS

SCALE: NTS

D16 AIR TERMINAL MOUNTING WOOD MAST

SCALE: NTS

DESIGNER NOTE: TO BE REMOVED WHEN PREPARING CONSTRUCTION DRAWINGS FOR SITE ADAPTATION DESIGN

SHEETS E-101-A, E-201-A. E-202-A, E-301-A, AND E-302-A IDENTIFY AN ALTERNATE LIGHTNING PROTECTION SYSTEM USING A MAST-TYPE DESIGN INSTEAD OF AN INTEGRAL-TYPE DESIGN. DESIGNER SHALL CONFIRM WITH THE OWNER THE TYPE OF PROTECTION SYSTEM TO BE INSTALLED AND REMOVE THE SHEETS IDENTIFYING THE NON-APPLICABLE DESIGN FROM THE CONSTRUCTION CONTRACT DOCUMENTS.

(A) - ALTERNATE LIGHTNING PROTECTION DESIGN

US Army Corps of Engineers ®

MARK	DESCRIPTION	DATE
1	LPS & Grounding Updates. Removed Air Terminals Lengthwise Along ECM. Added "-A" Sheets for Mast-Type LPS Design	JAN. 2024

DESIGNED BY: J. DENTON
DRAWN BY: J. DENTON
CHECKED BY: G. SILLIVANT
SUBMITTED BY: FES. MCX
SIZE: ANSI D
ISSUE DATE: JANUARY 2024
SOLICITATION NO.:
CONTRACT NO.:

U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER, HUNTSVILLE, ALABAMA

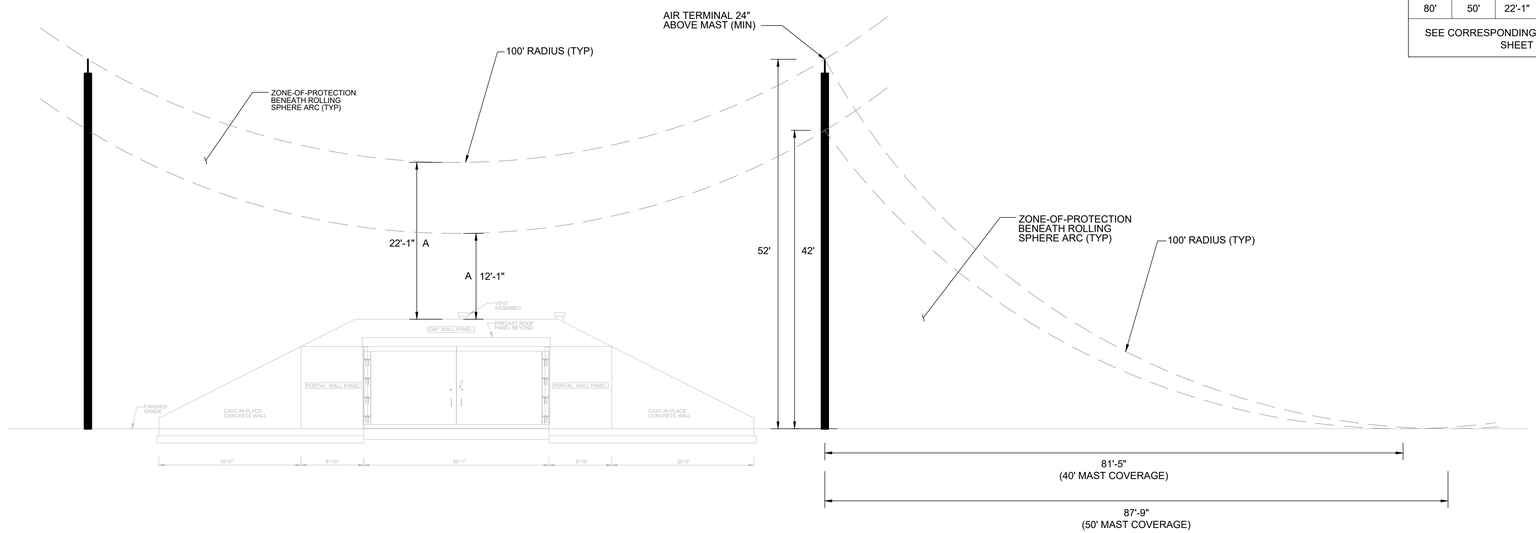
MODULAR STORAGE MAGAZINE
BOX-TYPE, STD 421-80-07 (REV. 1)

GROUNDING AND BONDING DETAILS

SHEET ID
E-202-A
Sheet 25 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

CORRESPONDING DISTANCES PER ECM LENGTH BASED ON MINIMUM MAST HEIGHT				
ECM	MAST	A	B	C
40'	40'	12'-1"	12'-1"	8'-9"
60'	40'	12'-1"	12'-1"	3'-9"
80'	50'	22'-1"	22'-1"	7'-0"
SEE CORRESPONDING LETTERS THIS SHEET				



H6 ROLLING SPHERE ANALYSIS - EXTENTS VIEW
SCALE: NTS

GENERAL NOTES:

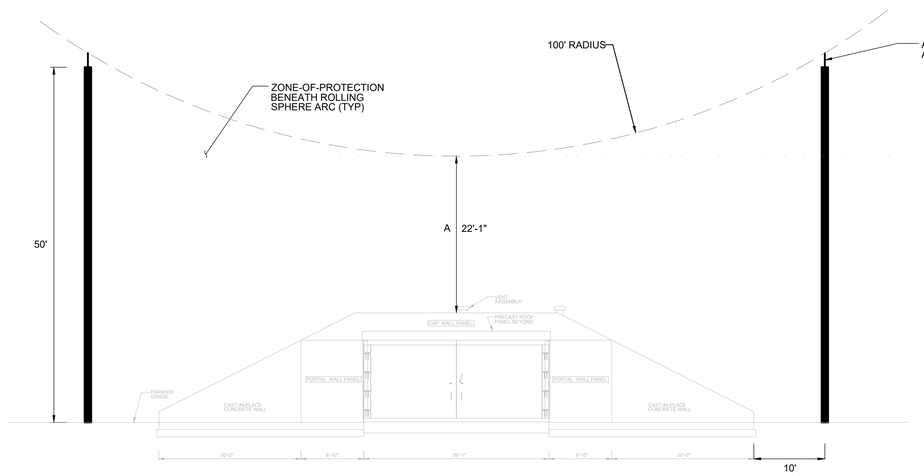
1. SEE GENERAL NOTES ON SHEET E-101-A.
2. ROLLING SPHERE METHOD (RSM) ANALYSIS DEMONSTRATES A ZONE OF PROTECTION BASED ON A 100' RADIUS STRIKING DISTANCE FOR THE ECM STRUCTURE AND HEAD WALL ASSEMBLY.
3. MEASURE CLEARANCES AND DIMENSIONS MAY VARY DEPENDING ON FINAL INSTALLATION CONDITIONS AND PRODUCT SELECTIONS.
4. LPS MAST'S HEIGHTS ARE REPRESENTATIVE OF AN ACCEPTABLE ZONE OF PROTECTION FOR THE 421-80-07 STANDARD ECM AND THE THREE STANDARD LENGTHS. DIFFERENT MAST HEIGHTS MAY BE SELECTED PROVIDED THE ZONE OF PROTECTION IS ACHIEVED. WOOD MASTS WITH AIR TERMINALS ARE DEPICTED IN THESE STANDARD DRAWINGS.
5. SEE TABLE THIS SHEET FOR THE CORRESPONDING DISTANCES FOR OTHER STANDARD ECM LENGTHS OF 40' AND 60'.
6. GROUNDING AND BONDING COMPONENTS / SYSTEMS ARE NOT DEPICTED IN THE RSM ANALYSIS SHEETS.
7. SEE STRUCTURAL SHEET TO CONFIRM ECM DIMENSIONS AND MEASUREMENTS.

ALTERNATE DESIGN GENERAL NOTES:

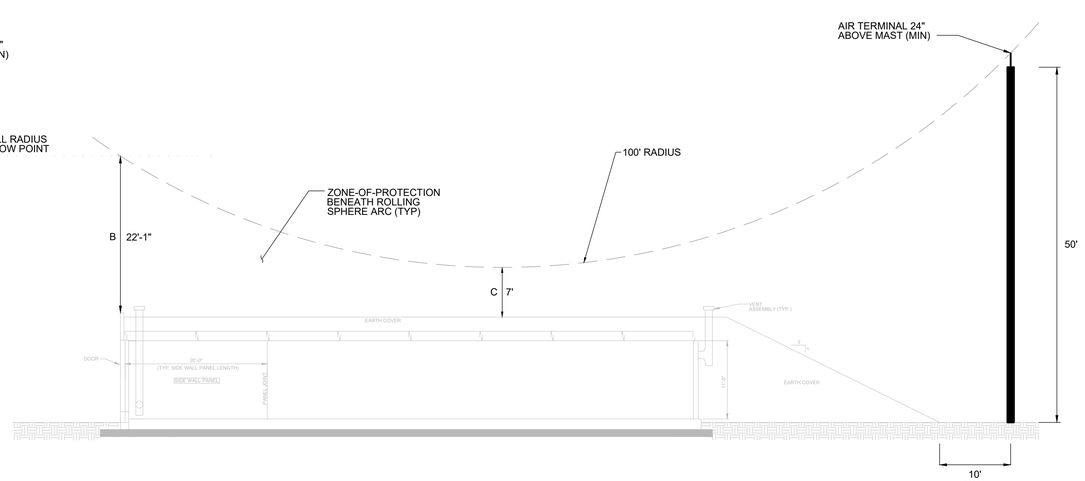
1. SEE GENERAL NOTES THIS SHEET.
2. USER AND OWNER HAS THE OPTION TO INSTALL EITHER TYPE OF PROTECTION SYSTEM ILLUSTRATED, INTEGRAL OR MAST-TYPE. BONDING AND GROUNDING REQUIREMENTS ARE SHOWN ON SHEETS E-101-A, E-201-A AND E-202-A.
3. ROLLING SPHERE ANALYSIS ILLUSTRATED THIS SHEET.

DESIGNER NOTE: TO BE REMOVED WHEN PREPARING CONSTRUCTION DRAWINGS FOR SITE ADAPTATION DESIGN

SHEETS E-101-A, E-201-A. E-202-A, AND E-301-A IDENTIFY AN ALTERNATE LIGHTNING PROTECTION SYSTEM USING A MAST-TYPE DESIGN INSTEAD OF AN INTEGRAL-TYPE DESIGN. DESIGNER SHALL CONFIRM WITH THE OWNER THE TYPE OF PROTECTION SYSTEM TO BE INSTALLED AND REMOVE THE SHEETS IDENTIFYING THE NON-APPLICABLE DESIGN FROM THE CONSTRUCTION CONTRACT DOCUMENTS.



B3 ROLLING SPHERE ANALYSIS - HEADWALL VIEW
SCALE: NTS



B11 ROLLING SPHERE ANALYSIS - CROSS SECTIONAL VIEW - 80' LENGTH
SCALE: NTS

(A) - ALTERNATE LIGHTNING PROTECTION DESIGN

US Army Corps of Engineers®

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ROLLING SPHERE METHOD ANALYSIS

SHEET ID
E-301-A
Sheet 26 of 26

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION