US Army Corps of Engineers®

US Army Corps of Engineers Huntsville Center

MODULAR STORAGE MAGAZINE, BOX-TYPE FLOW-THRU STD 421-80-10 REVISION 1

SOLICITATION NO.:

CONTRACT NO.:

ISSUE DATE:

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	Removed Hasps. Modified ILD Door Details, implemented Lessons Learned, Electrical Updates	SEPT. 2025

%PRODUCTION DATA 1%

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DESIGNED BY: J. LIMPHREY
DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FES MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
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U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

COVER SHEET

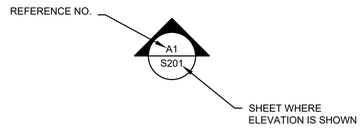
SHEET ID

G-001

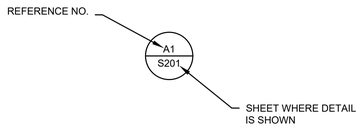
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

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
UON	UNLESS OTHERWISE NOTED
VIF	VERIFY IN FIELD
WWF	WELDED WIRE FABRIC
WWR	WELDED WIRE REINFORCEMENT
W/	WITH
WP	WORKING POINT



ELEVATION REFERENCE



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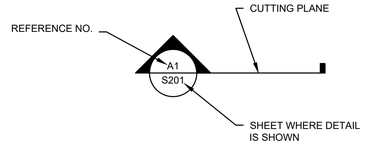

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1

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INDEX, SYMBOLS, & ABBREVIATIONS

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G-002

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

1.0 DESIGN CRITERIA

A. BUILDING CODES AND SPECIFICATIONS:

1. INTERNATIONAL BUILDING CODE 2021 (IBC) AS MODIFIED BY UFC 1-200-01
2. AMERICAN CONCRETE INSTITUTE (ACI 318-14)
3. AMERICAN INSTITUTE OF STEEL CONSTRUCTION
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:

RISK CATEGORY=III
Ie= 1.25
Ss= 1.1g
Sds= 0.8 g
S1 = 0.52g
Sd1= 0.61g
SITE CLASS: D
BASIC SEISMIC-FORCE RESISTING SYSTEM=
INTERMEDIATE PRECAST SHEAR WALLS, R = 4
SEISMIC DESIGN CATEGORY= D
ANALYSIS PROCEDURE = EQUIVALENT LATERAL FORCE PROCEDURE

E. SOILS

SOIL DENSITY (Y): 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 FOR CAST-IN-PLACE CONSTRUCTION U.O.N.:

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 EQUIVALENT TO 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 DISCONTINUOUS 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 F1554
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

6.0 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

7.0 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 A MINIMUM 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 FOUNDATION PEDESTALS AND PRECAST ROOF PANELS, AND BETWEEN PRECAST WALLS AND CONCRETE PEDESTAL FOOTING SHALL BE PROVIDED 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 DO NOT 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 OFFICER, 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. 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 PACKAGE DATED SEPTEMBER 2025, STD 421-80-10 REVISION 1, SHEETS 1-28, UPDATES AND SUPERSEDES THE STANDARD DESIGN 421-80-10 DATED MARCH 2019,SHEETS 1-28.

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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.
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 LATEST 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.

D5 SPECIAL INSPECTION SCHEDULE
SCALE: N.T.S.

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	SEPT. 2025

%PRODUCTION DATA 1%
%PRODUCTION DATA 4%
%PRODUCTION DATA 3%
%PRODUCTION DATA 2%

DESIGNED BY: J. LIMPHREY
DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FELIX MICA
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

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

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

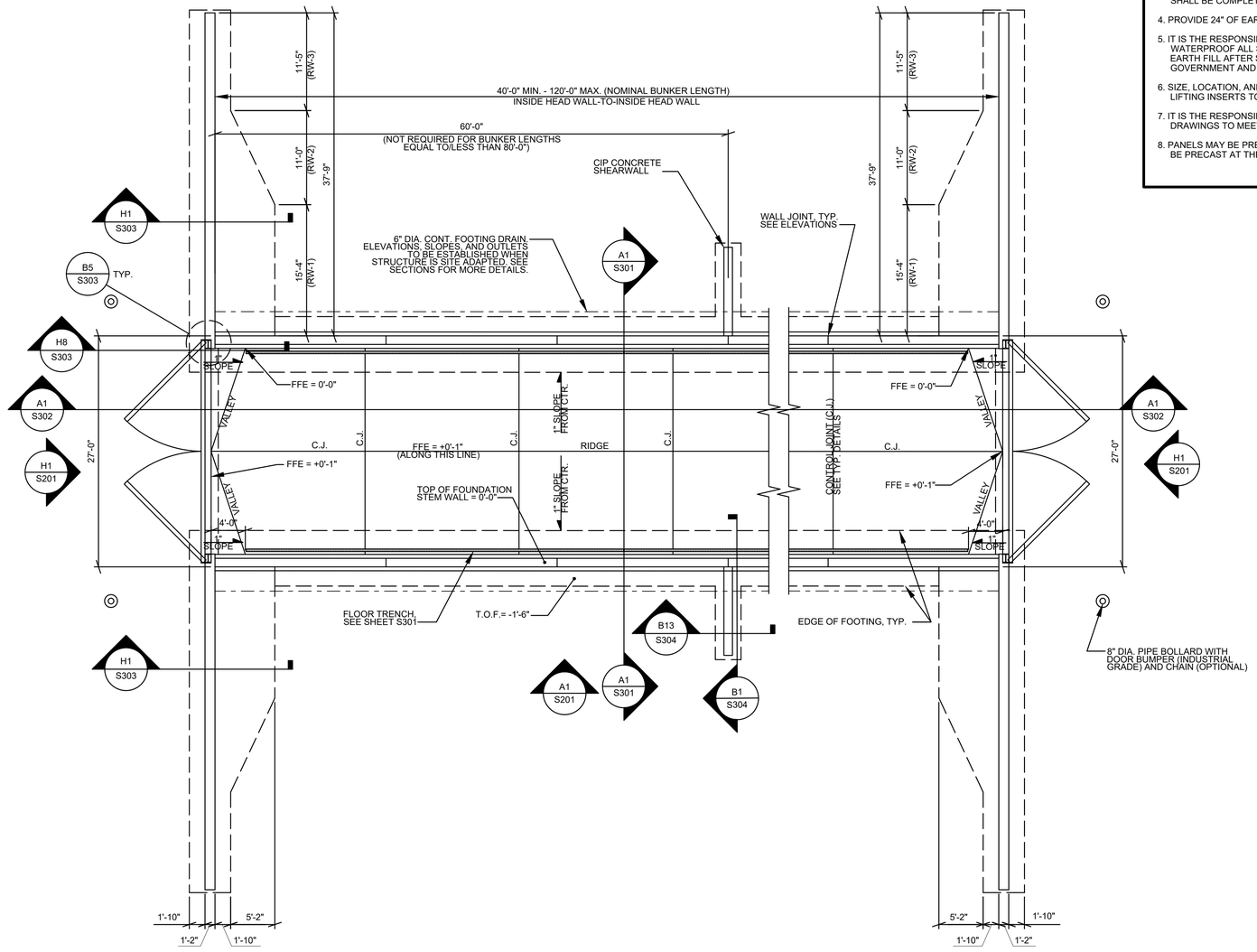
SPECIAL INSPECTIONS

SHEET ID
S-002

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL SHEET 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 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. IT IS THE RESPONSIBILITY OF THE SITE-ADAPT DESIGNER-OF-RECORD TO WATERPROOF ALL SURFACES OF THE SHELTER WHICH WILL BE IN CONTACT WITH EARTH FILL AFTER SHELTER IS ERECTED. SUBMIT SHOP DRAWINGS FOR GOVERNMENT AND AE APPROVAL.
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 ADAPTION 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 MAY BE PRECAST AT THE JOB-SITE.



C5 FOUNDATION PLAN
SCALE: 1/8"=1'-0"

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1	Removed Hasps, Modified ILD Door Details, Implemented Lessons Learned, Electrical Updates	SEPT. 2025

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%PRODUCTION DATA 2%

DESIGNED BY: J. LIMPHREY
DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FESS MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
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421-80-10 (REV. 1)

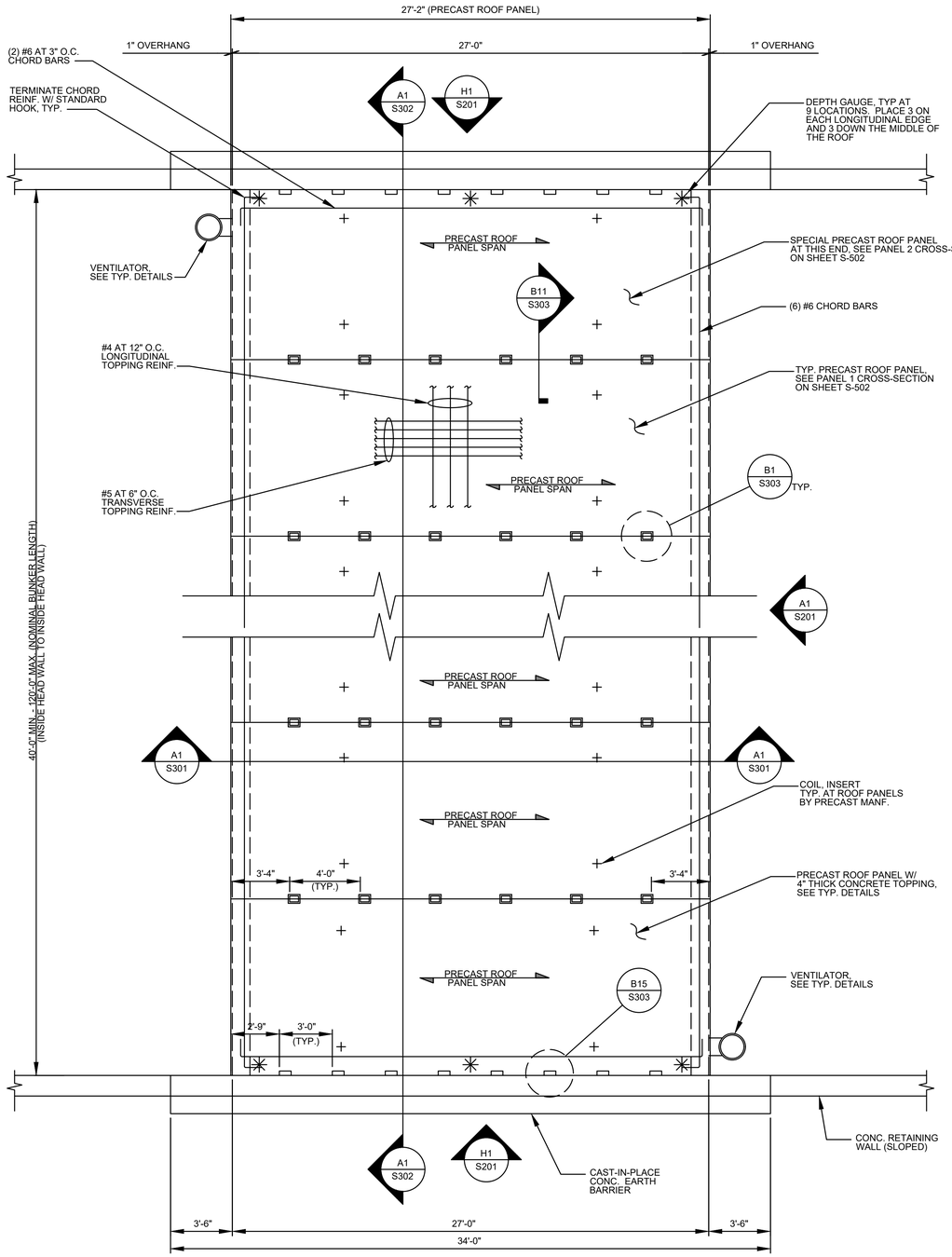
FOUNDATION PLAN

SHEET ID
S-101

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL SHEET 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 ADAPTION 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 MAY BE 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.



F8 ROOF FRAMING PLAN
SCALE: 1/4"=1'-0"

0 2' 4' 8'

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DESIGNED BY: J. LIMPHREY
DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FESE MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

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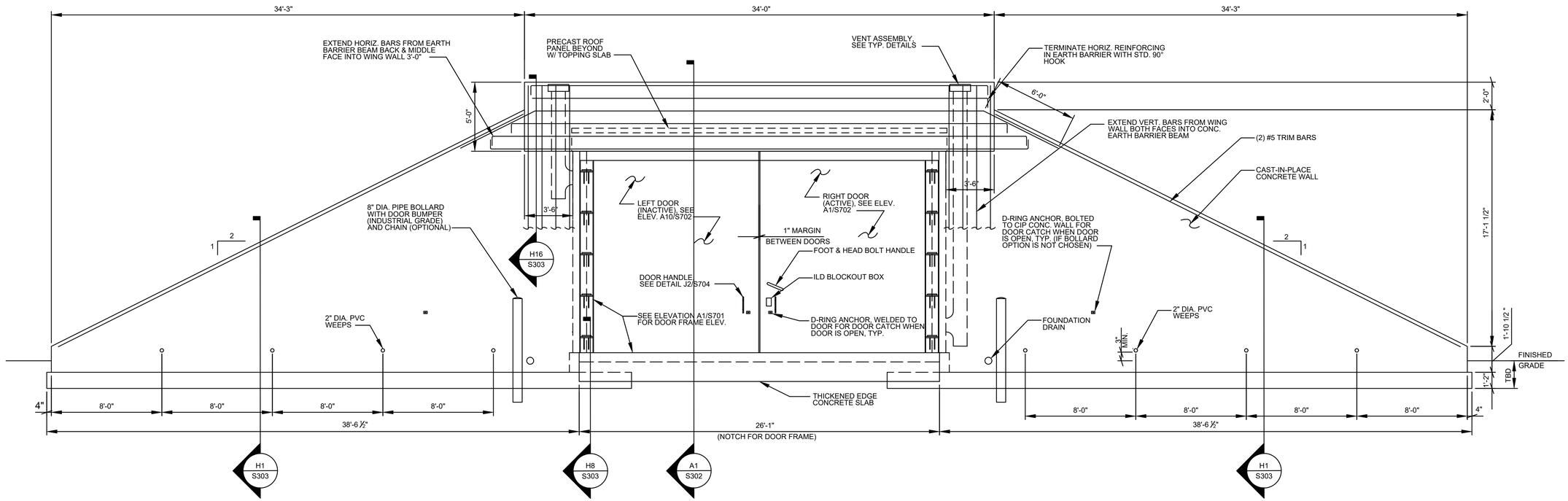
MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)

ROOF FRAMING PLAN

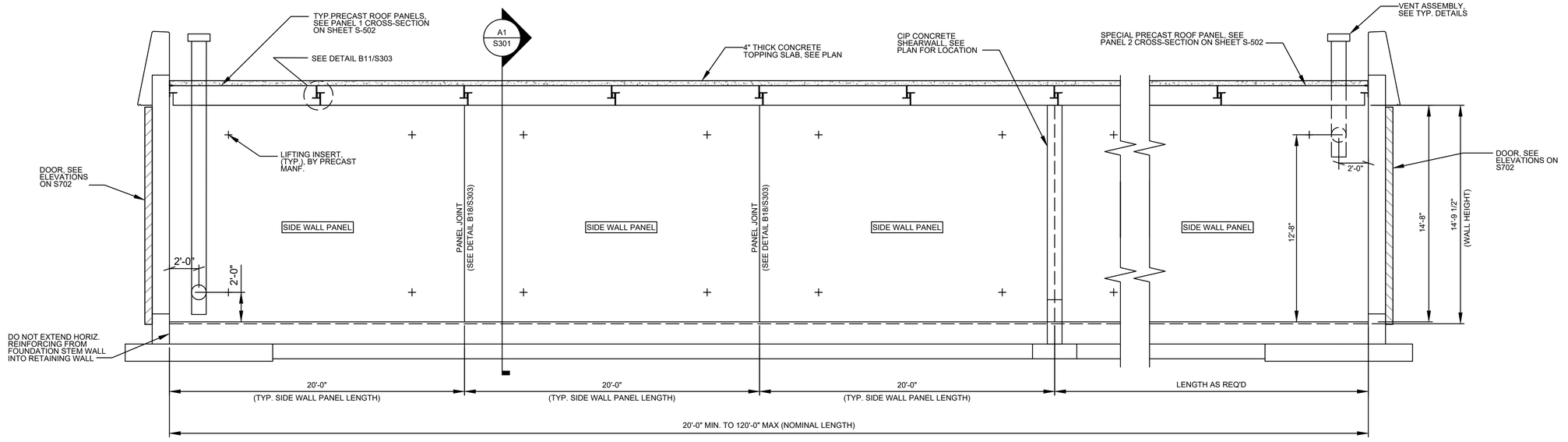
SHEET ID
S-102

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



H1 WALL ELEVATION

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



A1 WALL ELEVATION

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

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DESIGNED BY: J. LIMPHREY
DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FELIX MICA
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
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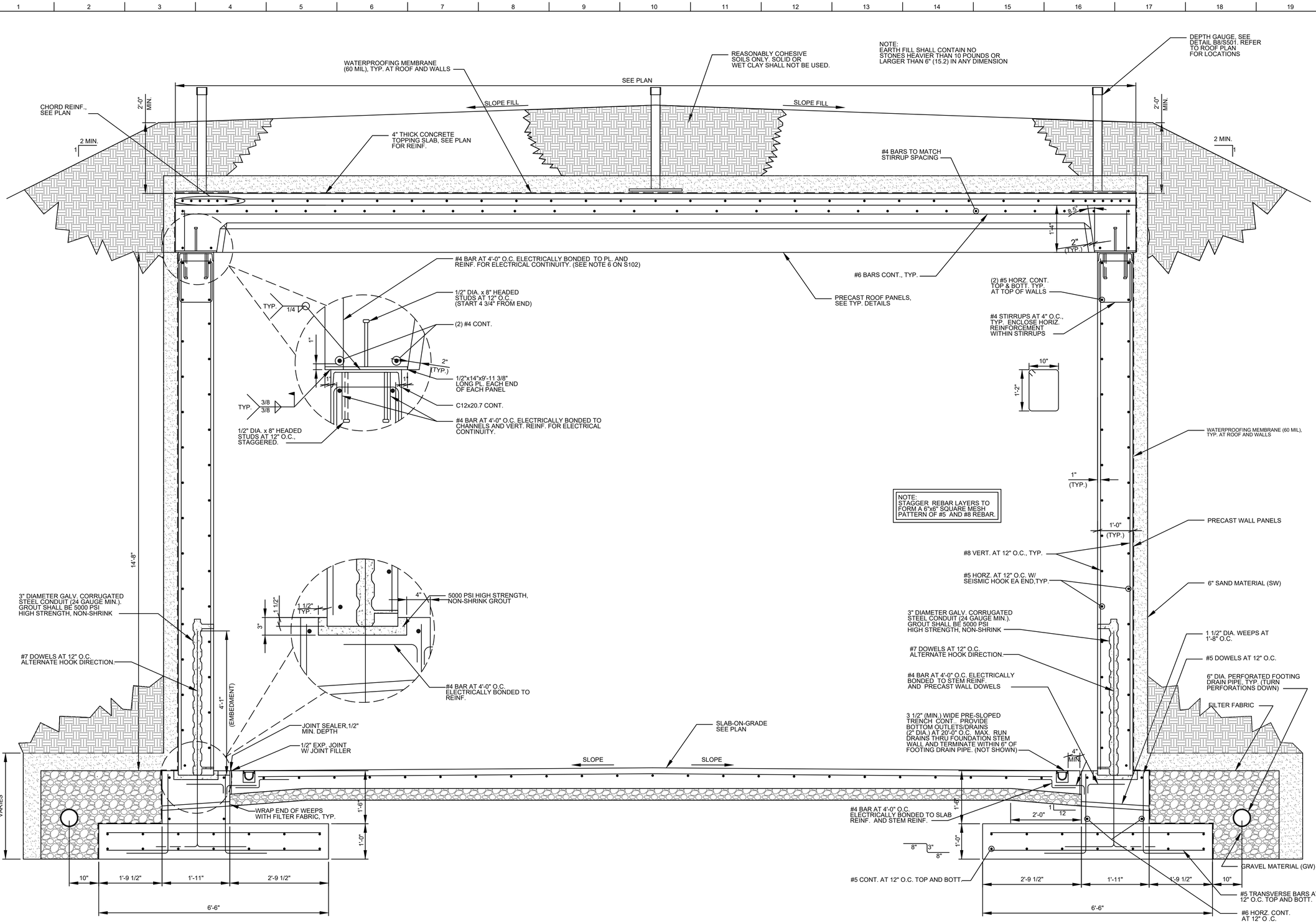
MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

ELEVATIONS

SHEET ID

S-201

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



A1 BUILDING SECTION

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

0 1' 2' 4'

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DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FEZ MICA
SIZE: ANSI D
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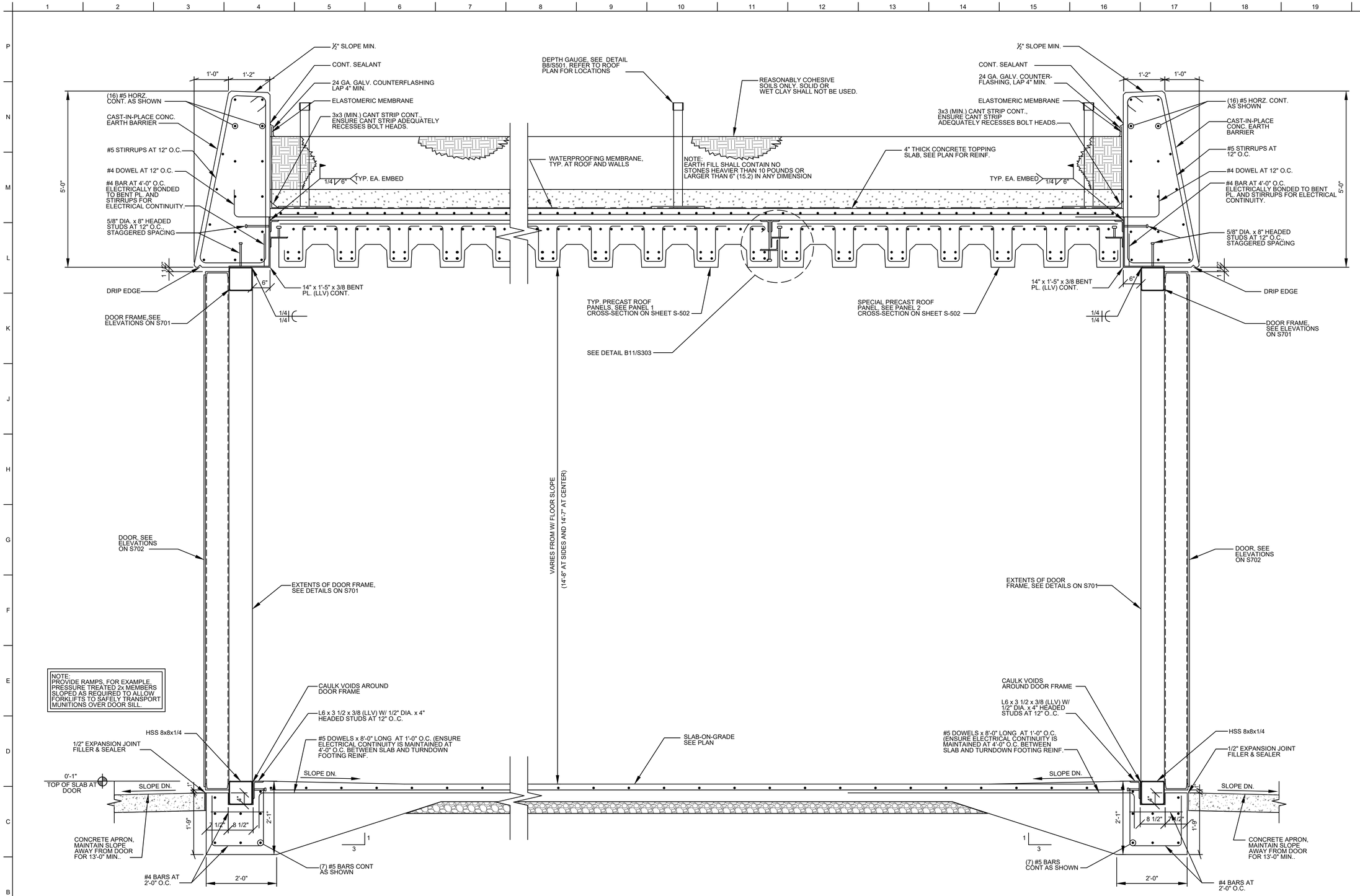
STD 421-80-10 (REV. 1)

BUILDING SECTIONS

SHEET ID

S-301

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



A1 BUILDING SECTION

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

0 1' 2' 4'

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DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FESS MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
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ENGINEERING AND SUPPORT CENTER
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MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

BUILDING SECTIONS

SHEET ID

S-302

%PRODUCTION DATA 1%
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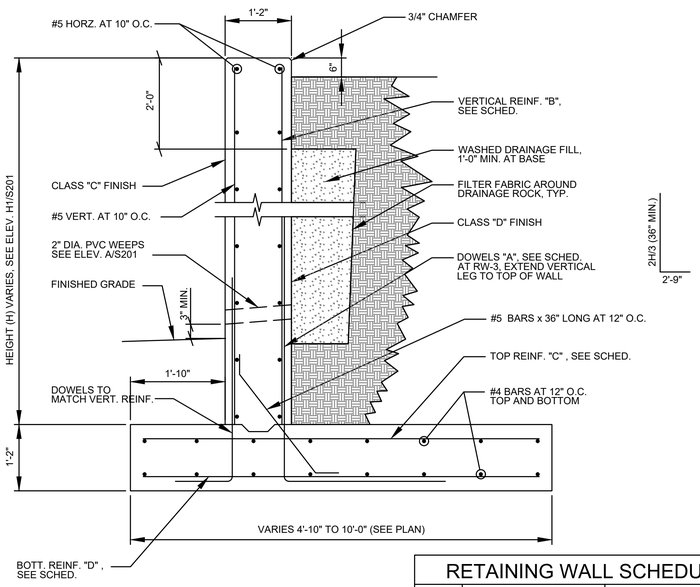
%PRODUCTION DATA 3%
%PRODUCTION DATA 2%

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



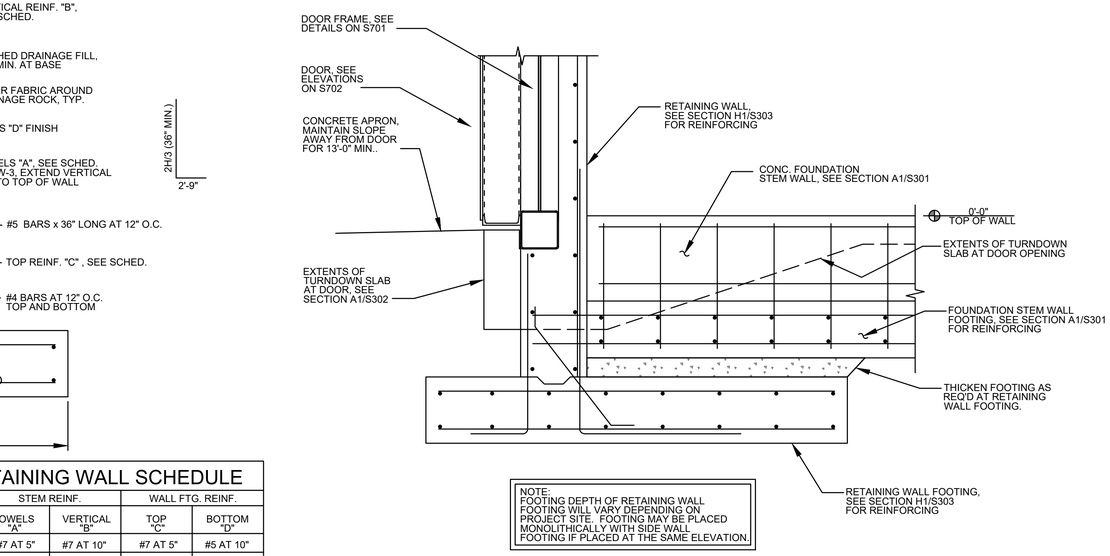
NOTES:

1. FRONT SIDE OF WALL MUST BE BACKFILLED AND COMPACTED BEFORE BACKFILLING BEHIND WALL.

RETAINING WALL SCHEDULE

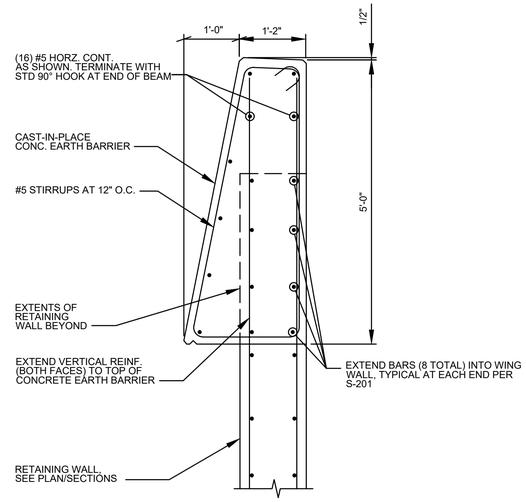
WALL TYPE	STEM REINF.		WALL FTG. REINF.	
	DOWELS "A"	VERTICAL "B"	TOP "C"	BOTTOM "D"
RW-1	#7 AT 5"	#7 AT 10"	#7 AT 5"	#5 AT 10"
RW-2	#7 AT 12"	#7 AT 12"	#7 AT 12"	#5 AT 12"
RW-3	#5 AT 10"	N/A	#5 AT 10"	#5 AT 10"

H1 SECTION
SCALE: 3/4"=1'-0"

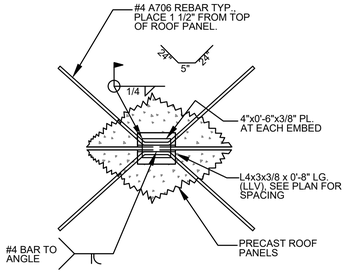


NOTE:
FOOTING DEPTH OF RETAINING WALL FOOTING WILL VARY DEPENDING ON PROJECT SITE. FOOTING MAY BE PLACED MONOLITHICALLY WITH SIDE WALL FOOTING IF PLACED AT THE SAME ELEVATION.

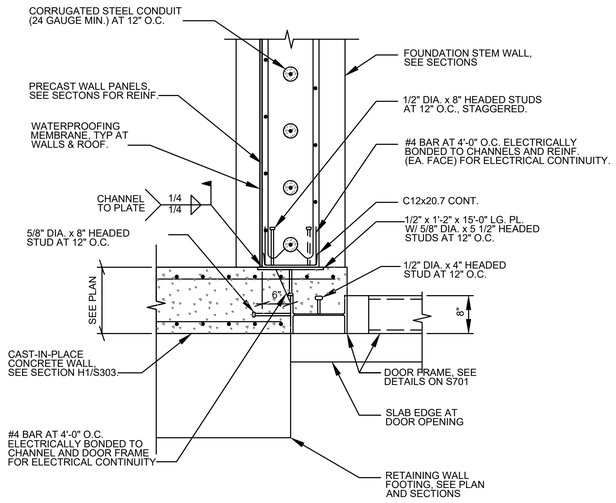
H8 SECTION
SCALE: 3/4"=1'-0"



H16 SECTION
SCALE: 3/4"=1'-0"

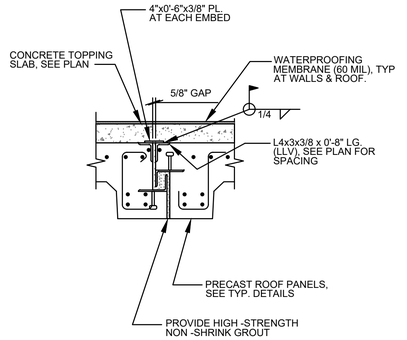


B1 DETAIL
SCALE: 3/4"=1'-0"

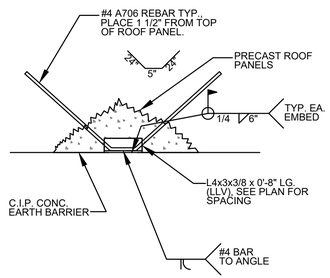


SHOWN ROTATED 90 DEGREES

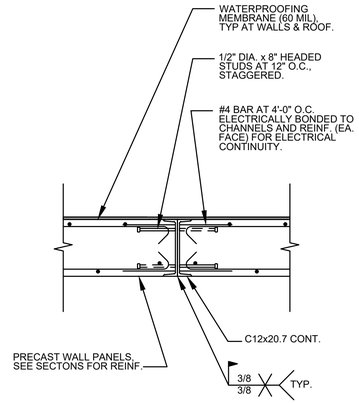
B5 DETAIL
SCALE: 3/4"=1'-0"



B11 DETAIL
SCALE: 3/4"=1'-0"



B15 DETAIL
SCALE: 3/4"=1'-0"



B18 DETAIL
SCALE: 3/4"=1'-0"

0 1' 2' 4'

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DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: KEN MICK
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
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CONTRACT NO.:

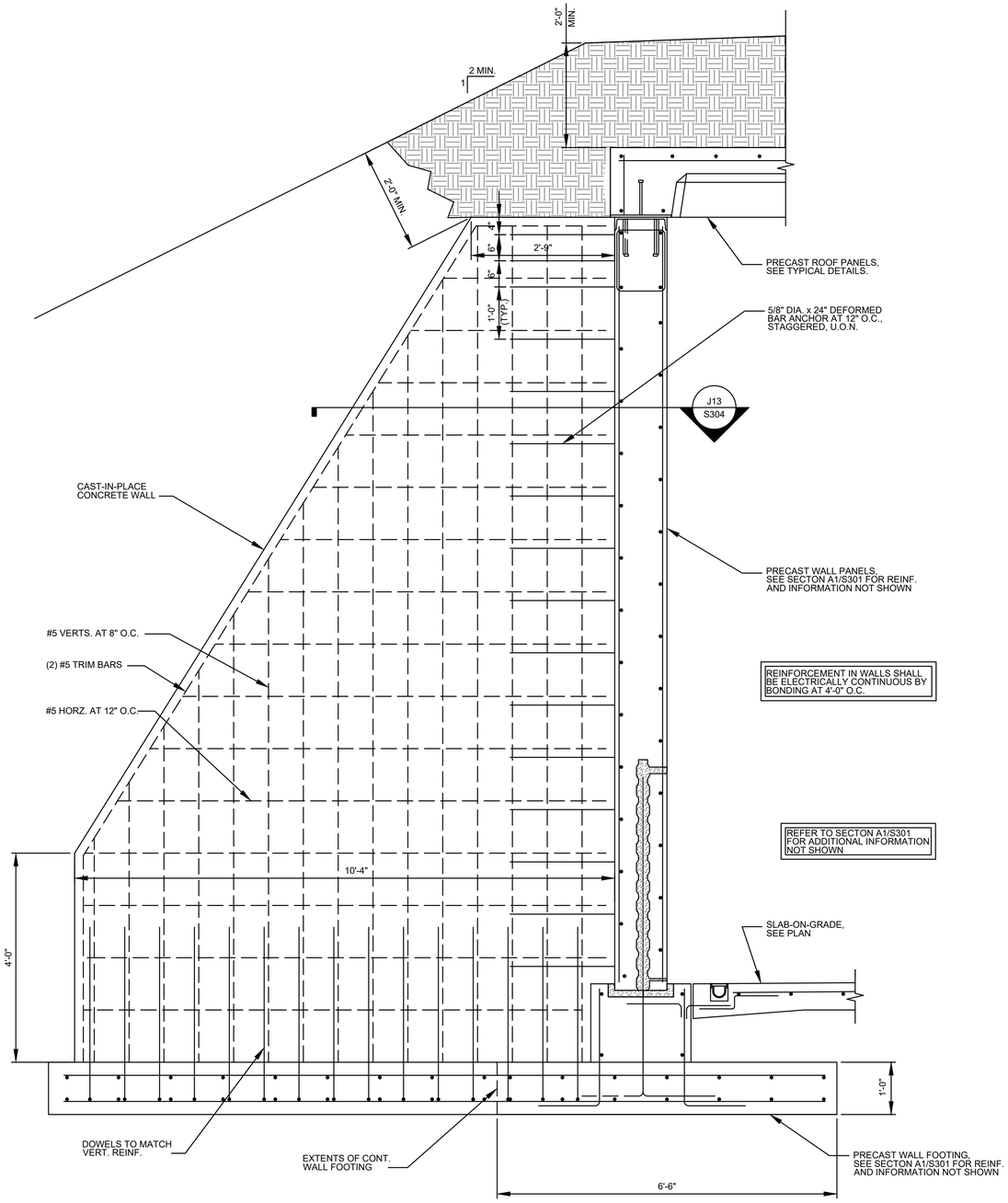
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

SECTIONS

SHEET ID
S-303

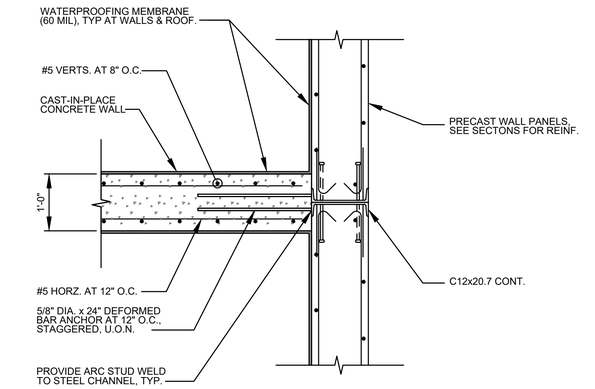
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



B1 SECTION

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

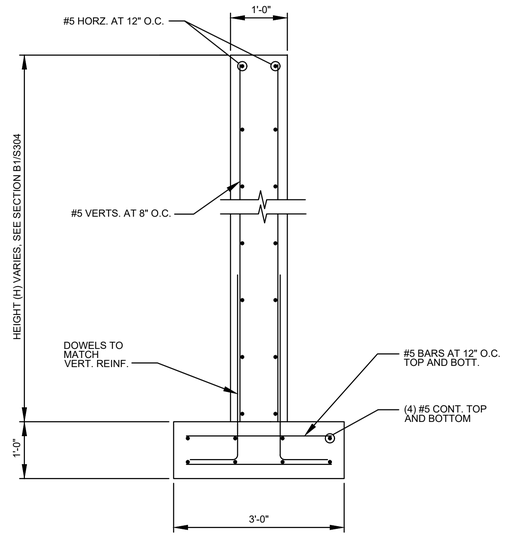
0 1' 2' 4'



J13 SECTION

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

0 1' 2' 4'



B13 SECTION

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

0 1' 2' 4'

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DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: ESD MCX
SIZE: ANSI D

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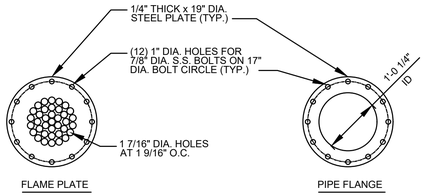
SECTIONS

SHEET ID

S-304

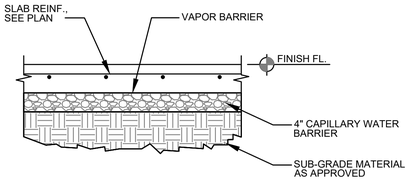
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



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

J2 VENTILATOR FLAME PLATE DETAIL

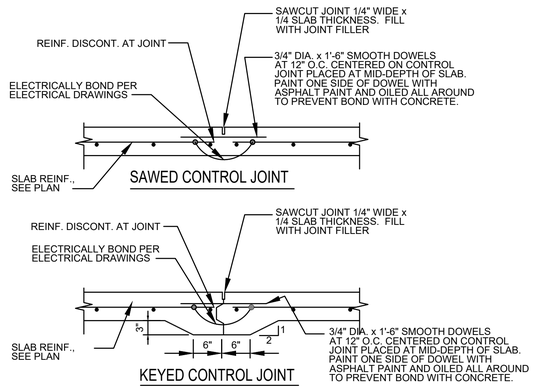
SCALE: 3/4"=1'-0"



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

J8 SLAB-ON-GRADE DETAIL

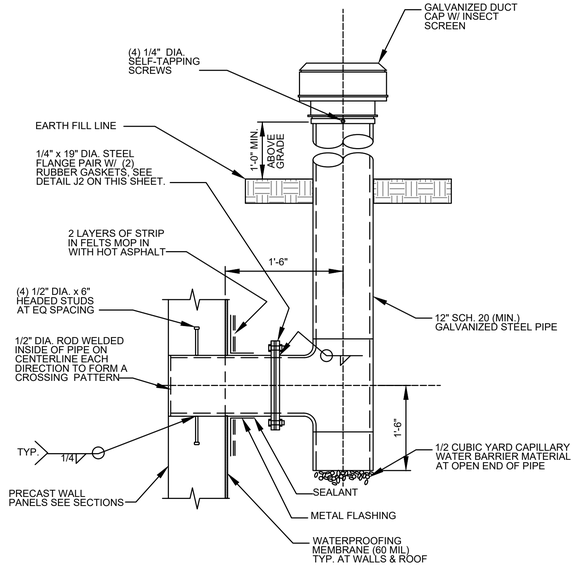
SCALE: 3/4"=1'-0"



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

J14 SLAB CONTROL JOINT DETAIL

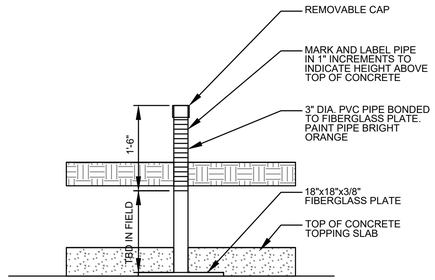
SCALE: 3/4"=1'-0"



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

B2 TYPICAL VENT DETAIL

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



B8 DEPTH GAUGE DETAIL

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

REINFORCING SPLICE LENGTH SCHEDULE PER ACI 318

REINFORCING YIELD STRENGTH, Fy = 60 KSI
CONCRETE COMPRESSIVE STRENGTH, f'c = 4000 PSI

SIZE OF BAR	REQUIRED SPLICE LENGTH	
	TOP BARS	OTHER BARS
	IN.	IN.
#3	25	19
#4	33	25
#5	41	31
#6	49	37
#7	71	54
#8	81	62
#9	91	70
#10	102	79

REINFORCING DEVELOPMENT LENGTH SCHEDULE PER ACI 318

REINFORCING YIELD STRENGTH, Fy = 60 KSI
CONCRETE COMPRESSIVE STRENGTH, f'c = 4000 PSI

SIZE OF BAR	REQUIRED DEVELOPMENT LENGTH	
	TOP BARS	OTHER BARS
	IN.	IN.
#3	19	15
#4	25	19
#5	31	24
#6	37	29
#7	54	42
#8	62	48
#9	70	54
#10	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

B14 SPLICE LAP AND DEVELOPMENT LENGTHS

SCALE: N.T.S.

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE
1	Removed Hasps, Modified ILD Door Details, Implemented Lessons Learned, Electrical Updates	SEPT. 2025

%PRODUCTION DATA 1%
%PRODUCTION DATA 4%
%PRODUCTION DATA 3%
%PRODUCTION DATA 2%

ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

DESIGNED BY: J. LIMPHREY
DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: FES MCX
SIZE: ANSI D

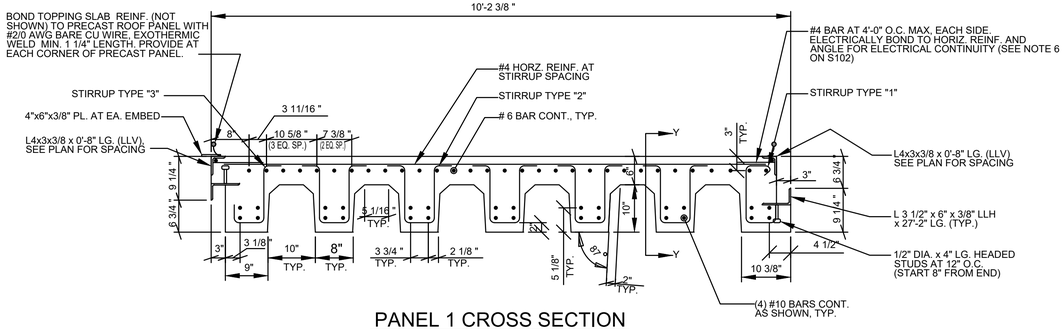
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

TYPICAL DETAILS

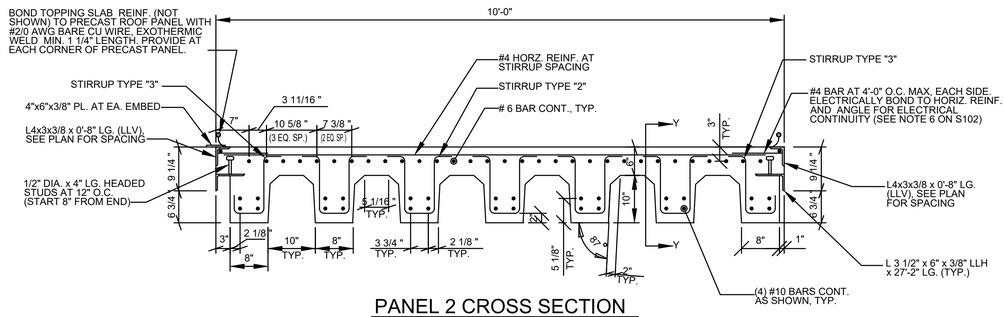
SHEET ID
S-501

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



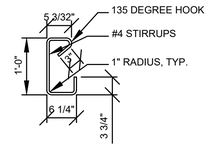
PANEL 1 CROSS SECTION

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



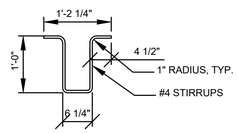
PANEL 2 CROSS SECTION

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



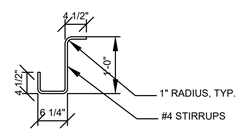
STIRRUP TYPE "1"

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



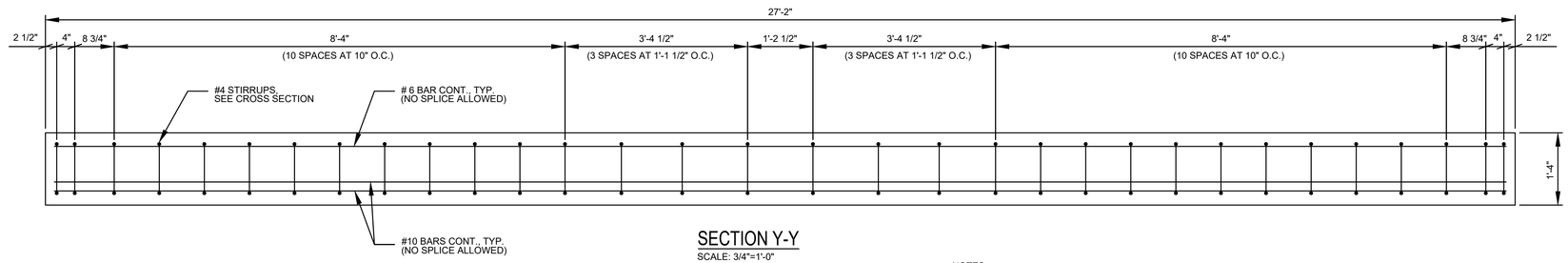
STIRRUP TYPE "2"

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



STIRRUP TYPE "3"

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



SECTION Y-Y

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

NOTES:

1. 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, ELECTRICALLLY BOND #4 BARS FROM BOTTOM PLATE TO #4 REINFORCEMENT.
2. CONCRETE TOPPING SLAB NOT SHOWN FOR CLARITY.

A3 PRECAST ROOF PANEL DETAIL

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

0 1' 2' 4'

US Army Corps of Engineers®

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DRAWN BY: J. LIMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: KEN MICK
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
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U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

TYPICAL DETAILS

SHEET ID

S-502

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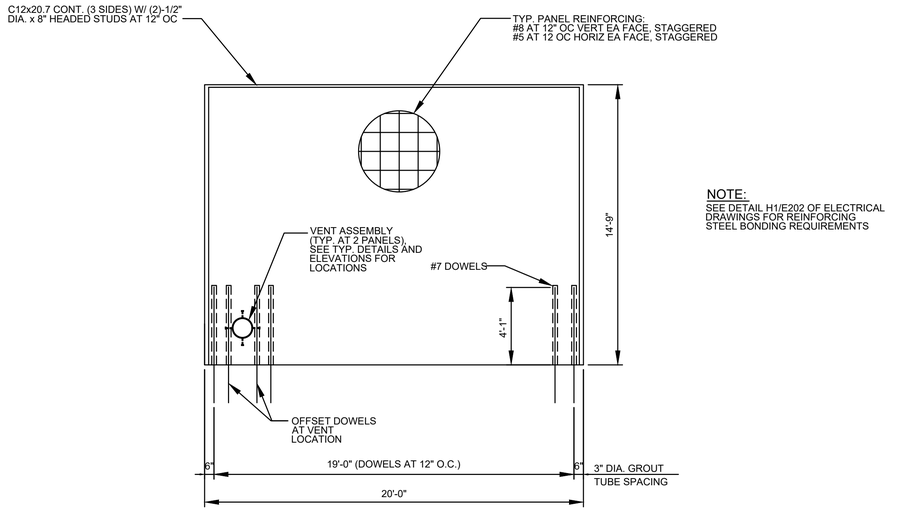
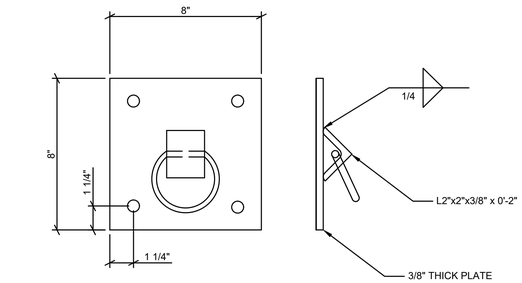
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



NOTE:
SEE DETAIL H1/E202 OF ELECTRICAL DRAWINGS FOR REINFORCING STEEL BONDING REQUIREMENTS

F12 SIDE WALL PANEL ELEVATION
SCALE: 1/4"=1'-0"



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

A14 D-RING DETAIL
SCALE: 3"=1'-0"

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DRAWN BY: J. LUMPHREY
CHECKED BY: R. WRIGHT
SUBMITTED BY: EFSC MCX
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ENGINEERING AND SUPPORT CENTER
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MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

PRECAST WALL PANEL DETAILS

SHEET ID
S-503

%PRODUCTION DATA 1%
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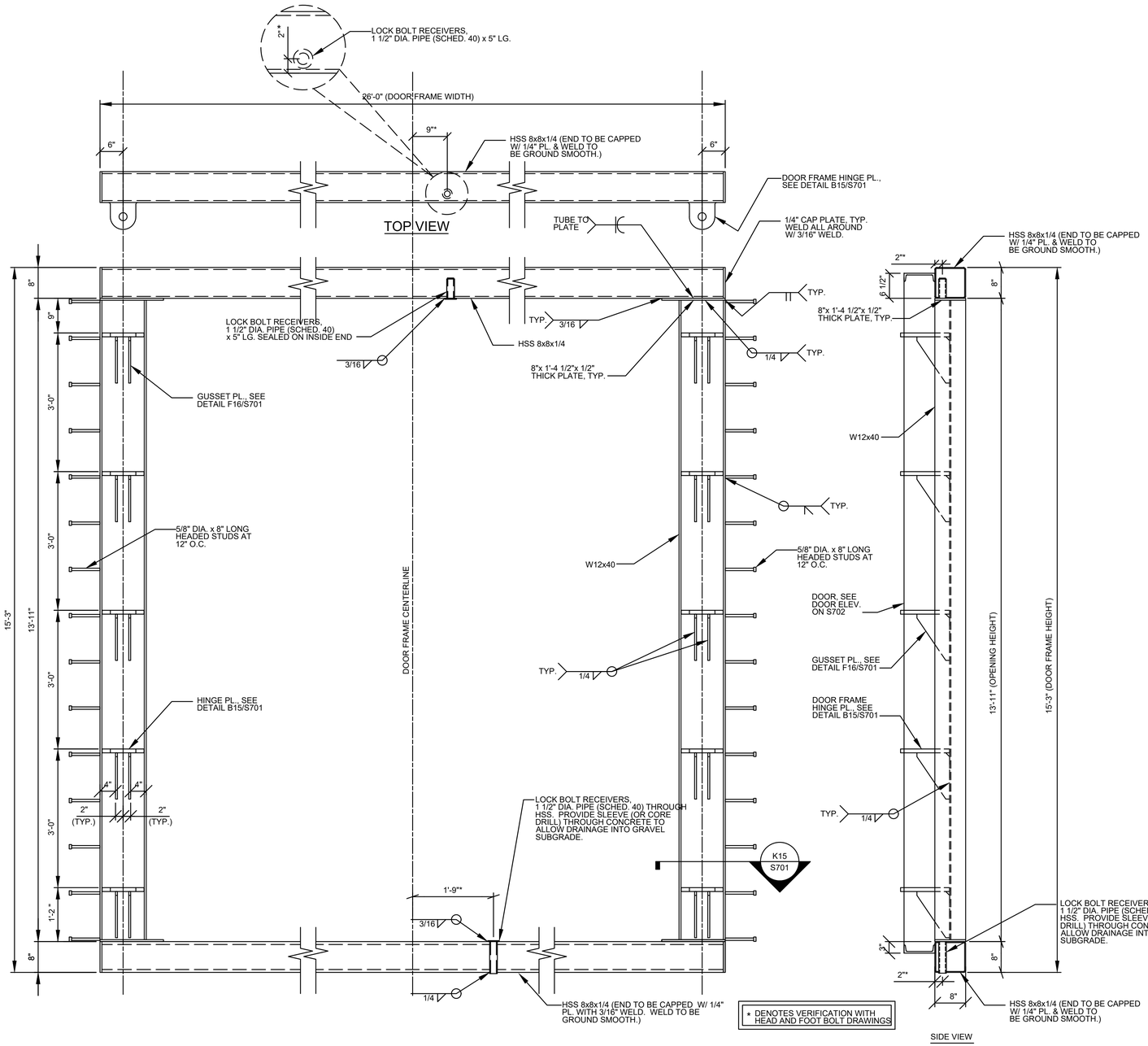
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



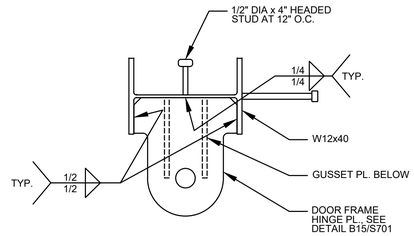
A1 DOOR FRAME ELEVATION

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

0 1' 2' 4'

NOTES:

1. THE 6 1/2" AND 3" DOOR OVERLAP AT THE TOP AND BOTT. 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.



NOTE:
CONCRETE WALLS NOT SHOWN. SEE DETAIL B5/S303 FOR WALLS

K15 SECTION

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

F16 GUSSET PLATE DETAIL

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

B15 DOOR FRAME HINGE PLATE DETAIL

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

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ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

DOOR FRAME ELEVATIONS

SHEET ID
S-701

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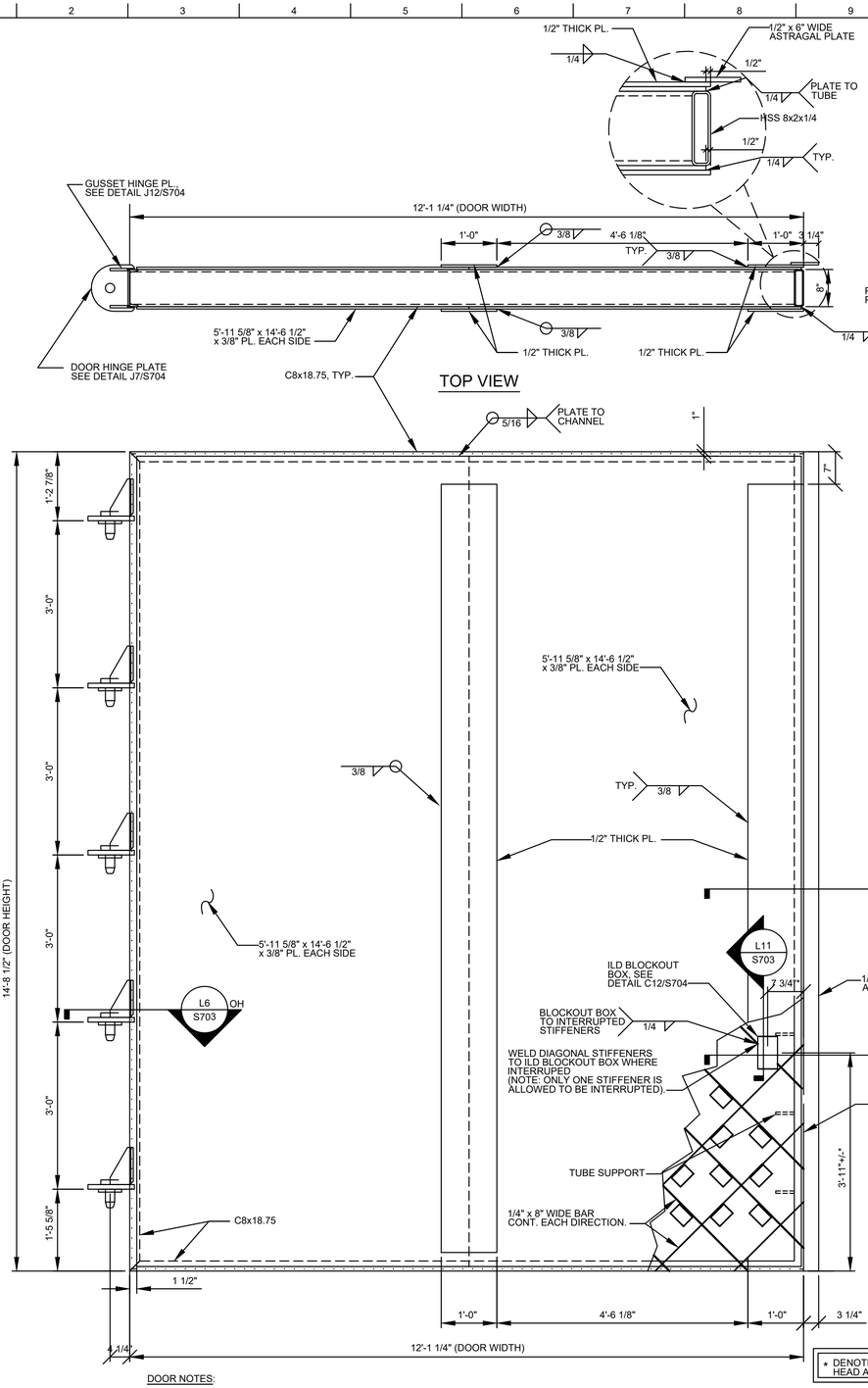
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



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DESIGNED BY:	J. UMPHREY
DRAWN BY:	J. UMPHREY
CHECKED BY:	R. WRIGHT
SUBMITTED BY:	ESS MCX
SIZE:	ANSI D

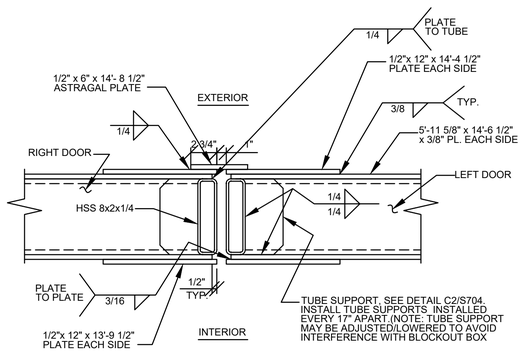
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

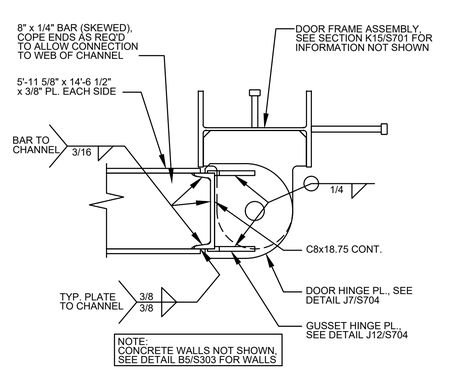
DOOR ELEVATIONS

SHEET ID
S-702

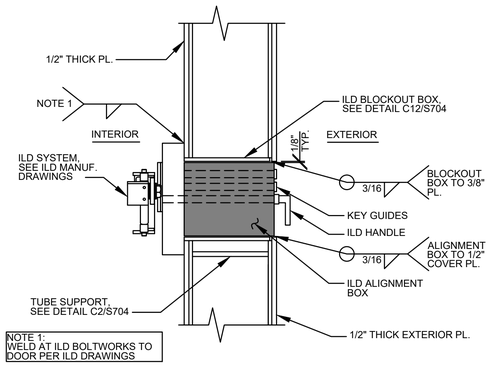
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



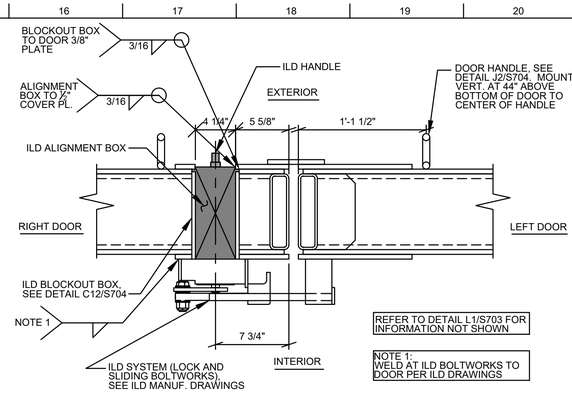
L1 SECTION
SCALE: 1 1/2"=1'-0"



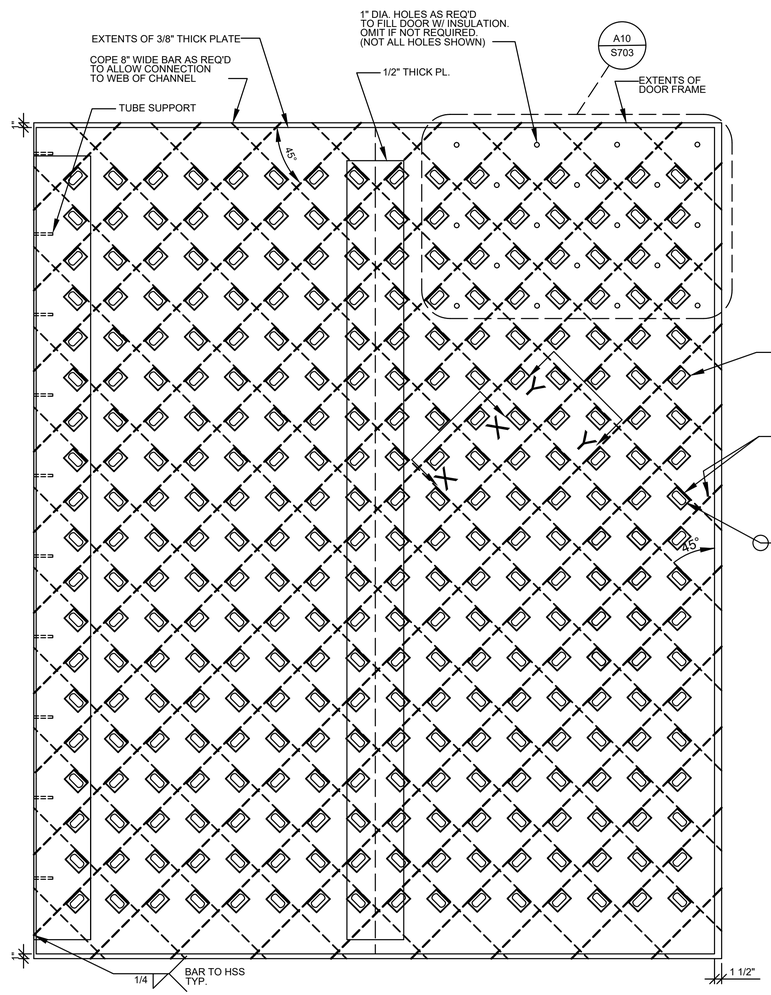
L6 SECTION
SCALE: 1 1/2"=1'-0"



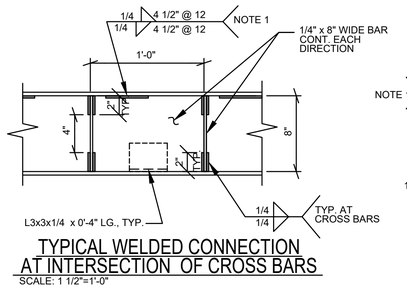
L11 SECTION
SCALE: 1 1/2"=1'-0"



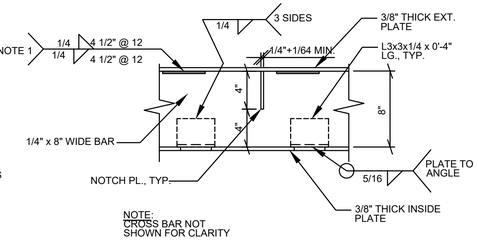
L16 SECTION
SCALE: 1 1/2"=1'-0"



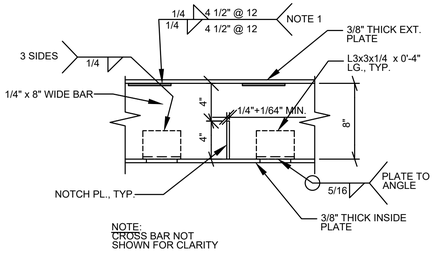
A1 LEFT DOOR PLATE ELEVATION "INSIDE VIEW"
SCALE: 3/4"=1'-0"



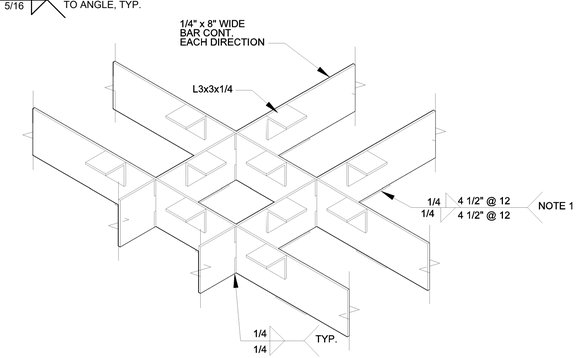
TYPICAL WELDED CONNECTION AT INTERSECTION OF CROSS BARS
SCALE: 1 1/2"=1'-0"



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

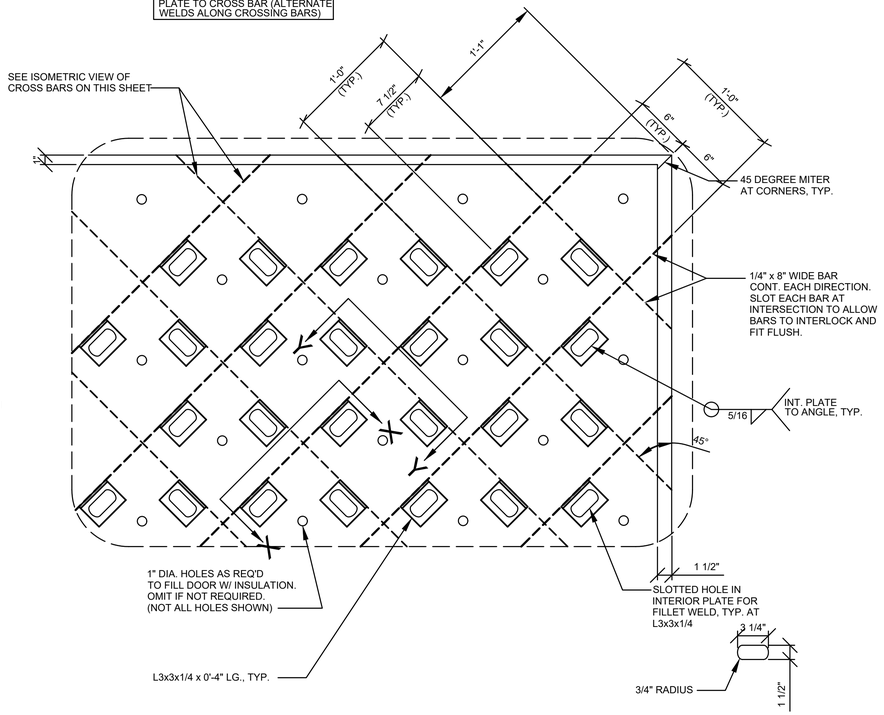


SECTION Y-Y
SCALE: 1 1/2"=1'-0"



"ISOMETRIC VIEW" OF WELDS AT CROSS BARS
SCALE: 1 1/2"=1'-0"

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



A10 ENLARGED DETAIL
SCALE: 1 1/2"=1'-0"

US Army Corps of Engineers®

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DRAWN BY: J. LUMPHREY
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SUBMITTED BY: FES MICX
SIZE: ANSI D

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

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

DOOR SECTIONS

SHEET ID
S-703

%PRODUCTION DATA 1%
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%PRODUCTION DATA 3%
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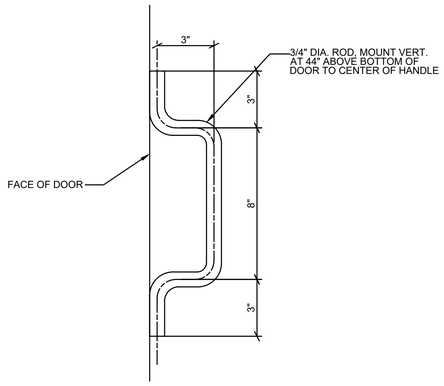
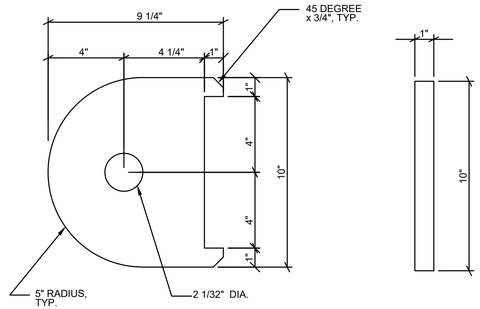
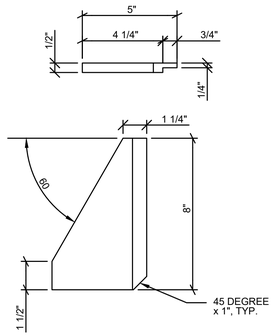
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



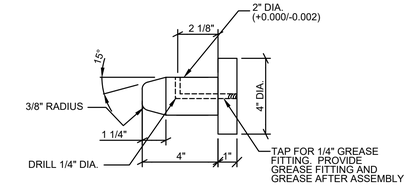
J2 HANDLE DETAIL
SCALE: 3"=1'-0" 0 3" 6" 1'



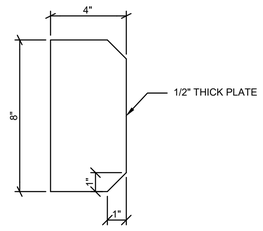
J7 DOOR HINGE PLATE DETAIL
SCALE: 3"=1'-0" 0 3" 6" 1'



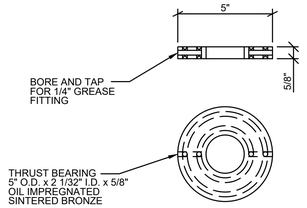
J12 GUSSET HINGE PLATE DETAIL
SCALE: 3"=1'-0" 0 3" 6" 1'



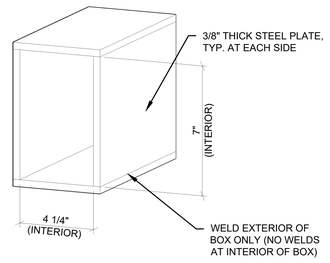
J17 HINGE PIN DETAIL
SCALE: 3"=1'-0" 0 3" 6" 1'



C2 TUBE SUPPORT PLATE DETAIL
SCALE: 3"=1'-0" 0 3" 6" 1'



C7 THRUST BEARING DETAIL
SCALE: 3"=1'-0" 0 3" 6" 1'



C12 ILD BLOCKOUT BOX DETAIL
SCALE: 3"=1'-0" 0 3" 6" 1'

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ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

DOOR DETAILS

SHEET ID
S-704

%PRODUCTION DATA 1%
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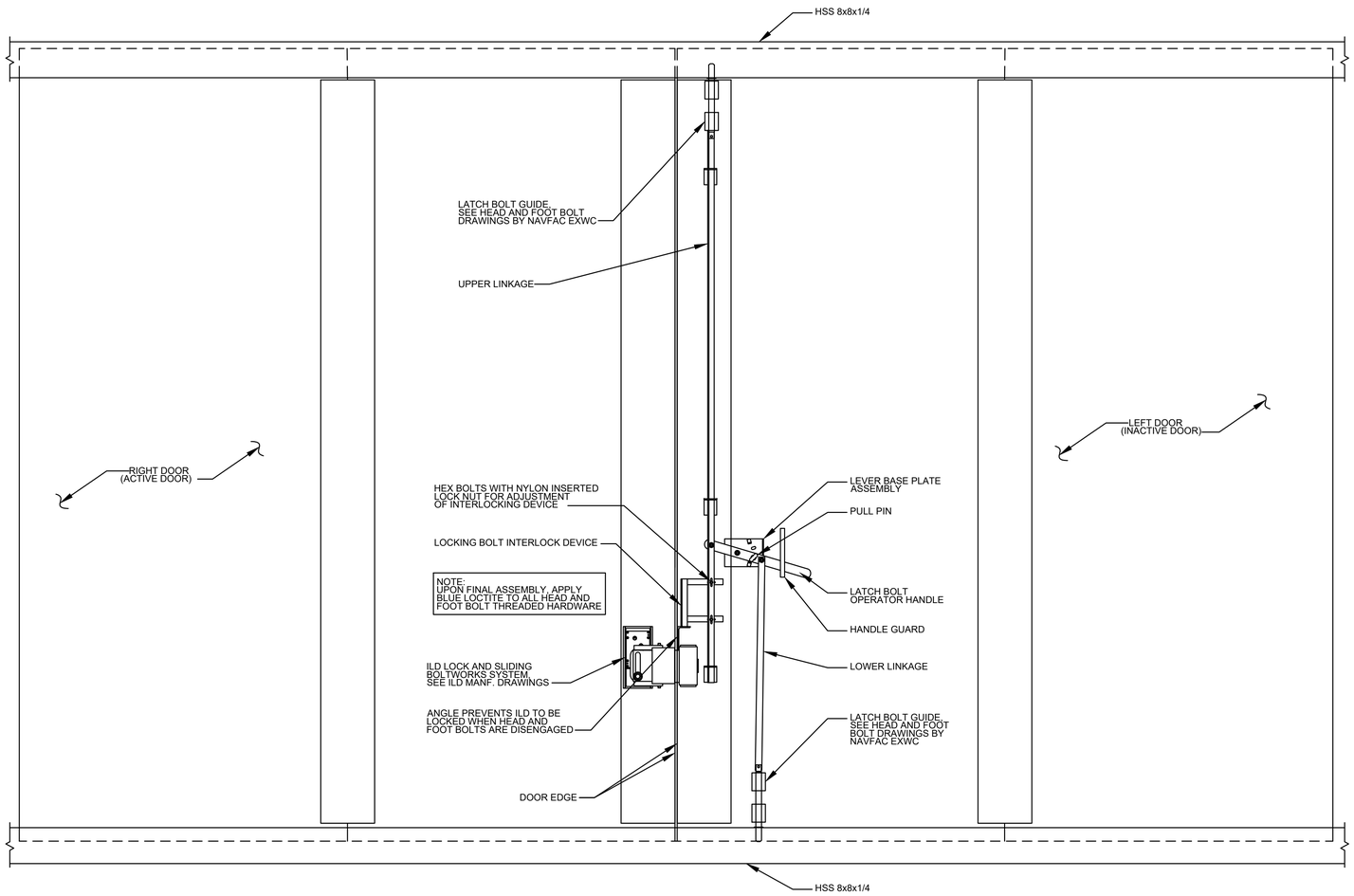
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL SHEET 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.



D2 INTERNAL LOCKING DEVICE (ILD) DETAIL

SCALE: 3/4"=1'-0"
VIEW FROM INSIDE OF MAGAZINE

0 1' 2' 4'

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HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX-TYPE, FLOW-THRU
STD 421-80-10 (REV. 1)

INTERNAL LOCKING DEVICE

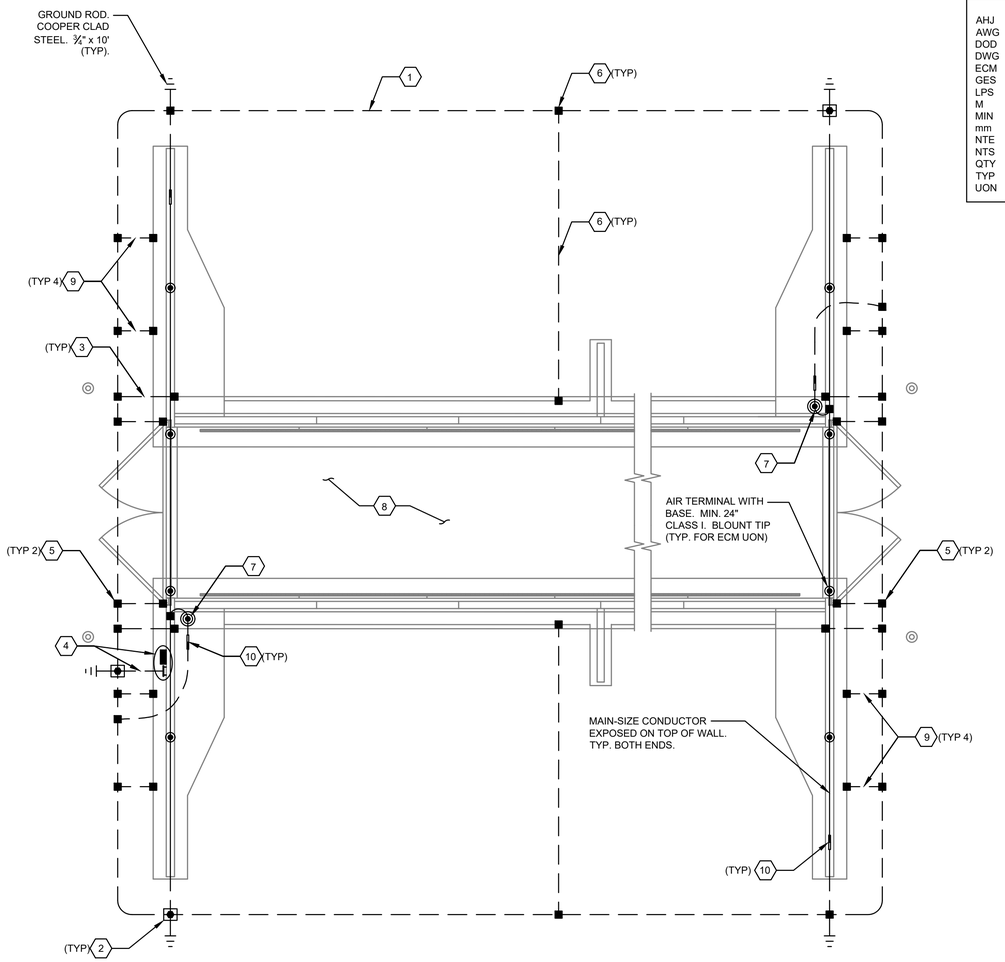
SHEET ID
S-705

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

MINIMUM SIZE LIGHTNING PROTECTION CONDUCTORS				
LIGHTNING CONDUCTORS	AREA (CM)	AREA (mm^2)	WEIGHT (lbs/1k ft.)	WEIGHT (kg/m)
• CLASS I MAIN-SIZE COPPER	57,400	35	187	0.32
• CLASS II MAIN-SIZE COPPER	115,000	70	375	0.62
• LIGHTNING BONDING COPPER	26,240	16	---	---

- SIZES SHOWN ARE BASED ON MINIMUM CLASS MATERIAL REQUIREMENTS FROM NFPA 780, TABLE 4.1.1.1.1/2. METRIC UNITS INDICATED ARE BASED ON THE NEXT LARGEST SIZE.
- ALUMINUM CONDUCTORS NOT INCLUDED NOR PERMITTED.

GROUNDING AND LPS CRITERIA FOR EXPLOSIVES FACILITIES		
DOD (APPLICABLE ALL AGENCIES)	NFPA 780	STANDARD FOR THE INSTALLATION OF LIGHTNING PROTECTION SYSTEMS
	DESR 6055.09	DEFENSE EXPLOSIVES SAFETY REGULATION
	UFC 3-575-01	LIGHTNING AND STATIC ELECTRICITY PROTECTION SYSTEMS
	UFC 4-420-01	AMMUNITION AND EXPLOSIVES STORAGE MAGAZINES
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



A5 GROUNDING AND LIGHTNING PROTECTION PLAN VIEW
NTS

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

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 GALV. - GALVANIZED
CU - COPPER

LIGHTNING PROTECTION CONDUCTORS AND CORRESPONDING AWG SIZES (NFPA 780 TABLE A.4.1.1.1.1/2)	
LIGHTNING CONDUCTORS	AREA (CIR. MILS)
• CLASS I MAIN-SIZE COPPER • #2 AWG	57,400 66,360
• CLASS II MAIN-SIZE COPPER • #2/0 AWG	115,000 133,100
• LIGHTNING BONDING COPPER • #6 AWG	26,240 26,240
ALUMINUM CONDUCTORS NOT PERMITTED FOR ECM CONSTRUCTION. SEE GENERAL NOTE 15.	

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. THE COMPLETED INSTALLATION SHALL BE CAPABLE OF OBTAINING AN UNDERWRITER'S LABORATORY (UL) MASTER LABEL OR EQUIVALENT THIRD-PARTY CERTIFICATION AS REQUIRED BY 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. REFER TO SHEET E-301 FOR A RSM ANALYSIS EXAMPLE. AIR TERMINALS ALONG THE LENGTH OF THE ECM OR BETWEEN THE FRONT AND REAR HEADWALLS ARE OPTIONAL IF A MINIMUM OF 2' OF EARTH COVER IS MAINTAINED.
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 AUXILIARY CONDUCTORS MUST RUN UNDERGROUND FOR AT LEAST 50' BEFORE ENTERING THE FACILITY. CONDUCTORS MUST BE SHIELDED OR 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 AND CONTENTS.
8. STATIC GROUND BUS BAR NOT DEPICTED. IF REQUIRED, SEE DA PAM 385-64, SECTION II; UFC 3-575-01, CHAPTER 2 AND DETAIL 'D' ON SHEET E-201 FOR MORE INFORMATION.
9. PROVIDE SURGE PROTECTION DEVICES (SPD) FOR CONDUCTIVE MEDIA AT THE POINT OF ENTRY INTO THE FACILITY. SPD's SHALL BE COMPLIANT WITH NFPA 780.
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 PROTECTED MATERIALS AS REQUIRED TO PREVENT CORROSION DUE TO DISSIMILAR METALS CONTACT. SEE ANSI/UL 96 SUGGESTED COMPATIBLE METALS THIS SHEET.
13. TWO VENTILATORS SHOWN. 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 DOD STANDARDS AND LOCAL STANDARDS. SEE CRITERIA TABLE THIS SHEET.
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.

KEYED NOTES:

1. GROUNDING ELECTRODE SYSTEM (G.E.S.), #4/0 AWG BARE COPPER CONDUCTOR. INSTALL IN DIRECT CONTACT WITH EARTH 3' - 8' FROM EDGE OF EARTH COVER AND MIN. 30" BELOW GRADE.
2. GROUND TEST WELL AND ¾" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQ'D. PROVIDE TRAFFIC RATED COVER. ONLY BOLTED CLAMP CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL A, SHEET E-201.
3. BOND FOUNDATION REBAR TO THE G.E.S. USING #4/0 AWG. TYPICAL EACH ECM CORNER AND AT DISTANCES NOT TO EXCEED 60'.
4. WHEN REQUIRED, PROVIDE POWER PANEL AND FIELD LOCATE PER SITE 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 SHEET E-202, DETAIL 'G' FOR SINGLE POINT GROUND BAR DETAIL.
5. BOND DOOR FRAME TO G.E.S. 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, SHEET E-102).
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. MINIMIZE DOWN CONDUCTORS' UPWARD BEND LENGTHS.
8. SEE DETAIL A, SHEET E-102 FOR GROUNDING OF THE PRECAST PANELS WITHIN THE INTERIOR OF THE ECM.
9. BOND WING-WALL RE-BAR TO THE G.E.S. USING #4/0 AWG BARE COPPER. MINIMUM TWO PLACES PER WING-WALL. SEE DETAIL D, SHEET E-202.
10. OPTIONAL PER USER REQUIREMENTS. PROVIDE A 4-BOLT INLINE CONNECTOR, OR EQUIVALENT OF MIN. 2" SURFACE CONTACT EACH CONDUCTOR, AT EACH DOWN CONDUCTOR EXTENDING FROM THE AIR TERMINAL SYSTEM IN ORDER TO SEPARATE THE BELOW GRADE FROM THE ABOVE GRADE SYSTEMS TO FACILITATE TESTING OF GROUNDING SYSTEMS. INSTALL EXPOSED AND WHERE ACCESSIBLE. ALL LOCATIONS MAY NOT BE SHOWN. SEE DETAIL E, SHEET E-202.

US Army Corps of Engineers®

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

ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:
DESIGNED BY: CEHNC-EDM-E
DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY:
SIZE: MCX
SCALE: ANSI D

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

MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)

GROUNDING AND LIGHTNING PROTECTION PLAN

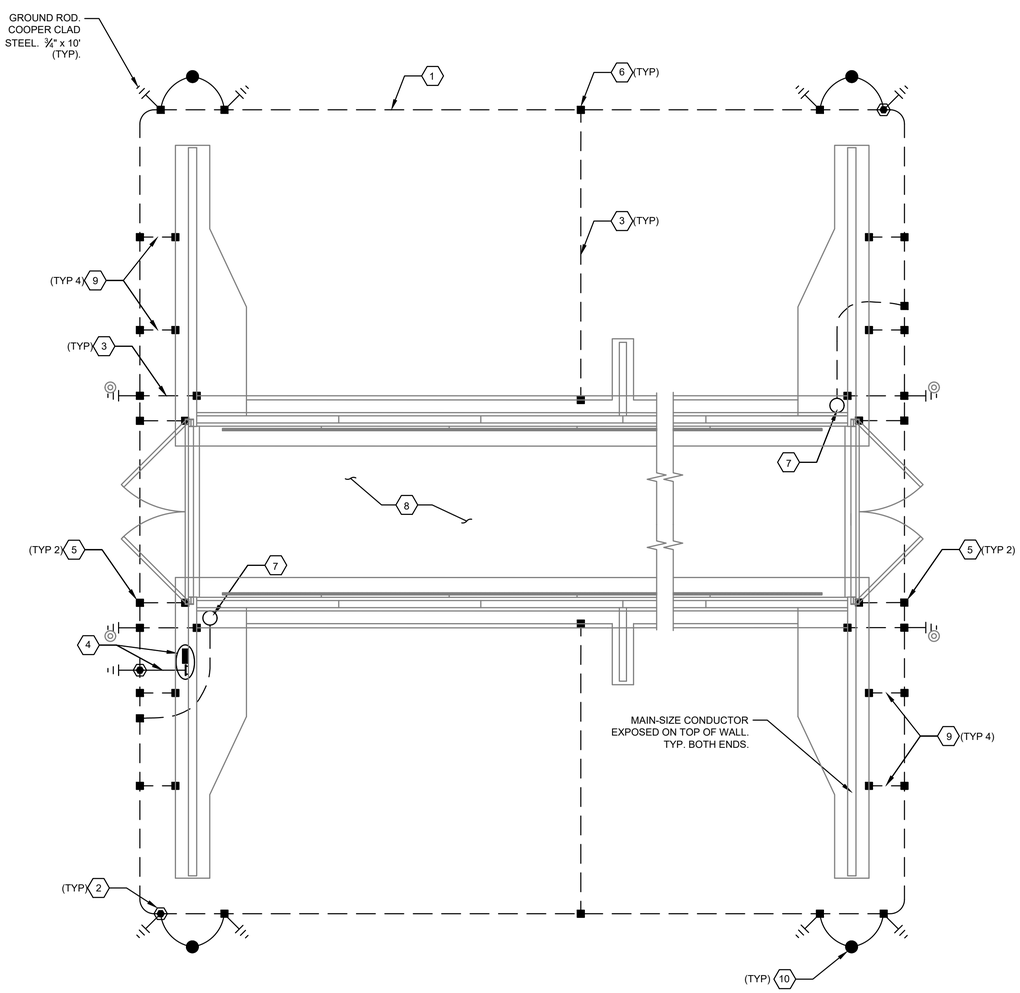
SHEET ID
E-101

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

MINIMUM SIZE LIGHTNING PROTECTION CONDUCTORS				
LIGHTNING CONDUCTORS	AREA (CM)	AREA (mm^2)	WEIGHT (lbs/1k ft.)	WEIGHT (kg/m)
• CLASS I MAIN-SIZE COPPER	57,400	35	187	0.32
• CLASS II MAIN-SIZE COPPER	115,000	70	375	0.62
• LIGHTNING BONDING COPPER	26,240	16	---	---

- SIZES SHOWN ARE BASED ON MINIMUM CLASS MATERIAL REQUIREMENTS FROM NFPA 780, TABLE 4.1.1.1.1/2. METRIC UNITS INDICATED ARE BASED ON THE NEXT LARGEST SIZE.
- ALUMINUM CONDUCTORS NOT INCLUDED NOR PERMITTED.

GROUNDING AND LPS CRITERIA FOR EXPLOSIVES FACILITIES		
DOD (APPLICABLE ALL AGENCIES)	NFPA 780	STANDARD FOR THE INSTALLATION OF LIGHTNING PROTECTION SYSTEMS
	DESR 6055.09	DEFENSE EXPLOSIVES SAFETY REGULATION
	UFC 3-575-01	LIGHTNING AND STATIC ELECTRICITY PROTECTION SYSTEMS
	UFC 4-420-01	AMMUNITION AND EXPLOSIVES STORAGE MAGAZINES
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



A1 GROUNDING AND LIGHTNING PROTECTION PLAN VIEW
NTS

KEYED NOTES:

11. 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.
12. THE COMPLETED INSTALLATION SHALL BE CAPABLE OF OBTAINING AN UNDERWRITER'S LABORATORY (UL) MASTER LABEL OR EQUIVALENT THIRD-PARTY CERTIFICATION AS REQUIRED BY THE AHJ.
13. LPS COMPONENTS SHALL BEAR THE UL LISTING OR LABEL WHEN AVAILABLE (OR LOCAL EQUIVALENT).

ALTERNATE DESIGN GENERAL NOTES:

1. SEE GENERAL NOTES THIS SHEET.
2. THIS SHEET SHOWS AN ALTERNATIVE LIGHTNING PROTECTION SYSTEM DESIGN USING A MAST-TYPE SYSTEM TO PROVIDE THE 100' RADIUS ZONE OF PROTECTION, INSTEAD OF AN INTEGRAL-TYPE SYSTEM AS SHOWN ON SHEET E-101 AND FOLLOWING.
3. USER AND OWNER HAS THE OPTION TO INSTALL EITHER PROTECTION SYSTEM. BONDING AND GROUNDING REQUIREMENTS REMAIN UNCHANGED AND ARE SHOWN ON SHEETS E-101-A, E-201-A AND E-202-A.
4. ROLLING SPHERE ANALYSIS FOR THE MAST-TYPE SYSTEM IS SHOWN ON SHEET E-301-A.
5. SHEETS RELATED TO THIS ALTERNATIVE DESIGN ARE IDENTIFIED WITH '-A' AT THE END OF THE SHEET NUMBER.

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

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

LIGHTNING PROTECTION CONDUCTORS AND CORRESPONDING AWG SIZES

(NFPA 780 TABLE A.4.1.1.1.1/2)

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

ALUMINUM CONDUCTORS NOT PERMITTED FOR ECM CONSTRUCTION. SEE GENERAL NOTE 15.

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.

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. THE COMPLETED INSTALLATION SHALL BE CAPABLE OF OBTAINING AN UNDERWRITER'S LABORATORY (UL) MASTER LABEL OR EQUIVALENT THIRD-PARTY CERTIFICATION AS REQUIRED BY 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. REFER TO SHEET E-301-A FOR THE RSM ANALYSIS EXAMPLE.
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 AUXILIARY CONDUCTORS MUST RUN UNDERGROUND FOR AT LEAST 50' BEFORE ENTERING THE FACILITY. CONDUCTORS MUST BE SHIELDED OR 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 AND CONTENTS.
8. STATIC GROUND BUS BAR NOT DEPICTED. IF REQUIRED, SEE DA PAM 385-64, SECTION II; UFC 3-575-01, CHAPTER 2 AND DETAIL 'G' ON SHEET E-202-A FOR MORE INFORMATION.
9. PROVIDE SURGE PROTECTION DEVICES (SPD) FOR CONDUCTIVE MEDIA AT THE POINT OF ENTRY INTO THE FACILITY. SPD's SHALL BE COMPLIANT WITH NFPA 780.
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 PROTECTED MATERIALS AS REQUIRED TO PREVENT CORROSION DUE TO DISSIMILAR METALS CONTACT. SEE ANSI/UL 96 SUGGESTED COMPATIBLE METALS THIS SHEET.
13. TWO VENTILATORS SHOWN. 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 DOD STANDARDS AND LOCAL STANDARDS. SEE CRITERIA TABLE THIS SHEET.
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.

KEYED NOTES:

1. #4/0 AWG BARE COPPER CONDUCTOR AND THE GROUNDING ELECTRODE SYSTEM (G.E.S.). INSTALL IN DIRECT CONTACT WITH EARTH 3' - 8' FROM EDGE OF EARTH COVER AND MIN. 30" BELOW GRADE.
2. GROUND TEST WELL WITH ¾" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQ'D. PROVIDE TRAFFIC RATED COVER. ONLY BOLTED CLAMP CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL A, SHEET E-201-A. PROVIDE MIN. THREE TEST WELLS TO FACILITATE TESTING.
3. BOND FOUNDATION REBAR TO THE G.E.S. USING #4/0 AWG. TYPICAL EACH ECM CORNER AND AT DISTANCES NOT TO EXCEED 60'.
4. WHEN REQUIRED, PROVIDE POWER PANEL AND FIELD LOCATE PER SITE 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 SHEET E-202-A, DETAIL 'E' FOR SINGLE POINT GROUND BAR DETAIL.
5. BOND DOOR FRAME TO G.E.S. 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. BOND VENTILATOR USING MINIMUM #2/0 AWG TO THE G.E.S.
8. SEE DETAIL D, SHEET E-201-A FOR GROUNDING OF THE PRECAST PANELS WITHIN THE INTERIOR OF THE ECM.
9. BOND WING-WALL RE-BAR TO THE G.E.S. USING #4/0 AWG BARE COPPER. MINIMUM TWO PLACES PER WING-WALL. SEE DETAIL D, SHEET E-202-A.
10. LPS MAST, WOOD OR METALLIC. WHERE WOOD MASTS ARE USED, PROVIDE MIN. 24" AIR TERMINAL ON TOP OF WOOD MASTS AND TWO #2/0 AWG DOWN CONDUCTORS ON OPPOSITE SIDE OF POLE (ILLUSTRATED IN PLAN VIEW). TERMINATE TO THE G.E.S. AND AT A GROUND ROD. MAST HEIGHT AND LOCATION SHALL BE AS SHOWN IN THE ROLLING SPHERE METHOD ANALYSIS, SHEETS E-301-A AND E-302-A. METALLIC MASTS DO NOT REQUIRE AIR TERMINALS OR DOWN CONDUCTORS. BOND METALLIC MASTS TO GROUND RING CONDUCTOR, MINIMUM TWO PLACES WITH #2/0 AWG.

US Army Corps of Engineers®

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

DESIGNED BY: CEHNC-EDM-E
DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY: SEE MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

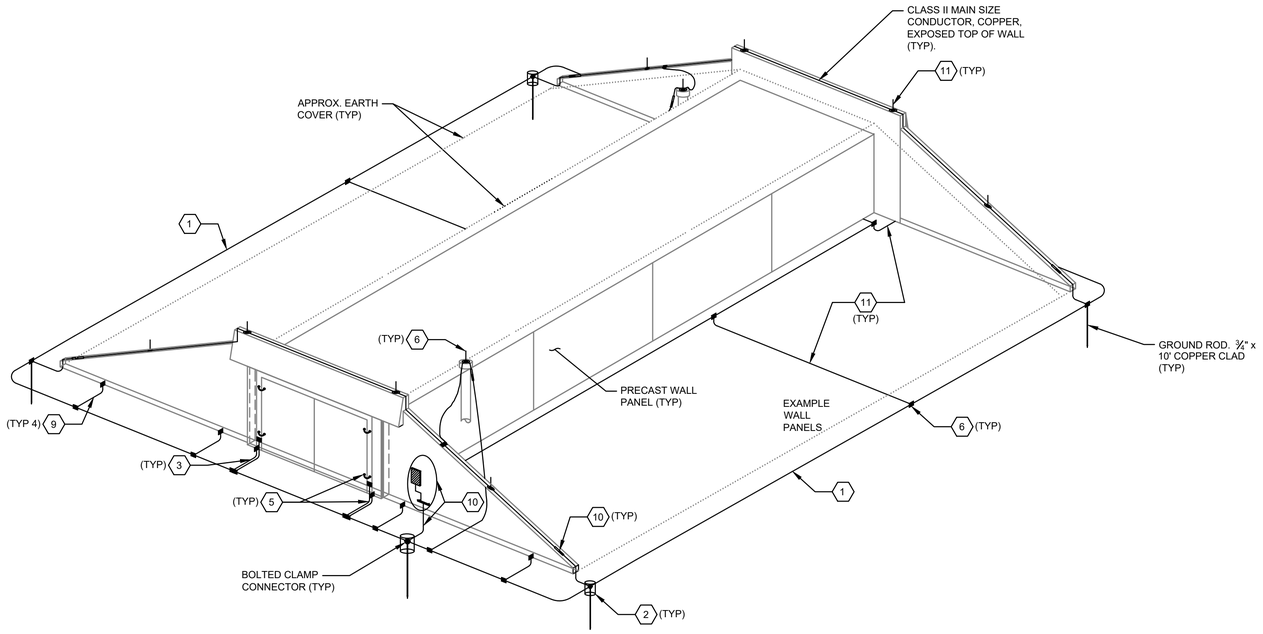
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)

GROUNDING AND LIGHTNING PROTECTION PLAN

SHEET ID
E-101-A

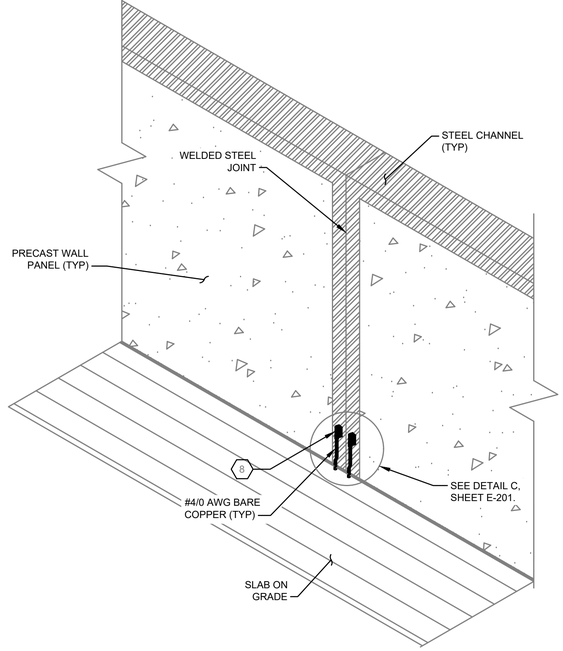
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



H1 GROUNDING AND LIGHTNING PROTECTION SYSTEM - ISOMETRIC VIEW

NTS

NON-SPECIFIC LENGTH SHOWN.



A1 PRECAST WALL PANEL INTERIOR GROUNDING

NTS

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET E-101.

KEYED NOTES:

1. #4/0 AWG BARE COPPER CONDUCTOR AND THE GROUNDING ELECTRODE SYSTEM (G.E.S.). INSTALL IN DIRECT CONTACT WITH EARTH 3' - 8' FROM EDGE OF EARTH COVER AND MIN. 30" BELOW GRADE.
2. GROUND TEST WELL WITH ¾" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQ'D. PROVIDE TRAFFIC RATED COVER. ONLY BOLTED CLAMP CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL A, SHEET E-201.
3. BOND FOUNDATION REBAR TO THE G.E.S. USING #4/0 AWG. TYPICAL EACH ECM CORNER AND AT DISTANCES NOT TO EXCEED 60'.
4. WHEN REQUIRED, PROVIDE POWER PANEL AND FIELD LOCATE PER SITE 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 SHEET E-202, DETAIL 'G' FOR SINGLE POINT GROUND BAR DETAIL.
5. BOND DOOR FRAME TO G.E.S. 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. "DEAD ENDED" CONDUCTORS SHALL MEET NFPA 780, 4.8.2.
8. PROVIDE A VERTICAL CABLE DROP EXOTHERMIC WELD TO THE STEEL FLANGE. CONNECT TO THE FOUNDATION REBAR WITH #4/0 AWG BARE COPPER. SEE DETAIL C, SHEET E-201. PROVIDE TWO WELDED CONNECTIONS EACH PANEL, ONE EACH END.
9. BOND WING-WALL RE-BAR TO THE G.E.S. USING #4/0 AWG BARE COPPER. MINIMUM TWO PLACES PER WING-WALL. SEE DETAIL D, SHEET E-202.
10. OPTIONAL PER USER REQUIREMENTS. PROVIDE A 4-BOLT INLINE CONNECTOR, OR EQUIVALENT OF MIN. 2" SURFACE CONTACT EACH CONDUCTOR, AT EACH DOWN CONDUCTOR EXTENDING FROM THE AIR TERMINAL SYSTEM IN ORDER TO SEPARATE THE BELOW GRADE FROM THE ABOVE GRADE SYSTEMS TO FACILITATE TESTING OF GROUNDING SYSTEMS. INSTALL EXPOSED AND WHERE ACCESSIBLE. ALL LOCATIONS MAY NOT BE SHOWN. SEE DETAIL E, SHEET E-202.
11. AIR TERMINAL WITH BASE, MIN. 24" CLASS I, BLUNT TIP. SEE SHEET E-301 FOR THE ROLLING SPHERE ANALYSIS EXAMPLE.

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

US Army Corps of Engineers®

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

DESIGNED BY: CEHNC-EDM-E
DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY: ESS MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

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

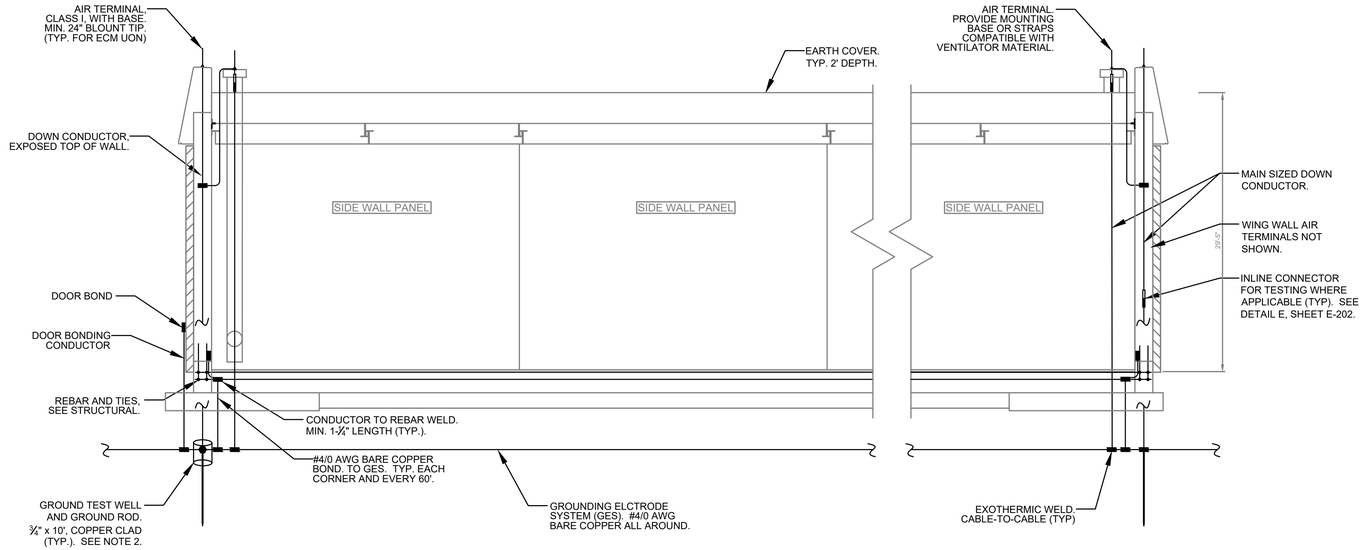
MODULAR STORAGE MAGAZINE
BOX - TYPE, FLOW-THRU
421-80-10 (REV. 1)

GROUNDING AND LIGHTNING PROTECTION SYSTEM

SHEET ID

E-102

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



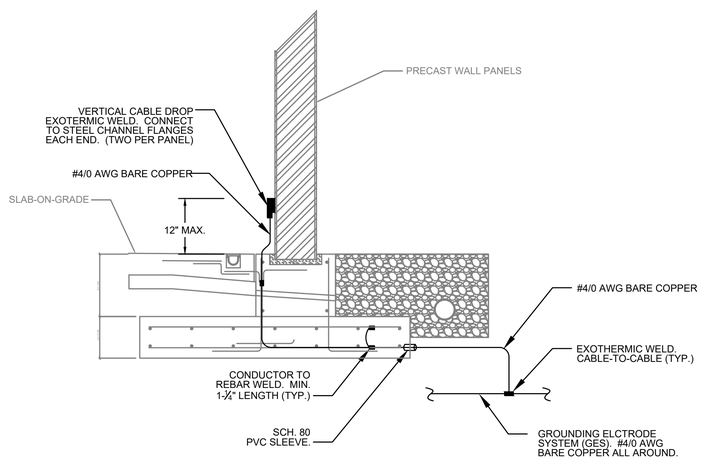
H4 TYPICAL ECM ELEVATION VIEW

NTS

NON-SPECIFIC LENGTH SHOWN.

GENERAL NOTES:

1. ONLY REAR VENTILATOR SHOWN FOR CLARITY. IF ADDITIONAL VENTILATORS ARE PRESENT, PROVIDE AIR TERMINALS, GROUNDING AND BONDING TYPICAL FOR REAR. ALL OTHER LPS COMPONENTS AND DESIGN ASPECTS REMAIN UNCHANGED.
2. GROUND TEST WELL WITH ¾" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQ'D. PROVIDE TRAFFIC RATED COVER. ONLY BOLTED CLAMP CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL A, THIS SHEET. SEE PLAN VIEW FOR QTY.
3. CONDUCTORS SHALL BE BARE COPPER, MINIMUM CLASS II MAIN SIZED, UNLESS OTHERWISE NOTED.
4. PROVIDE SOLID CONCRETE BLOCK ON WHICH TO MOUNT AIR TERMINALS. SIZE AS REQUIRED TO SUPPORT FOOTING AND ANCHORS. AIR TERMINAL TO MAINTAIN MINIMUM 2' ABOVE EARTH COVER.
5. CAST GROUND PLATE SHALL BE COPPER ALLOY. HOLE SPACING SHALL BE NEMA STANDARD FOR 2-HOLES. ½"-13 THREADED HOLES, ½" DEEP. PRODUCT SHALL BE EQUIVALENT TO CADWELD B16 SERIES CAST GROUND PLATE AND B122 SERIES TYPE GL LUG.
6. SEE GENERAL NOTES ON DRAWING E-101.



A3 WALL PANEL TO FOUNDATION BONDING DETAIL

NTS

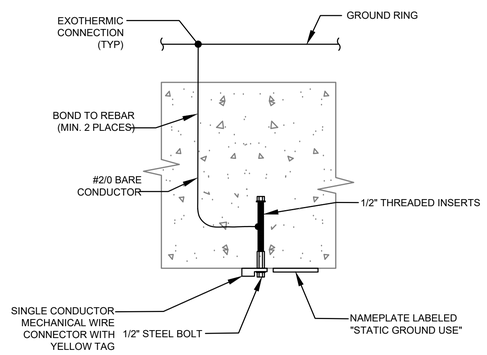
NOTES:

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

"*NOT IN SERVICE - NO MAINTENANCE REQUIRED.*

INSTALLATION MEETS STATIC/FACILITY GROUND REQUIREMENTS PER DA PAM 385-64. ACTIVITY SHALL PERFORM TESTING PER DA PAM 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."

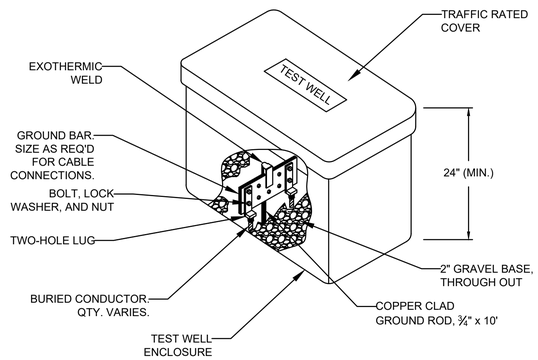


A10 OPTIONAL STATIC GROUND INSERT DETAIL

NTS

NOTE:

A. RECTANGULAR ENCLOSURE ILLUSTRATED - EXAMPLE ONLY.



A15 GROUND TEST WELL DETAIL

NTS

US Army Corps of Engineers®

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1	Removed Hasps. Modified ILD Door Details. Implemented Lessons Learned. Electrical Updates	SEPT. 2024

ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

DESIGNED BY: CEHNC-EDM-E
DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY: ESS MCX
SIZE: ANSI D

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

MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)

GROUNDING AND LIGHTNING PROTECTION DETAILS

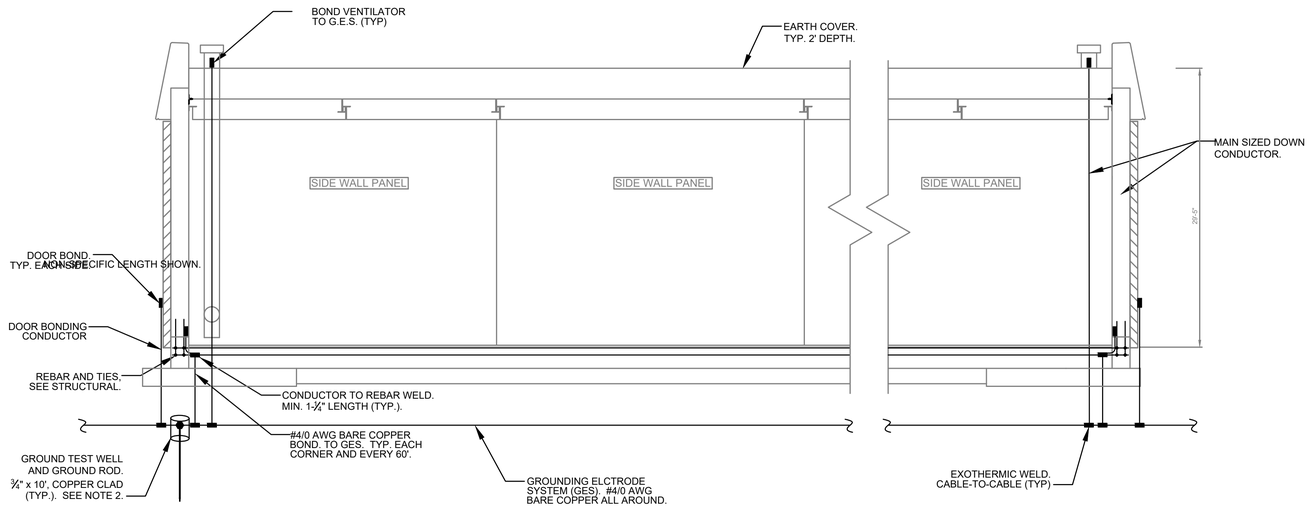
SHEET ID

E-201

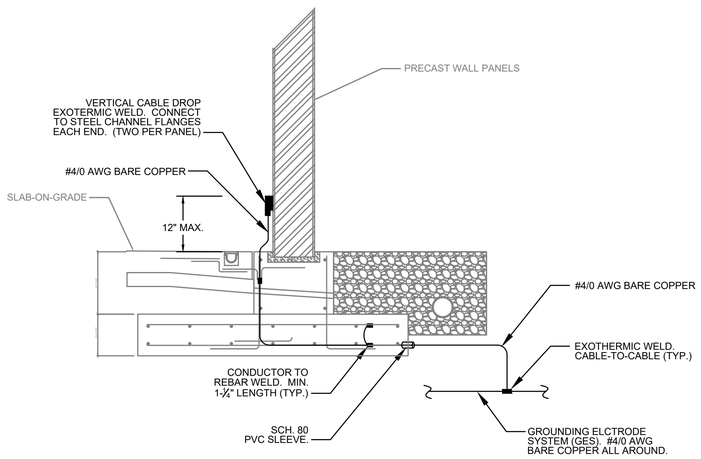
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL NOTES:

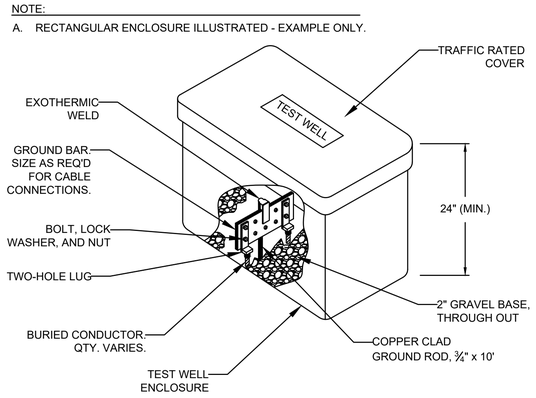
1. GROUND TEST WELL WITH ¾" x 10' COPPER CLAD GROUND ROD. TEST WELLS SIZED AS REQ'D. PROVIDE TRAFFIC RATED COVER. ONLY BOLTED CLAMP CONNECTORS PERMITTED WITHIN GROUND TEST WELLS. SEE DETAIL A, THIS SHEET. SEE PLAN VIEW FOR QTY.
2. CONDUCTORS SHALL BE BARE COPPER, MINIMUM CLASS II MAIN SIZED, UNLESS OTHERWISE NOTED.
3. PROVIDE SOLID CONCRETE BLOCK ON WHICH TO MOUNT AIR TERMINALS. SIZE AS REQUIRED TO SUPPORT FOOTING AND ANCHORS. AIR TERMINAL TO MAINTAIN MINIMUM 2' ABOVE EARTH COVER.
4. PROVIDE A VERTICAL CABLE DROP EXOTHERMIC WELD TO THE STEEL FLANGE. CONNECT TO FOUNDATION REBAR WITH #4/0 AWG BARE COPPER. SEE DETAIL C, THIS SHEET. TWO WELDED CONNECTION EACH PANEL, ONE EACH END.
5. SEE GENERAL NOTES ON DRAWING E-101-A.



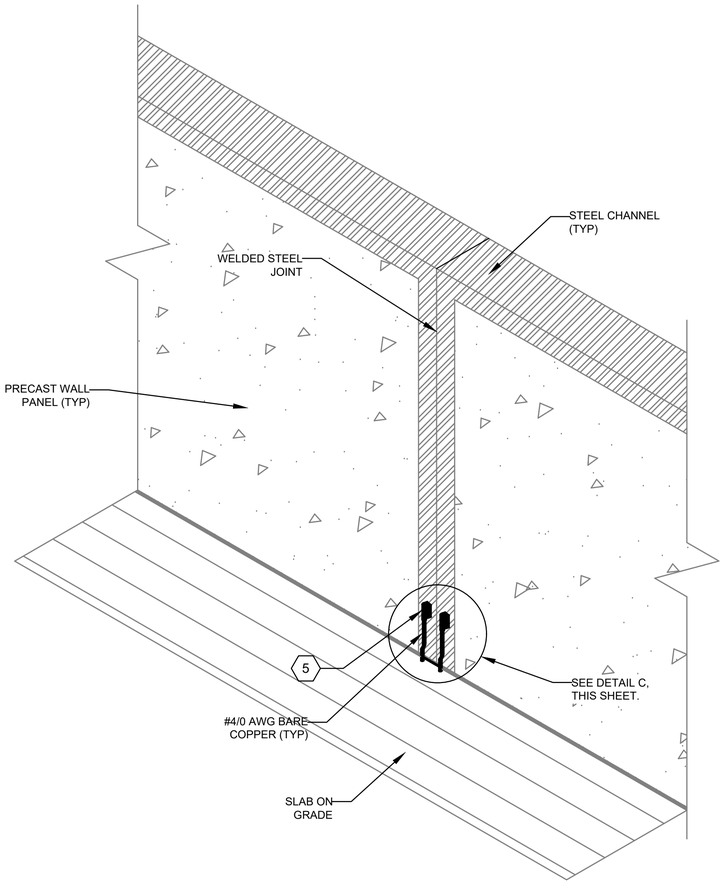
F1 TYPICAL ECM ELEVATION VIEW
NTS



A1 WALL PANEL TO FOUNDATION BONDING DETAIL
NTS



A8 GROUND TEST WELL DETAIL
NTS



A14 PRECAST WALL PANEL INTERIOR GROUNDING
NTS

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DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY: SEE MCX
SEE SPEC
ANSI D

ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

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

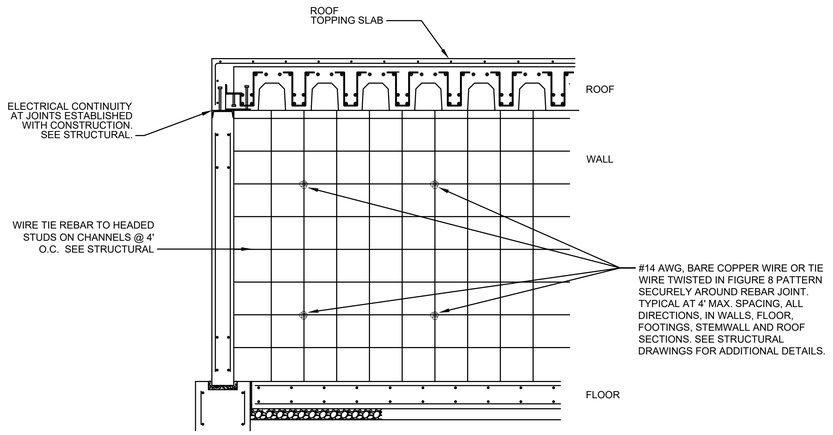
MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)
GROUNDING AND LIGHTNING PROTECTION DETAILS

SHEET ID
E-201-A

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

GENERAL NOTES:

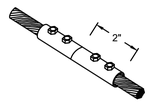
1. CONDUCTORS SHALL BE COPPER, MINIMUM SIZE #2/0 AWG BARE COPPER, UON.
2. UNLESS OTHERWISE NOTED, BONDING AS SHOWN WITHIN THE DETAILS OF THIS SHEET SHALL BE MINIMUM EVERY 4' IN ALL DIRECTIONS.
3. SEE GENERAL NOTES ON DRAWING E-101.



NOTES:

A. "TACK" WELDING MAY BE USED IN LIEU OF TIE WIRE 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.

H1 PANEL BONDING DETAILS
NTS

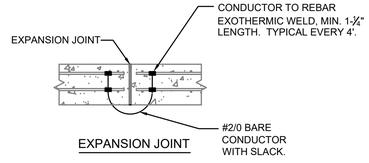


CONNECTOR SHALL PROVIDE MIN. 2" CONNECTION LENGTH EACH CONDUCTOR OR EQUIVALENT SURFACE AREA CONTACT.

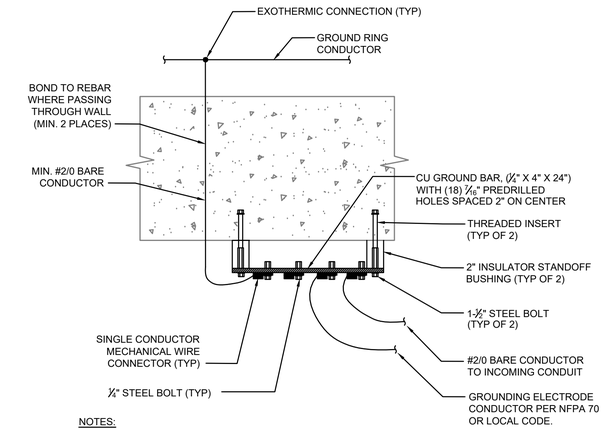
NOTES:

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 ISOLATE THE BELOW GRADE GROUNDING SYSTEM FROM THE ABOVE GRADE AIR TERMINALS AND MAIN CONDUCTORS SYSTEM. NOT NECESSARY WHERE ISOLATION CAN BE MADE AT A TEST WELL. USER OPTION TO INSTALL.
B. INLINE CONNECTORS SHALL BE INSTALLED EXPOSED AND WHERE EASILY ACCESSIBLE.

L9 TYPICAL INLINE CONNECTOR (DISCONNECT)
NTS



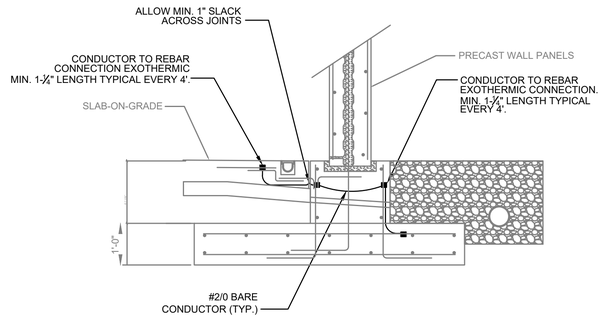
E9 TYPICAL BOND CONNECTION AT VARIOUS CONSTRUCTION JOINTS
NTS



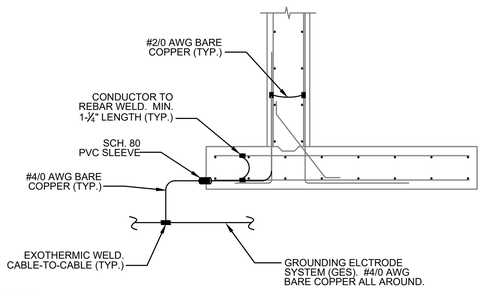
NOTES:

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 DETAIL SHOWN.

H15 SINGLE POINT GROUND BAR DETAIL
NTS



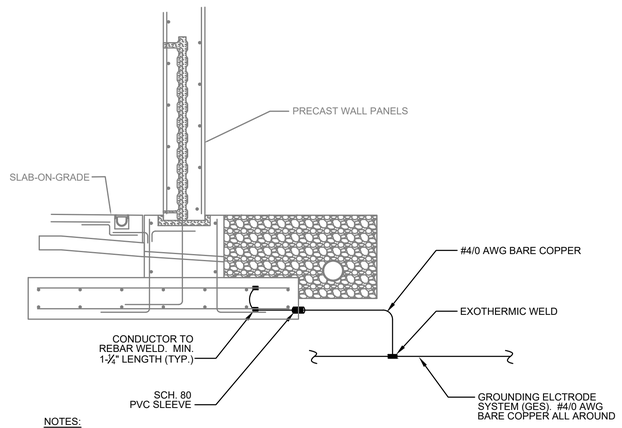
A1 FLOOR TO FOUNDATION BONDING DETAIL
NTS



NOTES:

A. BOND WING WALL AS SHOWN A MINIMUM TWO PLACE FOR EACH WING WALL.

A9 WING-WALL TO G.E.S. BONDING DETAIL
NTS



NOTES:

A. TYPICAL FOUNDATION TO G.E.S BONDING DETAIL. PROVIDE AT EACH ECM CORNER AND AT DISTANCES NOT TO EXCEED (NTE) 60'.

A15 FOUNDATION TO G.E.S.BONDING DETAIL
NTS

US Army Corps of Engineers®

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

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DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY: FESS MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

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

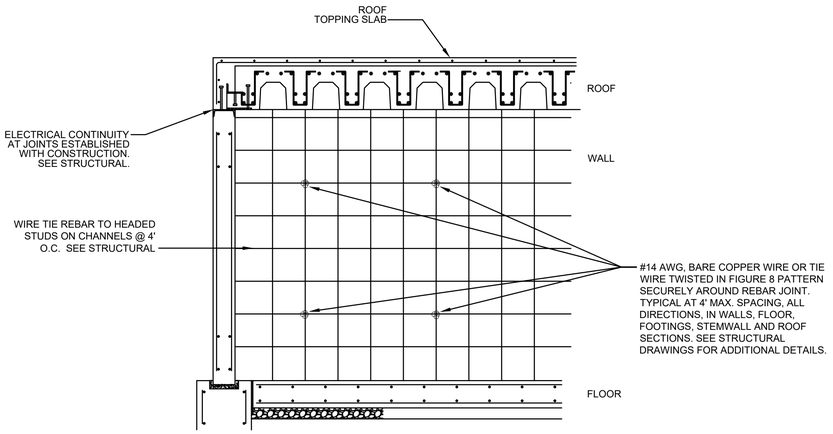
MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)

GROUNDING AND BONDING DETAILS

SHEET ID

E-202

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

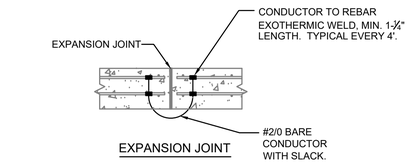


NOTES:

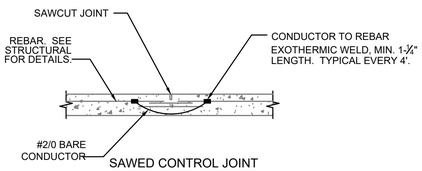
A. "TACK" WELDING MAY BE USED IN LIEU OF TIE WIRE FOR ELECTRICAL CONTINUITY.
B. BONDING AND GROUNDING NOTE: ELECTRICAL BONDING REQUIREMENTS INTERNAL TO PRECAST ROOF AND WALL PANELS SHALL BE PROVIDED BY THE PRECAST MANUFACTURER IN ACCORDANCE WITH THE STRUCTURAL DRAWINGS. ELECTRICAL BONDING REQUIREMENTS 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.

J1 PANEL BONDING DETAILS

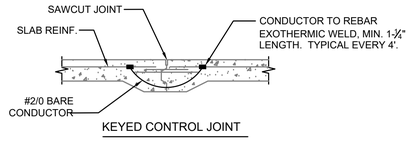
NTS



EXPANSION JOINT



SAWED CONTROL JOINT



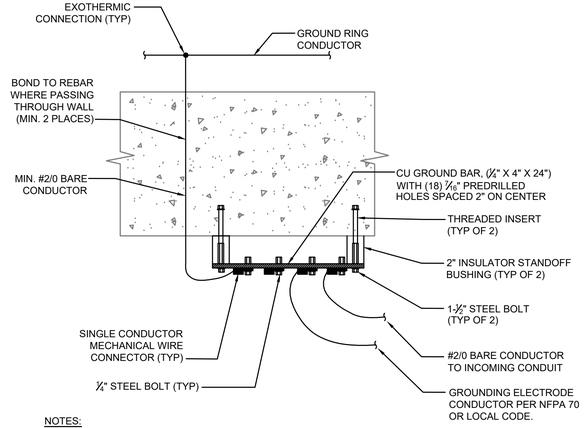
KEYED CONTROL JOINT

J9 TYPICAL BOND CONNECTION AT VARIOUS CONSTRUCTION JOINTS

NTS

GENERAL NOTES:

1. CONDUCTORS SHALL BE COPPER, MINIMUM SIZE #2/0 AWG BARE COPPER, UON.
2. UNLESS OTHERWISE NOTED, BONDING AS SHOWN WITHIN THE DETAILS OF THIS SHEET SHALL BE MINIMUM EVERY 4' IN ALL DIRECTIONS.
3. SEE GENERAL NOTES ON DRAWING E-101-A.

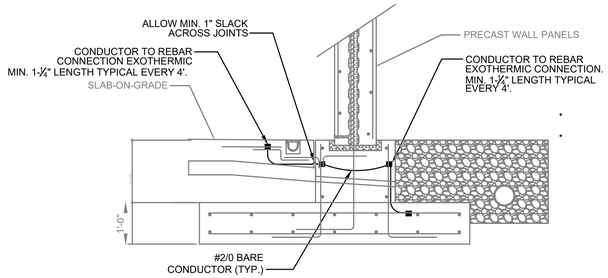


NOTES:

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 DETAIL SHOWN.

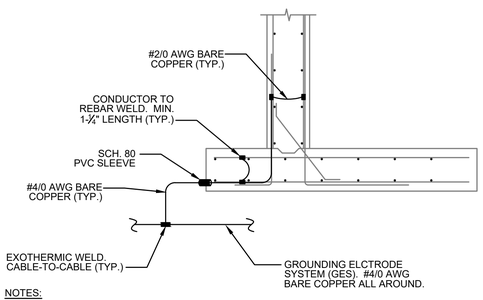
H15 SINGLE POINT GROUND BAR DETAIL

NTS



E5 FLOOR TO FOUNDATION BONDING DETAIL

NTS

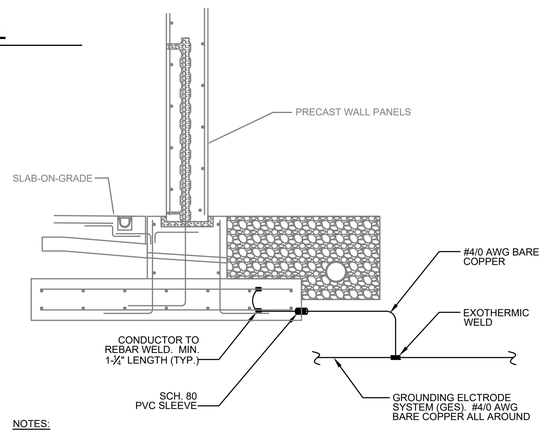


NOTES:

A. BOND WING WALL AS SHOWN A MINIMUM TWO PLACE FOR EACH WING WALL.

A1 WING-WALL TO G.E.S. BONDING DETAIL

NTS

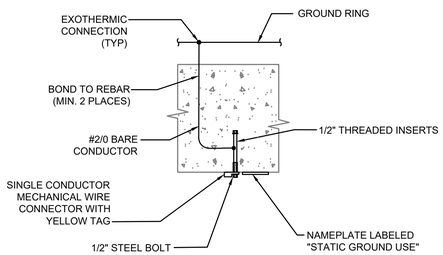


NOTES:

A. TYPICAL FOUNDATION TO G.E.S BONDING DETAIL. PROVIDE AT EACH ECM CORNER AND AT DISTANCES NOT TO EXCEED (NTE) 60'.

A9 FOUNDATION TO G.E.S.BONDING DETAIL

NTS



NOTES:

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

"NOT IN SERVICE - NO MAINTENANCE REQUIRED.

INSTALLATION MEETS STATIC/FACILITY GROUND REQUIREMENTS PER DA PAM 385-64. ACTIVITY SHALL PERFORM TESTING PER DA PAM 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."

B15 OPTIONAL STATIC GROUND INSERT DETAIL

NTS

US Army Corps of Engineers®

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DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY: MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
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U.S. ARMY CORPS OF ENGINEERS
ENGINEERING AND SUPPORT CENTER
HUNTSVILLE, ALABAMA

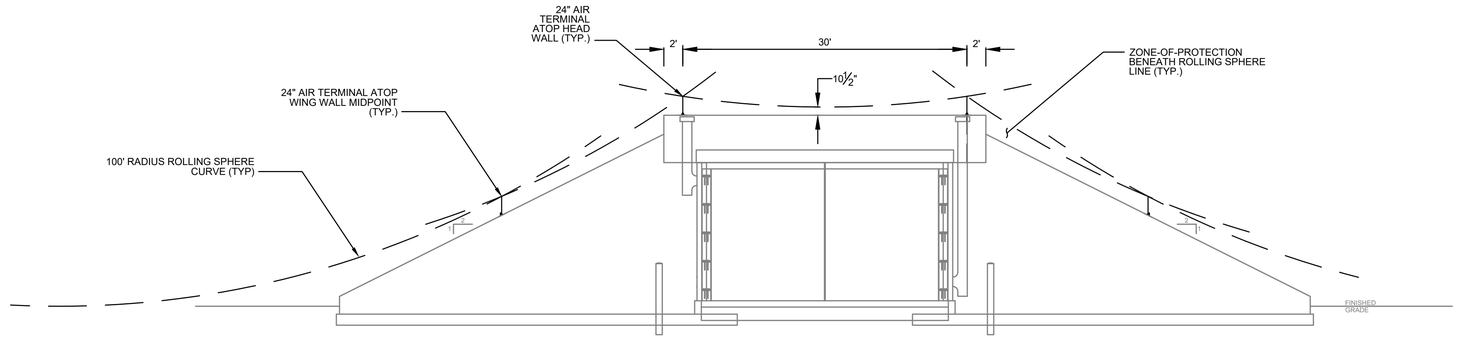
MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)

GROUNDING AND BONDING DETAILS

SHEET ID

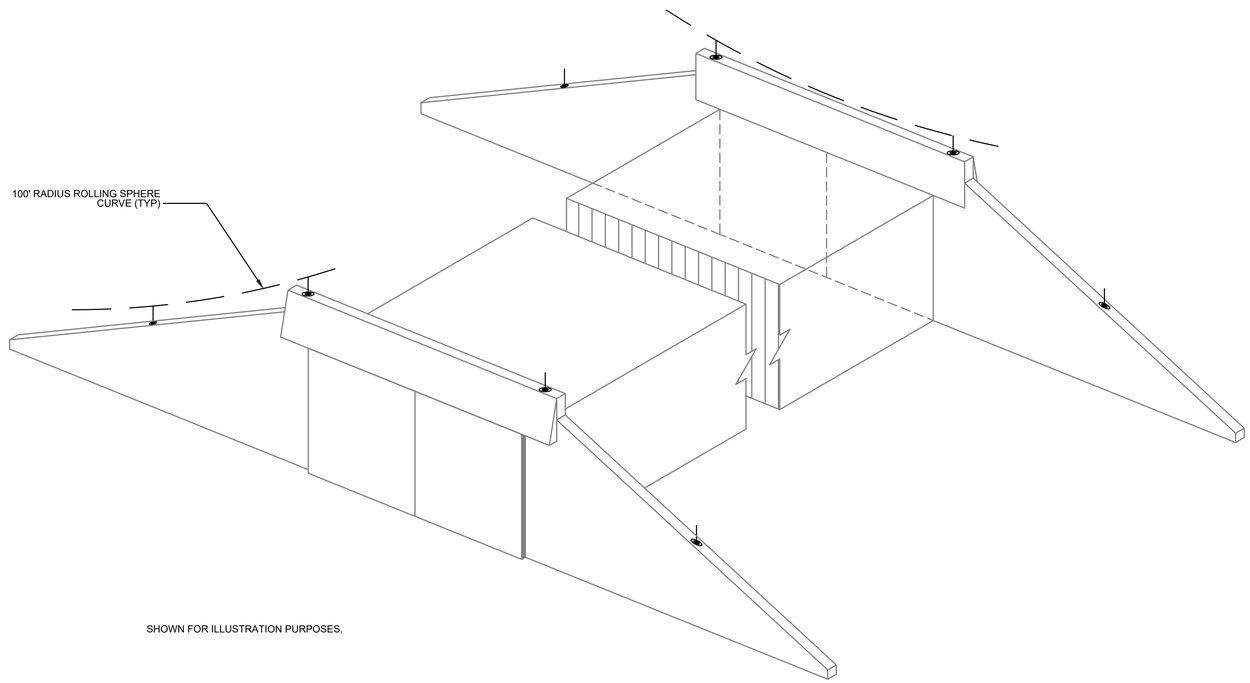
E-202-A

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION



J3 ROLLING SPHERE ANALYSIS - HEAD WALL VIEW (TYP. 2)

NTS



SHOWN FOR ILLUSTRATION PURPOSES.

A8 ROLLING SPHERE ANALYSIS - ISOMETRIC VIEW

NTS

GENERAL NOTES:

1. 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.
2. MEASURED CLEARANCES AND DIMENSIONS MAY VARY DEPENDING ON FINAL INSTALLATION CONDITIONS.
3. REFER TO STRUCTURAL DRAWINGS FOR COMPLETE DIMENSIONAL INFORMATION.
4. VENTILATORS ARE NOT SHOWN IN THE RSM ANALYSIS FOR THE HEADWALL. AIR TERMINALS ON TOP OF THE VENTILATORS ARE INSTALLED TO PROVIDE PROTECTION FOR THE VENTILATORS. ADDITIONAL AIR TERMINALS WILL BROADEN THE ZONE OF PROTECTION WHEN FACTORED INTO THE RSM ANALYSIS.
5. GROUNDING AND BONDING COMPONENTS / SYSTEMS ARE NOT REPRESENTED IN THE RSM ANALYSIS.
6. SEE GENERAL NOTES ON DRAWING E-101.

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, FLOW-THRU
421-80-10 (REV. 1)

ROLLING SPHERE METHOD ANALYSIS

SHEET ID

E-301

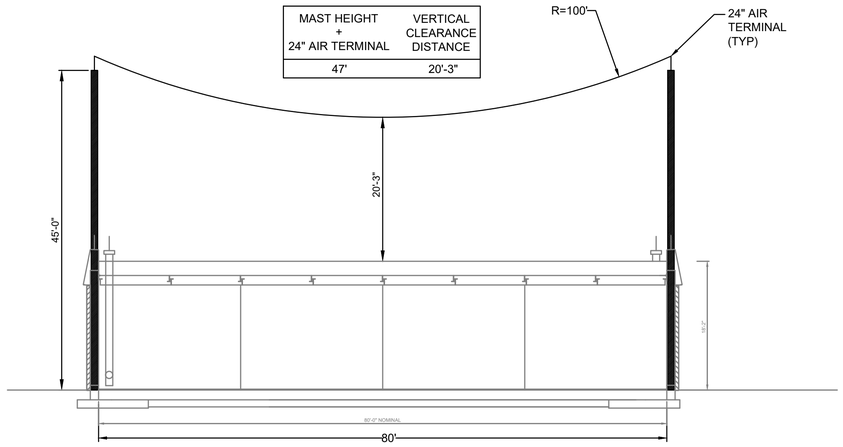
STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION

CLEARANCE DISTANCES ARE BASED ON THE STANDARD ECM CONSTRUCTION AND THE RELATIVE MAST PLACEMENT TO THE ECM. CLEARANCES WILL VARY BASED ON POLE PLACEMENT AND HEIGHT. THESE DIAGRAMA ARE TO BE USED AS GUIDANCE IN DEVELOPING A SITE SPECIFIC LPS THAT PROVIDES THE REQUIRED ZONE-OF-PROTECTION.

GENERAL NOTES:

1. ROLLING SPHERE METHOD (RSM) ANALYSIS DEMONSTRATES A ZONE-OF-PROTECTION BASED ON A 100' RADIUS STRIKING DISTANCE FOR THE ECM HEAD WALL ASSEMBLY.
2. MEASURED CLEARANCES AND DIMENSIONS MAY VARY DEPENDING ON FINAL INSTALLATION CONDITIONS.
3. REFER TO STRUCTURAL DRAWINGS FOR COMPLETE DIMENSIONAL INFORMATION.
4. GROUNDING AND BONDING COMPONENTS / SYSTEMS ARE NOT REPRESENTED IN THE RSM ANALYSIS.
5. SEE GENERAL NOTES ON DRAWING E-101-A.

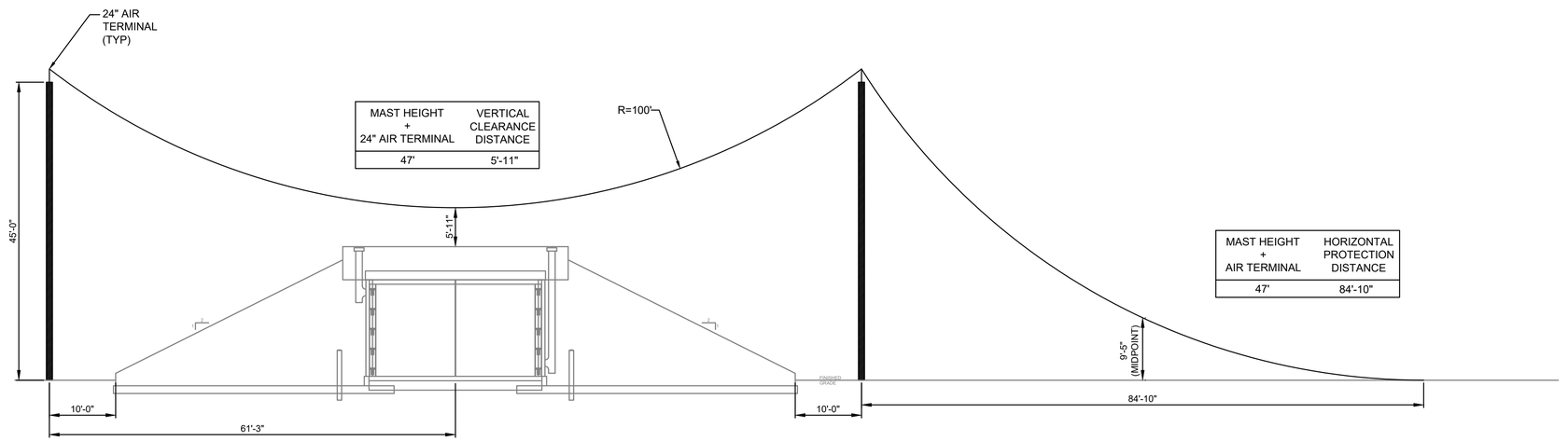
MAST HEIGHT + 24" AIR TERMINAL	VERTICAL CLEARANCE DISTANCE
47'	20'-3"



G12 ROLLING SPHERE ANALYSIS - CROSS-SECTIONAL VIEW
NTS

MAST HEIGHT + 24" AIR TERMINAL	VERTICAL CLEARANCE DISTANCE
47'	5'-11"

MAST HEIGHT + AIR TERMINAL	HORIZONTAL PROTECTION DISTANCE
47'	84'-10"



A5 ROLLING SPHERE ANALYSIS - HEAD WALL VIEW (TYP. 2)
NTS

US Army Corps of Engineers®

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

DESIGNED BY: CEHNC-EDM-E
DRAWN BY: JRD
CHECKED BY: JRD
SUBMITTED BY: EES MCX
SIZE: ANSI D
ISSUE DATE: SEPTEMBER 2025
SOLICITATION NO.:
CONTRACT NO.:

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

MODULAR STORAGE MAGAZINE
BOX- TYPE, FLOW-THRU
421-80-10 (REV. 1)
ROLLING SPHERE METHOD ANALYSIS

SHEET ID
E-301-A

STANDARD DESIGN DRAWINGS - NOT FOR CONSTRUCTION