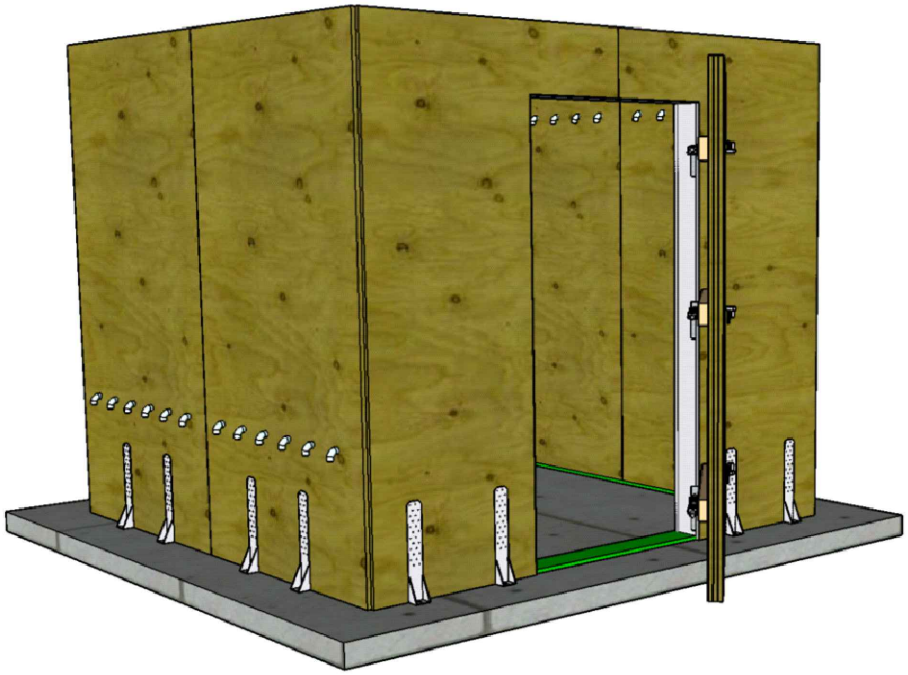
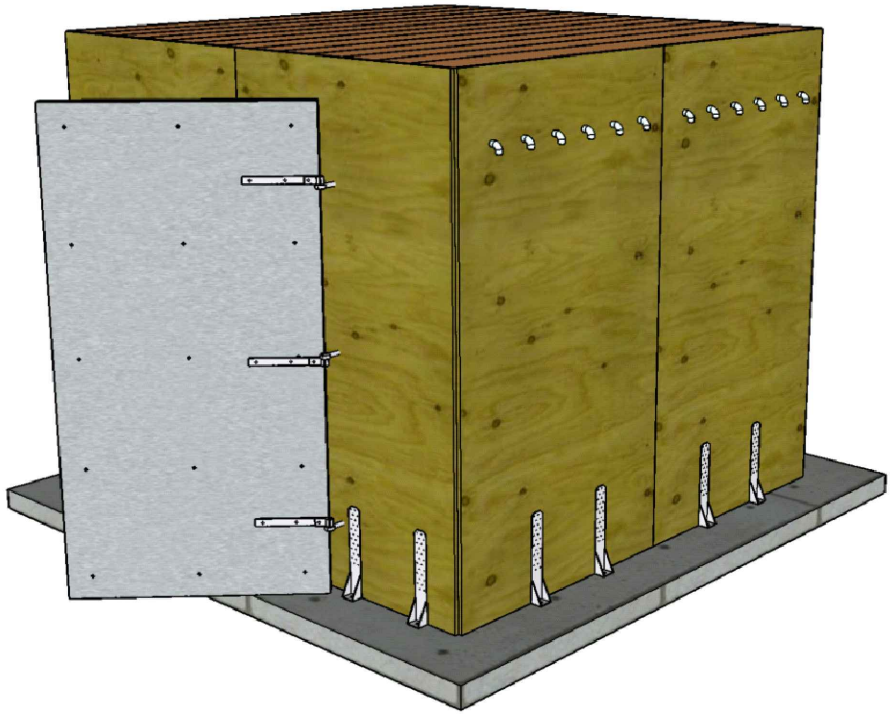
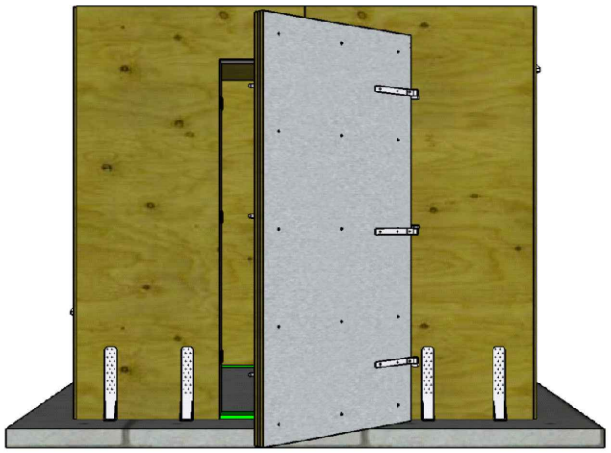
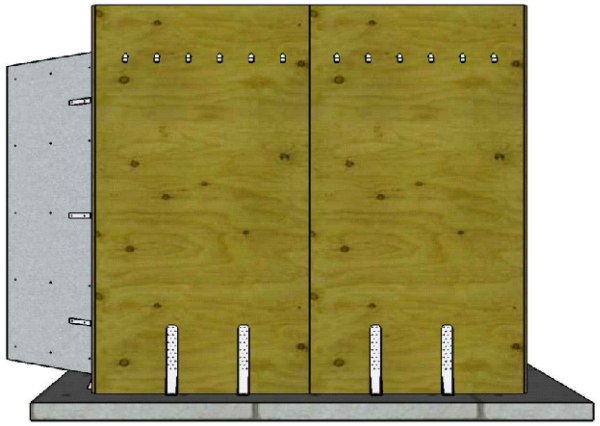
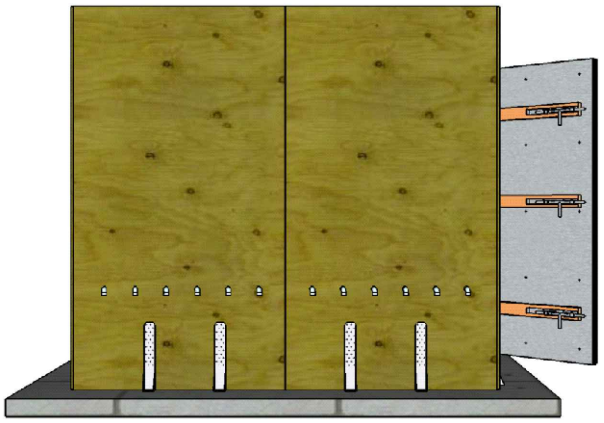
USDA FOREST PRODUCTS LABORATORY
8' x 8' WOOD TORNADO SHELTER











CONCEPT, DESIGN, AND TESTING BY ROBERT H. FALK, PhD, PE
OF FOREST PRODUCTS LABORATORY

CONSTRUCTION DRAWINGS PREPARED BY LUIS ROMEO ESCOBAR
OF HOME INNOVATION RESEARCH LABS

PAGE 2 GENERAL NOTES

THESE CONSTRUCTION DRAWINGS REPRESENT THE FINISHED STRUCTURE. CONSTRUCTION MEANS AND METHODS CAN BE FOUND IN THE CONSTRUCTION GUIDE.

THE BUILDER SHALL PROVIDE WEATHER PROTECTION TO THE STRUCTURE DURING CONSTRUCTION.

IF THERE IS A CONFLICT AMONG THE CONSTRUCTION GUIDE, GENERAL NOTES, SPECIFICATIONS, AND PLANS, THE MORE STRINGENT CRITERIA SHALL APPLY.

THE BUILDER SHALL BE RESPONSIBLE FOR VERIFICATION AND COORDINATION OF ALL DIMENSIONS, CONDITIONS, AND ELEVATIONS.

COMPLETE INSPECTION REQUIREMENTS SHALL BE AS DIRECTED BY THE LOCAL BUILDING DEPARTMENT.

THE CONSTRUCTION DRAWINGS SHALL NOT BE SCALED.

FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OF UPLIFT/SHEAR RESISTANCE CONNECTORS.

FOR ALL CONSTRUCTION, USE ONLY SCREWS AND HARDWARE THAT HAVE BEEN EVALUATED THROUGH AN ANSI-APPROVED PRODUCT CERTIFICATION BODY SUCH AS IAPMO-OES OR ICC-ES.

VENTILATION IS TO BE PROVIDED PER PLAN DETAILS.

MAXIMUM WALL HEIGHT FOR SHELTER SHALL BE 8'-0".

PAGE 3 BEAMS CONSTRUCTION

EACH BEAM MADE BY NAILING AND GLUING THREE 2x8s.

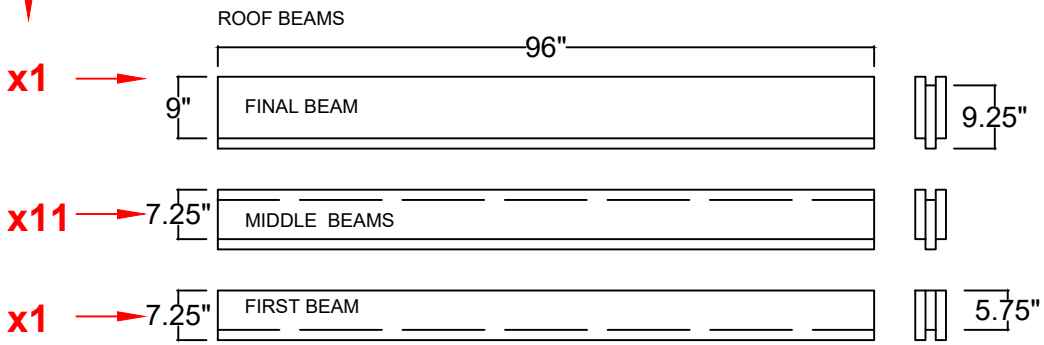
TWO ROWS OF 16D NAILS SPACED 11" OC ALONG LENGTH OF 2x8s BOARDS.

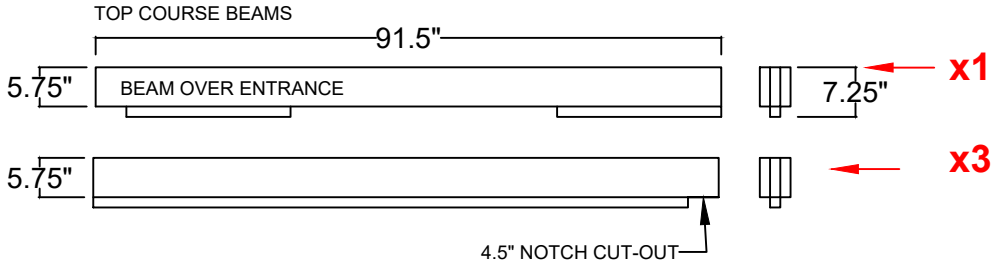
MIDDLE BEAM OFFSET 1.5" TO CREATE TONGUE-AND-GROOVE CROSS-SECTION.

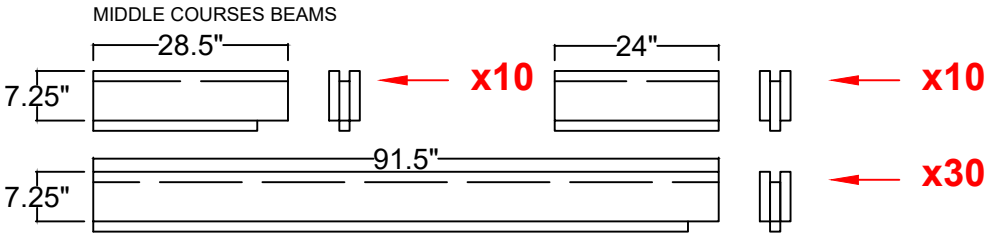
TWO BEADS OF CONSTRUCTION ADHESIVE ALONG LENGTH OF BOARDS FOR ADDED STRENGTH.

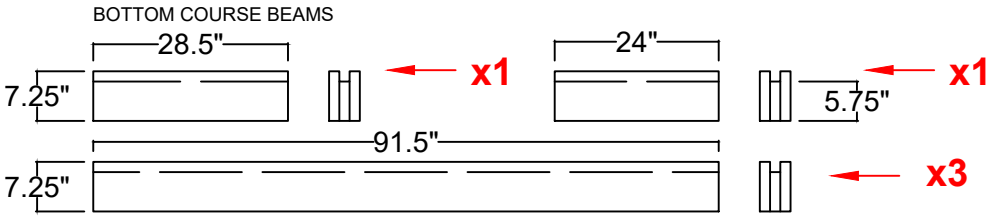
4.5" NOTCH CUT OUT OF ENDS OF SOME BEAMS SO THEY OVERLAP AT CORNERS IN LOG-CABIN STYLE.

72 BEAMS TOTAL

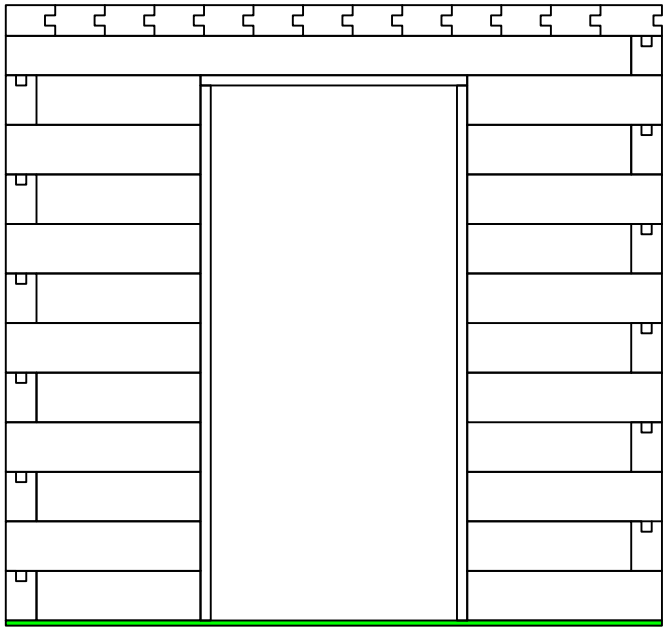








ENTRANCE WALL (USED AS EXAMPLE)



PAGE 4
WALL AND ROOF BEAMS

CONSTRUCTION ADHESIVE APPLIED TO INSIDE FACES OF BEAM GROOVES AS WALL BEAMS ARE STACKED ONE COURSE ON TOP OF PREVIOUS.

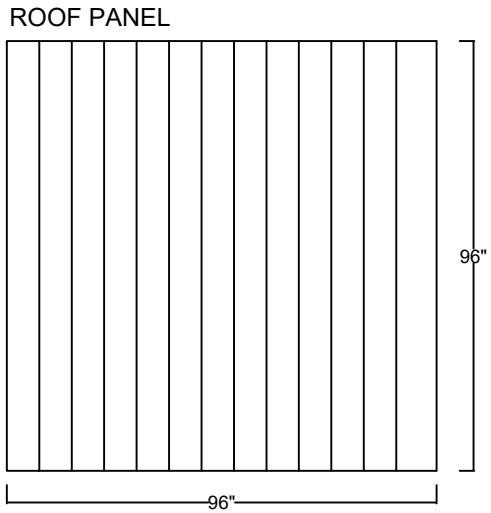
HAMMER BEAMS DOWN TO ENSURE A TIGHT FIT AND FLAT TOP.

ENTRANCE HEADER AND JAMBS INSTALLED WITH 16D NAILS.

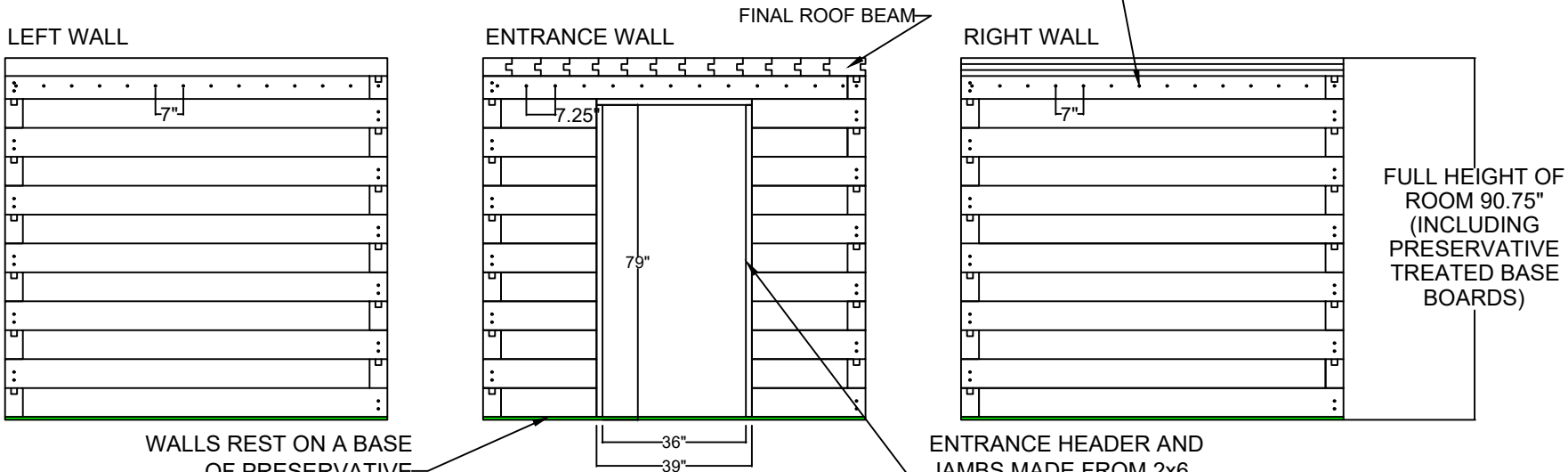
ROOF BEAMS INSTALLED FROM LEFT TO RIGHT.

ROOF BEAMS ATTACHED TO WALLS BY DRIVING 8" LONG WOOD SCREWS UP AT 45 DEGREE ANGLES THROUGH WALLS BELOW.

OBSERVE SCREW SCHEDULE IN DIAGRAMS.

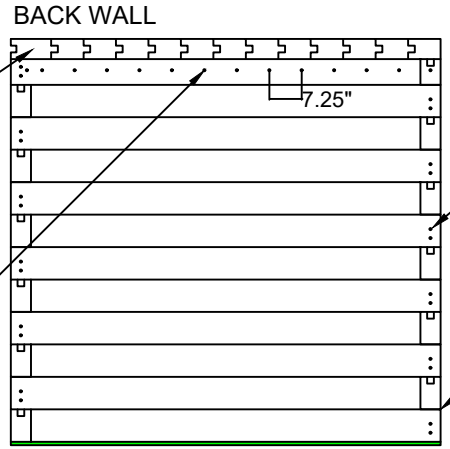


LEFT AND RIGHT WALL:
14 SCREWS SPACED 7" OC ALONG FULL LENGTH OF WALL USED TO SECURE FIRST AND FINAL ROOF BEAMS TO WALLS BELOW



WALLS REST ON A BASE OF PRESERVATIVE TREATED 1x6 BOARDS

ENTRANCE HEADER AND JAMBS MADE FROM 2x6 BOARDS RIP-CUT TO MATCH WALL THICKNESS



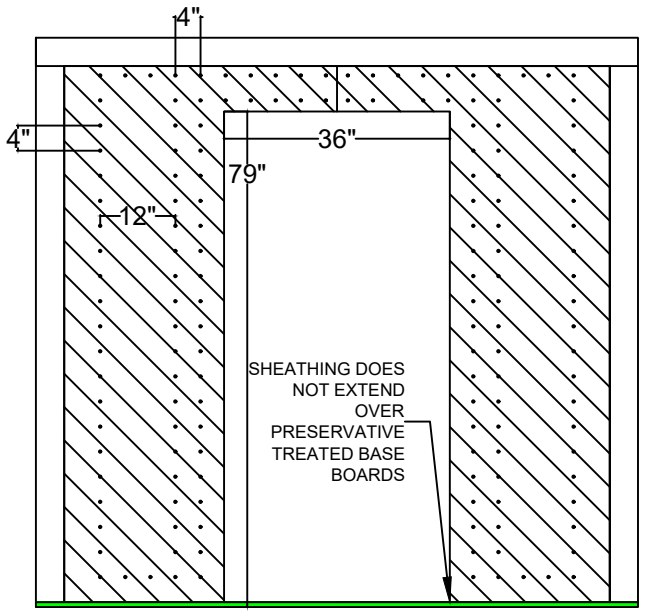
FINAL ROOF BEAM TWO SCREWS USED TO SECURE THIS BEAM TO WALL BELOW

EVERY CORNER REINFORCED WITH TWO 8" LONG WOOD SCREWS

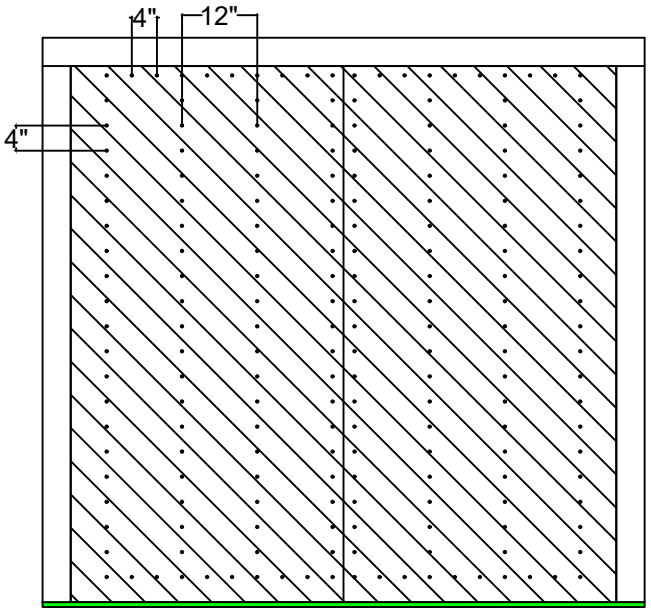
ENTRANCE AND BACK WALL: ONE SCREW PER ROOF BEAM FOR FIRST 12 BEAMS SCREWS SPACED 7.25" OC DRIVEN UP AT 45 DEGREE ANGLE THROUGH WALL BELOW

BEAMS INSTALLED BY STACKING ONE COURSE ON TOP OF THE PREVIOUS COURSE; CORNERS OVERLAP IN LOG CABIN MANNER

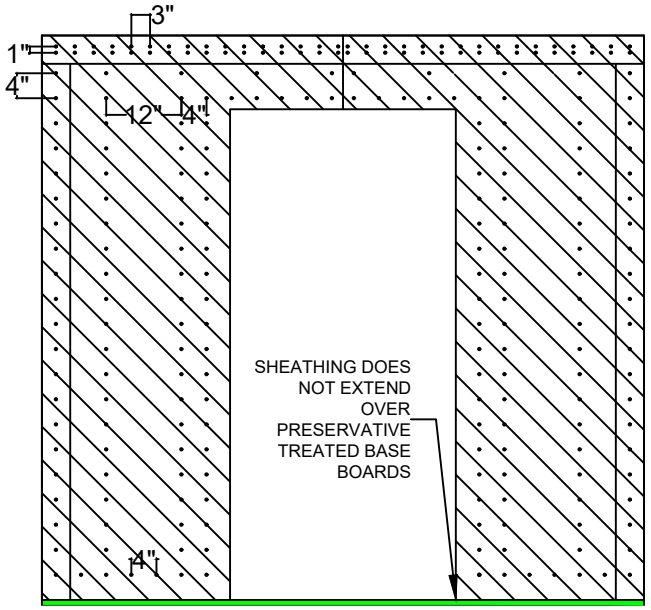
INTERIOR SHEATHING - ENTRANCE WALL



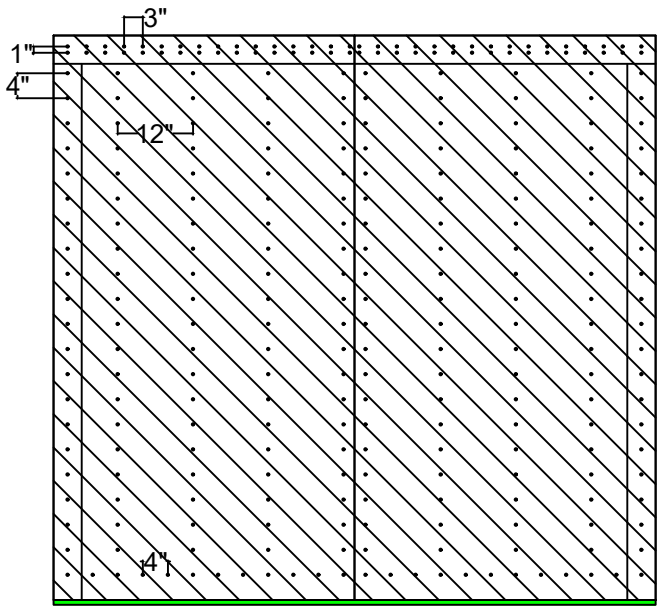
INTERIOR SHEATHING - LEFT, RIGHT, BACK WALL



EXTERIOR SHEATHING - ENTRANCE WALL



EXTERIOR SHEATHING - LEFT, RIGHT, BACK WALL



PAGE 5 SHEATHING

INTERIOR AND EXTERIOR 23/32 PLYWOOD SHEATHING.

TWO SHEETS PER WALL, TWO SHEETS FOR INTERIOR CEILING.

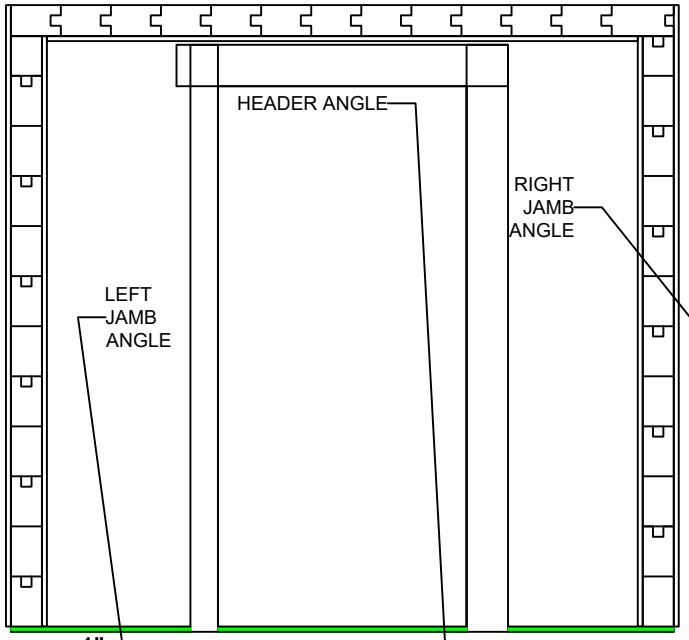
CUT PLYWOOD SHEETS TO FIT ACTUAL WALL DIMENSIONS.

SHEATHING ON INTERIOR AND EXTERIOR ENTRANCE WALL MUST BE CUT TO ACCOMMODATE 36"x79' ENTRANCE OPENING.

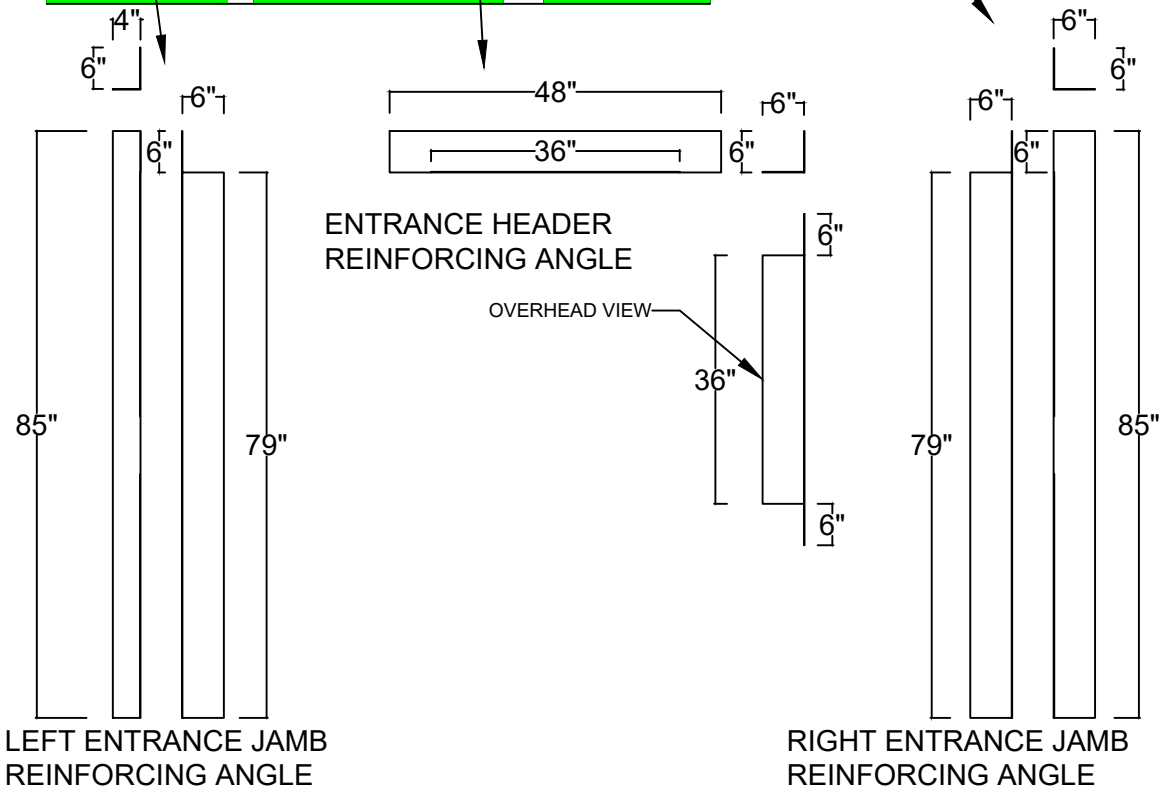
CONSTRUCTION ADHESIVE AND 16D NAILS USED TO ATTACH SHEATHING TO WALLS.

OBSERVE NAILING PATTERN SHOWN; NOTE: TWO ROWS OF NAILS SPACED 3" OC AT CEILING BEAMS FOR EXTERIOR.

REINFORCING ENTRANCE HEADER/JAMB ANGLES -
VIEW FROM ROOM INTERIOR



PAGE 6
ENTRANCE REINFORCEMENT



CUSTOM-MADE REINFORCEMENT ANGLES INSTALLED AT ROOM ENTRANCE.

14 GAUGE STEEL; L-SHAPE WITH 90 DEGREE BEND.

HEADER ANGLE INSTALLED FIRST; LEFT AND RIGHT JAMB ANGLES OVERLAP.

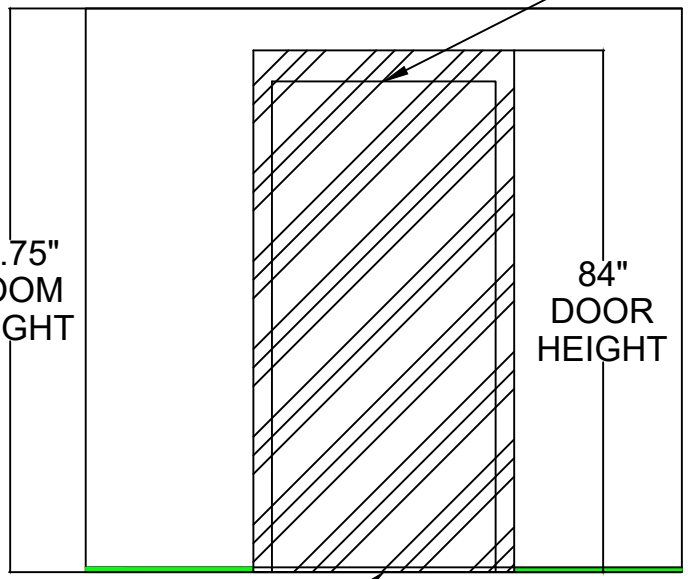
3" LAG BOLTS SPACED 12" OC ALONG LENGTH ON ROOM INTERIOR ON JAMB (WALL THICKNESS) FOR JAMB ANGLES.

3" LAG BOLTS SPACED 10" OC ALONG LENGTH ON HEADER ANGLE.

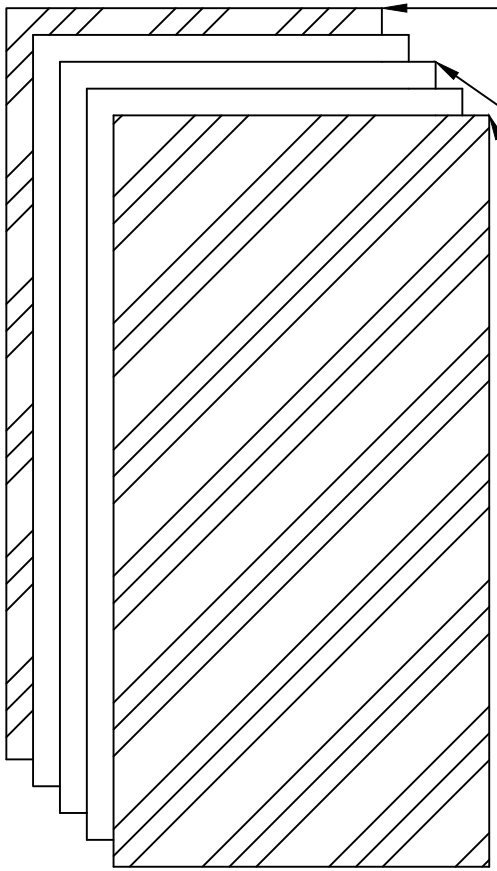
FIELD DRILL HOLE WHERE JAMB ANGLES OVERLAP HEADER ANGLE.

OVERLAY DOOR - VIEW FROM ROOM EXTERIOR

OUTLINE OF ENTRANCE OPENING



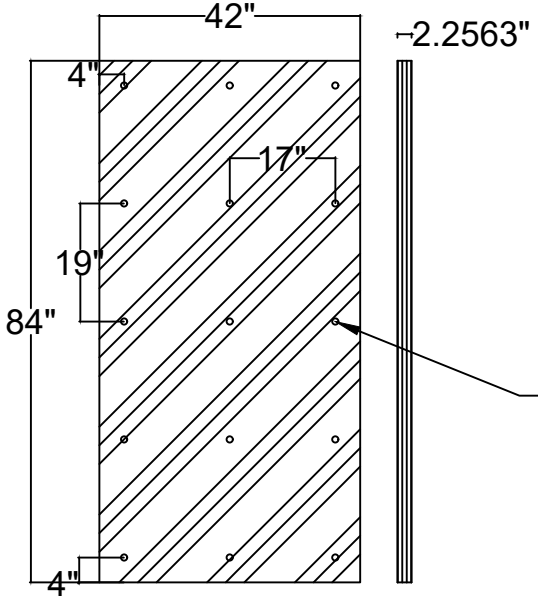
DOOR FULLY COVERS ENTRANCE OPENING



18 GAUGE COLD ROLLED STEEL SKIN

3 LAYERS 23/32 PLYWOOD

18 GAUGE COLD ROLLED STEEL SKIN

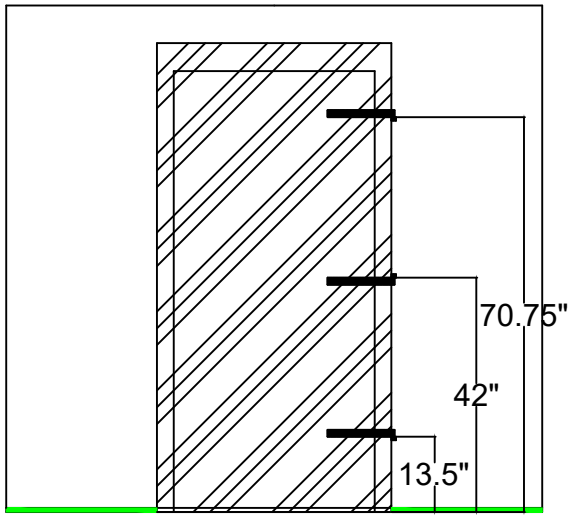


FIVE LAYERS OF DOOR HELD TOGETHER WITH 15 BOLTS, 3/8" DIAMETER, 2-1/2" LONG; WASHERS ON EXTERIOR AND INTERIOR

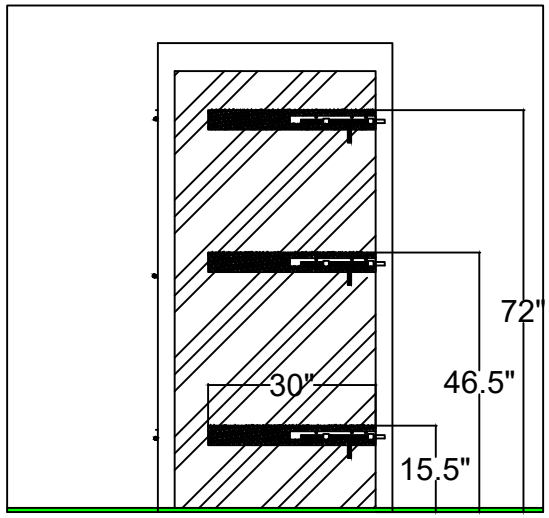
BOLTS SPACED 19" OC VERTICALLY AND 17" OC HORIZONTALLY

PAGE 7
DOOR BUILD

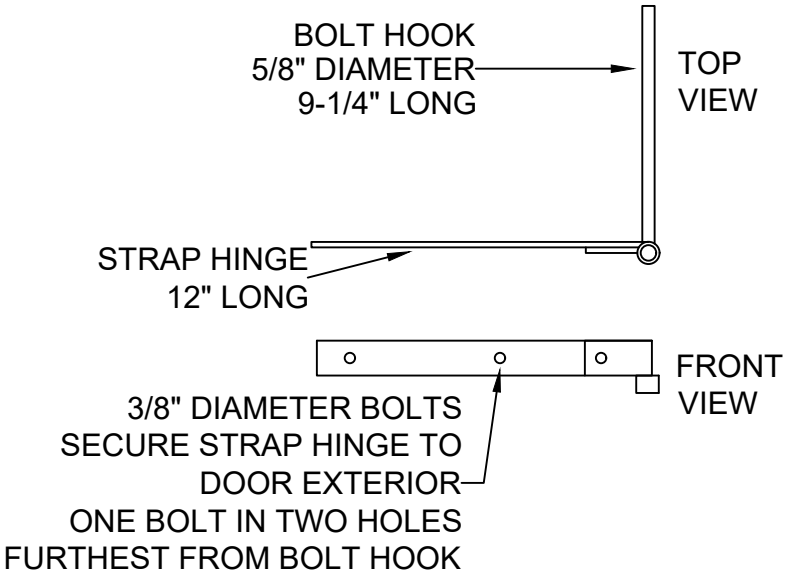
DOOR MOUNTING HARDWARE -
VIEW FROM ROOM EXTERIOR

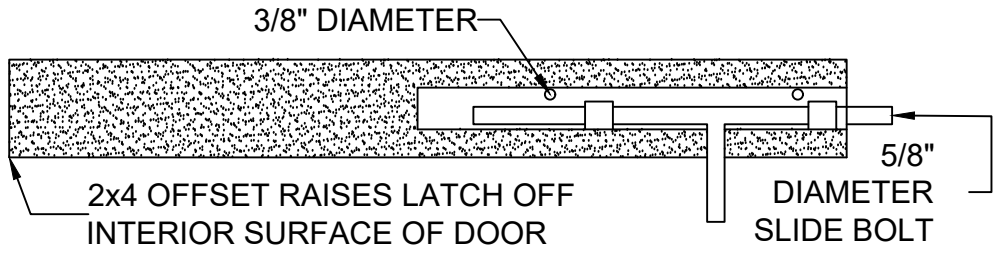


DOOR LOCKING HARDWARE -
VIEW FROM ROOM INTERIOR



PAGE 8
DOOR HARDWARE

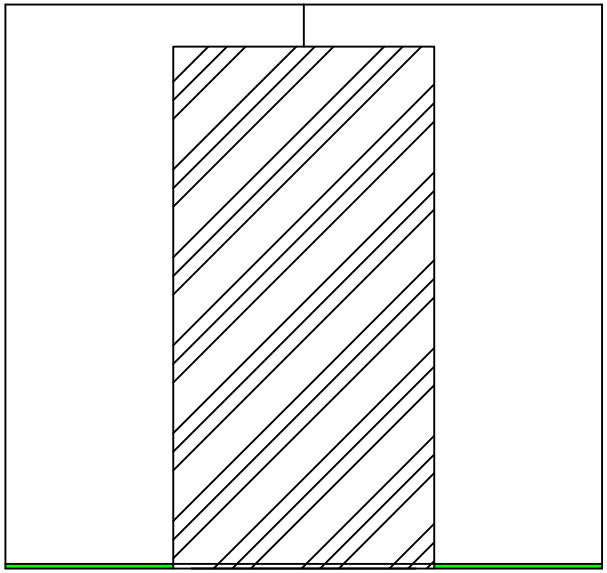




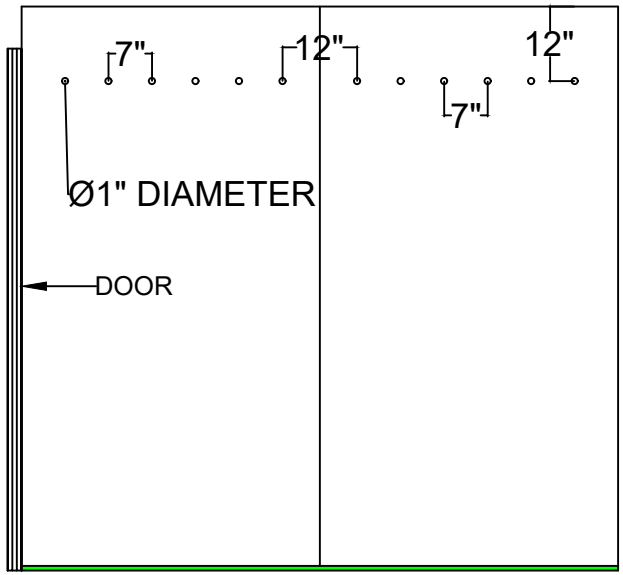
LOCKING MECHANISM DETAIL: SLIDE BOLT
INSTALLED OVER 2x4 DOOR LATCH OFFSET

TWO 3/8" DIAMETER BOLTS USED TO INSTALL EACH
SLIDE BOLT ON 2x4 DOOR LATCH OFFSET AND
THROUGH DOOR

FRONT WALL - NO VENTILATION HOLES



RIGHT WALL - VENTILATION HOLES

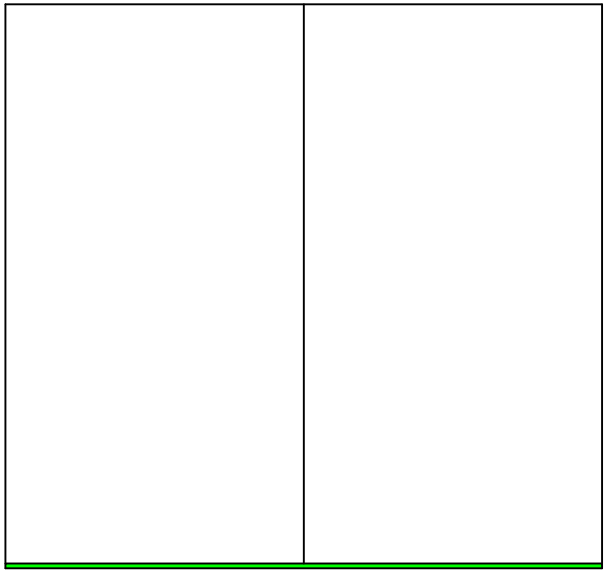


VENTILATION PROVIDED BY 24 HOLES, 1" DIAMETER

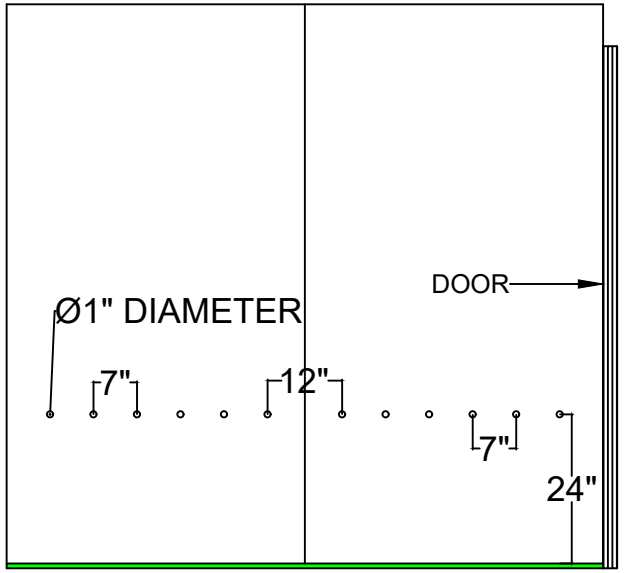
TWELVE HOLES ON WALL TO RIGHT OF ENTRANCE WALL LOCATED 1' FROM TOP OF WALL; HOLES SPACED 7" OC

TWELVE HOLES ON WALL TO LEFT OF ENTRANCE WALL ARE LOCATED 2' FROM BOTTOM OF WALL; HOLES SPACED 7" OC

BACK WALL - NO VENTILATION HOLES

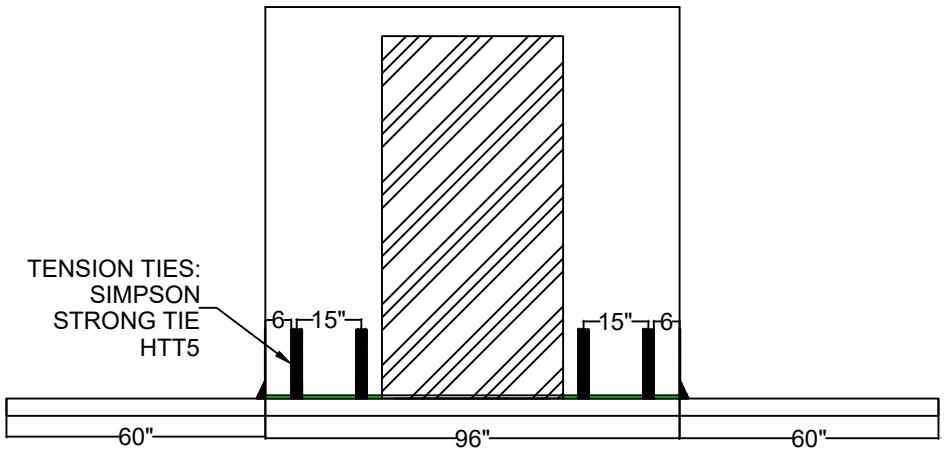


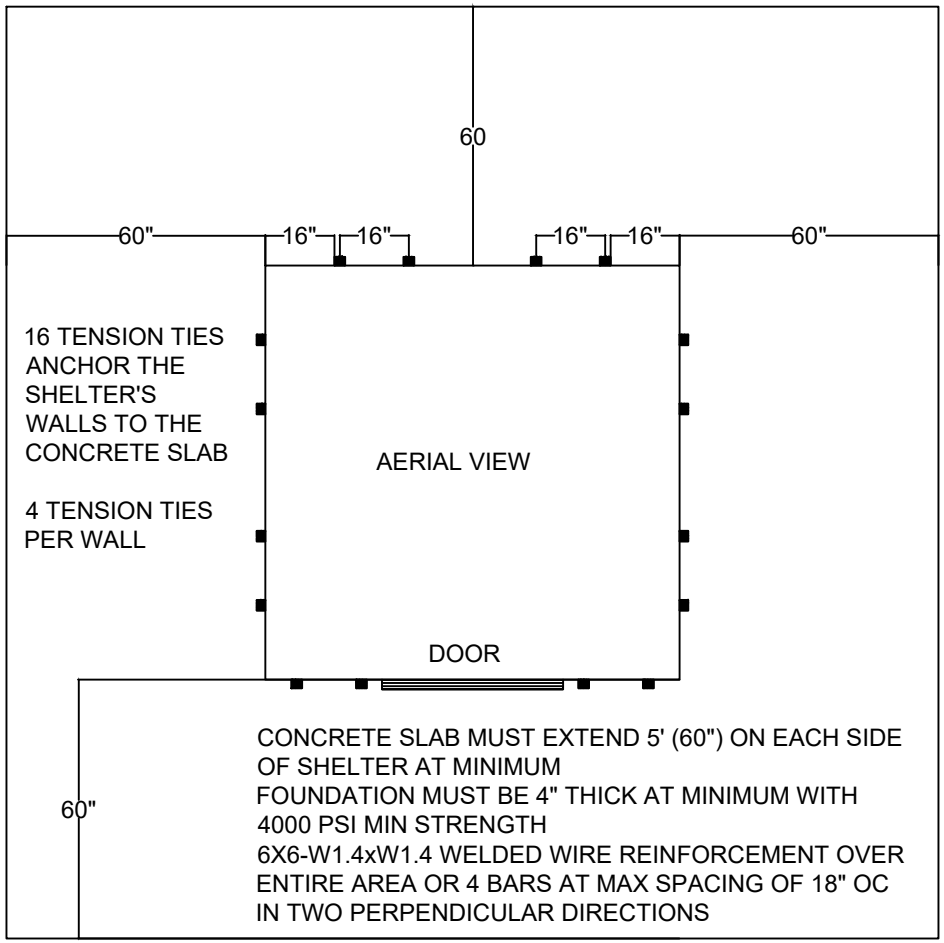
LEFT WALL - VENTILATION HOLES



PAGE 9
VENTILATION

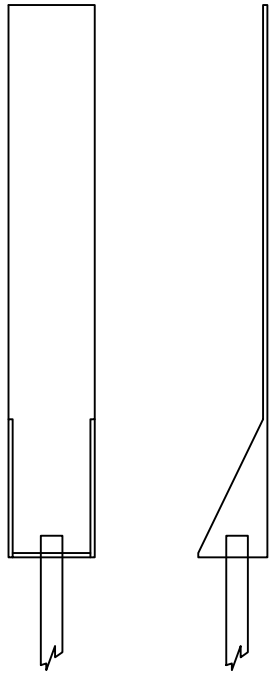
ENTRANCE WALL





CONCRETE SLAB MUST EXTEND 5' (60") ON EACH SIDE OF SHELTER AT MINIMUM
FOUNDATION MUST BE 4" THICK AT MINIMUM WITH 4000 PSI MIN STRENGTH
6X6-W1.4xW1.4 WELDED WIRE REINFORCEMENT OVER ENTIRE AREA OR 4 BARS AT MAX SPACING OF 18" OC IN TWO PERPENDICULAR DIRECTIONS

DETAIL: CONCRETE ANCHOR
SIMPSON STRONG TIE HTT5



TENSION TIE / ANCHOR STUD - FRONT VIEW

TENSION TIE / ANCHOR STUD - SIDE VIEW

FOLLOW ANCHOR MANUFACTURER'S INSTALLATION INSTRUCTIONS REGARDING FASTENERS CONNECTION TO SLAB

MADE BY INSTALLING $\frac{5}{8}$" DIAMETER ANCHOR STUD IN EACH TENSION TIE AND SEALING WITH ANCHOR EPOXY

PAGE 10
ANCHORING

RIGHT SIDE WALL