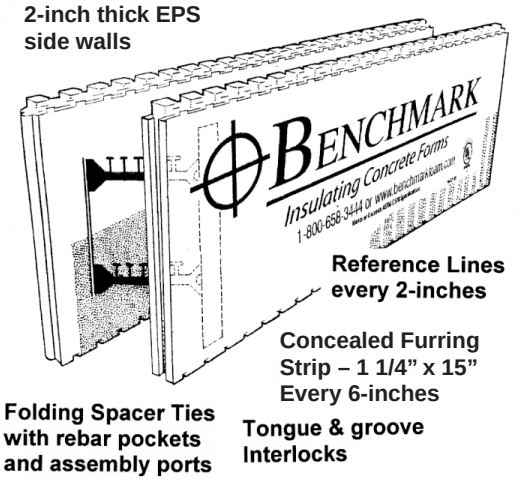
SAFE ROOM STORM SHELTER

Installation Guide

The 8' x 8' Safe Room Storm Shelter design by Benchmark Foam, Inc. has been reviewed and approved by licensed Structural Engineer, Jim Lange of Lange Structural Group.

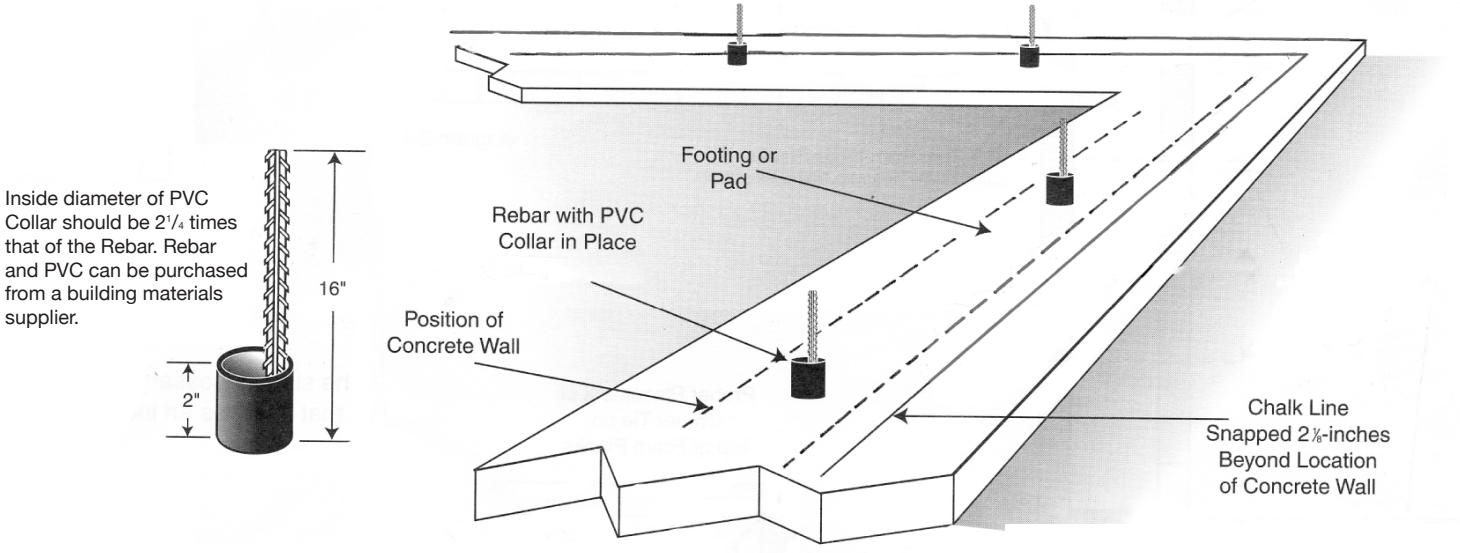
The first phase of construction of a Safe Room Storm Shelter from Benchmark Foam includes assembly and installation of Insulated Concrete Forms (ICFs). Benchmark ICF components should only be installed by workers who have been properly trained. It is the installer's responsibility to make sure that training is done before construction begins. Serious injury or death may result from safety hazards caused by improper assembly and installation of ICF components! Before beginning, check local engineering and building codes on cast-in-place concrete construction. This guide covers typical building situations and is not meant to replace specific codes for engineering or safety.

If you have questions about the assembly and installation techniques in this guide, contact your Benchmark ICF supplier.



1. Footing or Pad Preparations

Footing or pad must be level, uniform and wide enough for the form to rest on. Footing must also be proper width and thickness for soil conditions. Check with local code officials for guidelines and specifications. For FEMA-funded projects, ensure footings adhere to specifications with your contractor or structural engineer. First course (row) of forms will be glued to the footing/pad, along the chalk line.



2. Start at a Corner

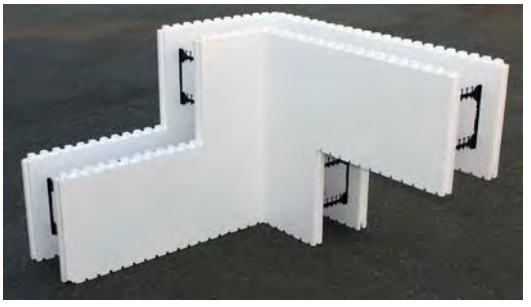
Using low expansion foam adhesive, run a bead of glue along the bottom side of the corner form. Set the Corner in place on the footing following the chalk line. Glue will normally set within 20 minutes.

3. Glue First Course of Forms

Once the first course of forms are set, place foam glue every 18-24 inches so that it expands enough to protrude from both sides of the form. Glue both sides of the form wall.

4. Alternate King Corners blocks

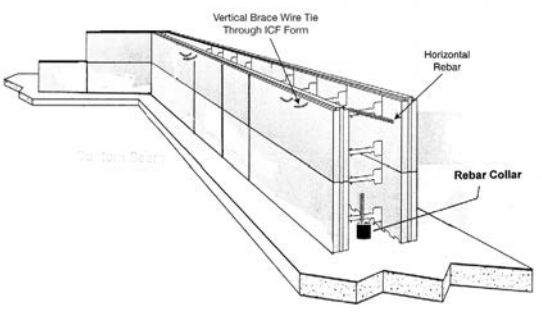
Using the alternating King Corner blocks, place the corner block onto the first row corner block. These alternating left and right King Corners produce staggered seams through the wall assembly.

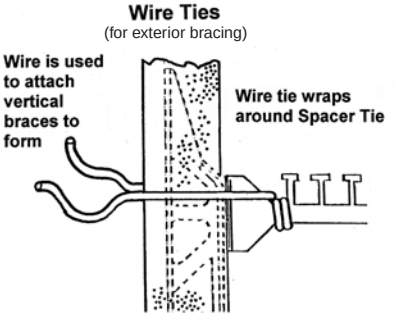


5. Wall Assembly

When assembled wall reaches 32 inches high, begin installing wire tires for exterior vertical bracing. A 24 inch length of 16-gauge wire is pressed through the ICF wall and wrapped around a Spacer Tie, leaving the ends extending out. As assembly continues, wire ties should be placed approximately every 32 inches up the wall, with rows placed approximately 6-8 ft apart, along the entire wall structure.

Horizontal rebar is placed into the rebar pockets of Spacer Ties and wire-tied to ties every 12 inches on center.



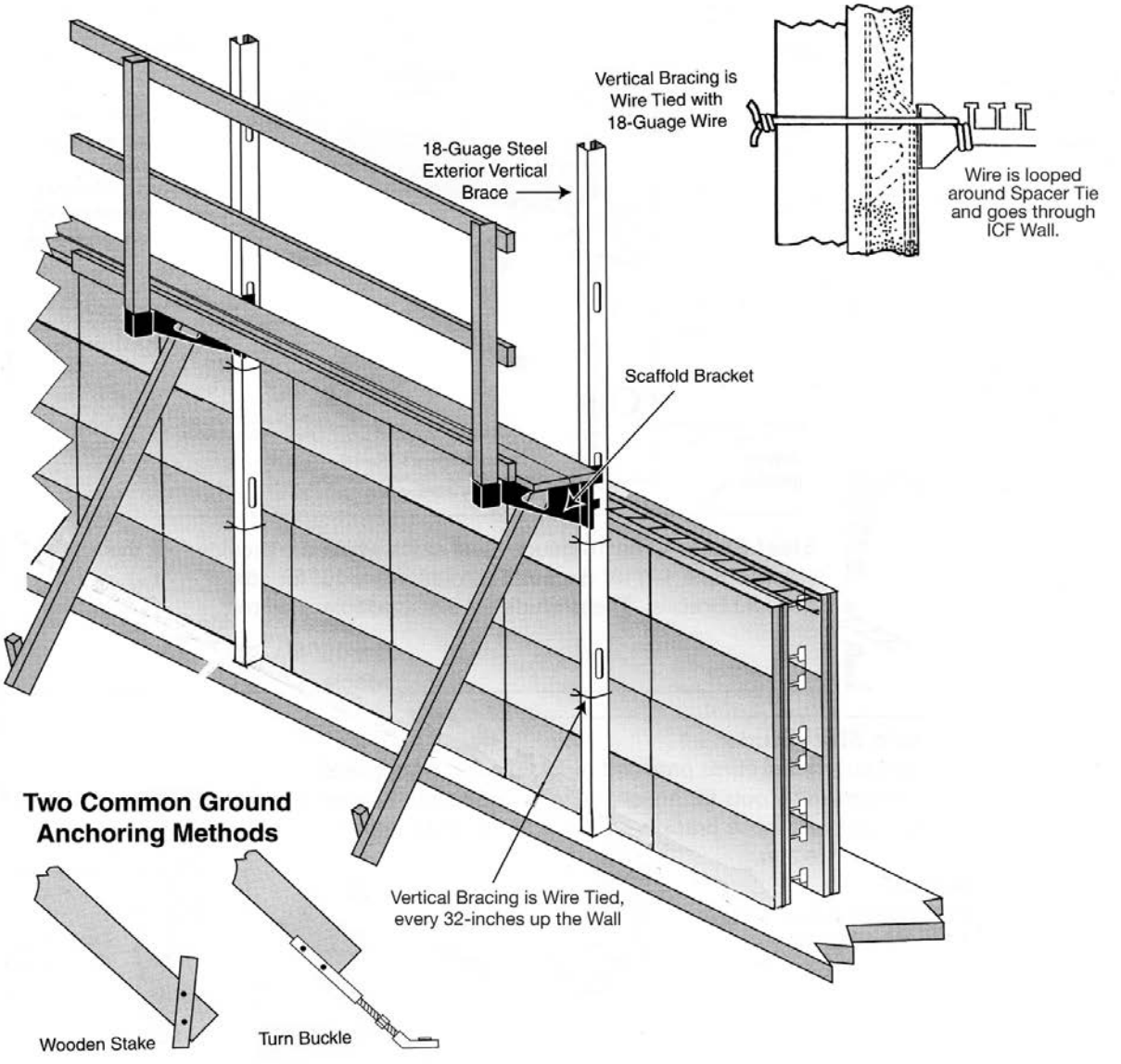


BENCHMARK FOAM INC.
Quick response is our guarantee.

5. Exterior Vertical Bracing

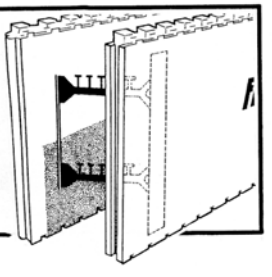
When assembled wall reaches 4-ft high, exterior vertical braces must be attached along one side of the ICF. They are placed approx. 6-ft to 8-ft* apart and are anchored to the form with the wire ties which were installed earlier. Braces can be good-quality dimensional lumber (2 x 4) or 18-gauge steel. Additional braces should be used next to window or door jambs. A diagonal kicker brace is anchored to each vertical brace. If optional steel In-Wall Bracing is not used, vertical braces should be placed approximately every 4-ft apart, to ensure proper alignment.

*Maximum spacing of 6 ft is allowed by OSHA guidelines, if brace is also being used to support a work platform.



Positive Interlocks

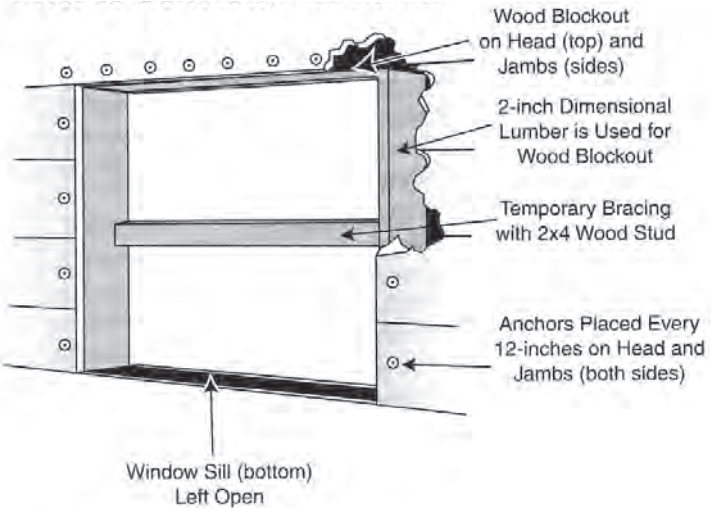
Benchmark ICF's have true 'tongue and groove' interlocks at the ends. Because of this, the blocks slide together during assembly. This feature eliminates the need to glue the blocks together to maintain proper alignment.

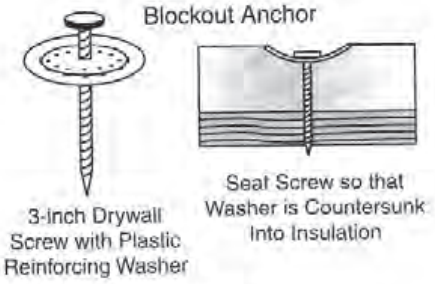


6. Door Casing & Bracing

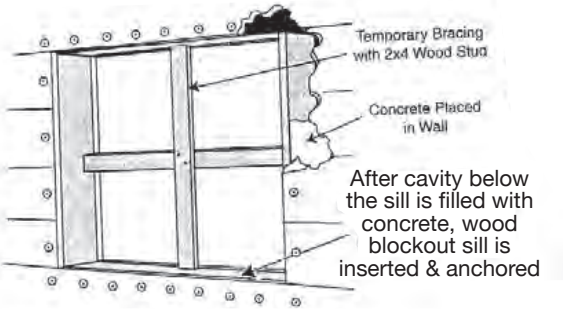
Openings can be built during wall assembly or they can be cut in with a hand saw after the wall is assembled.

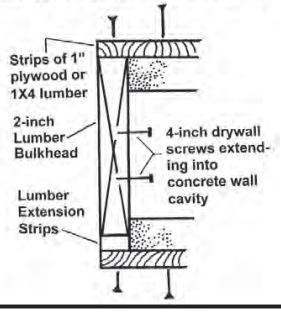
BEFORE concrete placement, ensure wood blockouts are securely anchored at head and jambs. A temporary 2"x 4" wood brace should be added to openings over 2 ft tall. Wood sill blockout is not placed at this time.





AFTER concrete placement is up to the sill height, position a wood blockout at the sill, between the forms and anchor. **Before continuing concrete placement**, add a temporary 2" x 4" wood brace to openings over 2 ft wide.

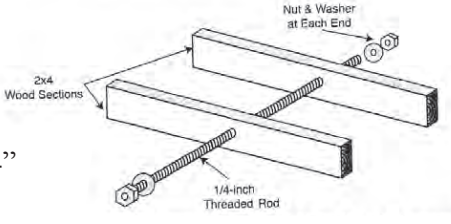


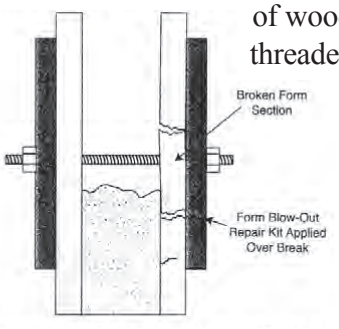


Alternate technique for door casing & bracing:
The 2" dimensional lumber for blockouts can be installed flush with trimmed edges of insulation. The 2" lumber is anchored in place with strips of 1" plywood or 1" x 4" dimensional lumber anchored to bulkhead and plastic spacer ties with drywall screws. Strips of 2" lumber are used to extend the width of the blockout lumber (concrete wall width + 4 inches).

7. Repair Kit

A blow-out repair kit should be made BEFORE the concrete arrives. It is used to repair a form break or blow-our and is constructed of two pieces of wood 2" x 4", approximately 18" long, and a length of 1/4" threaded rod, nuts and washers as shown.

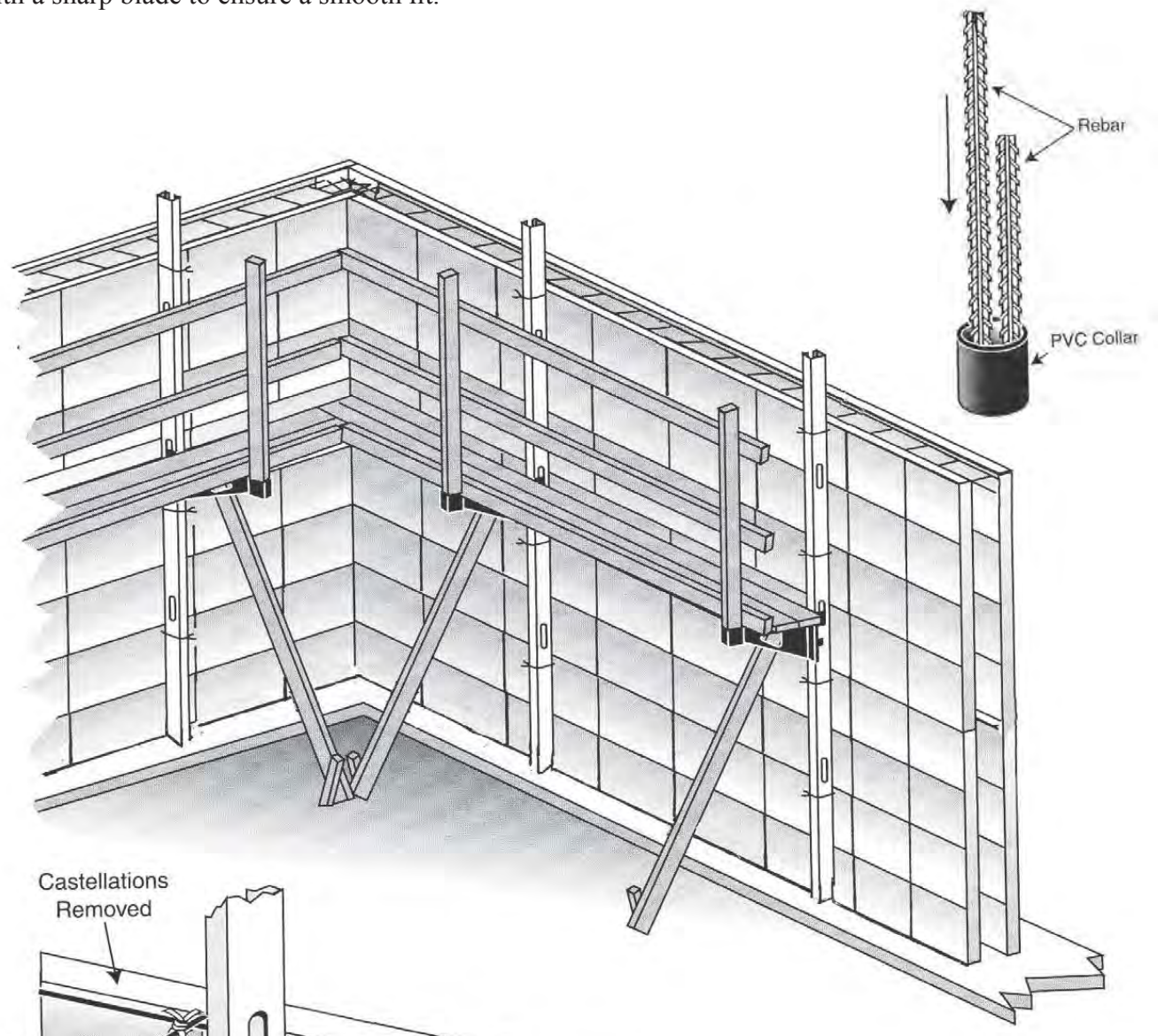


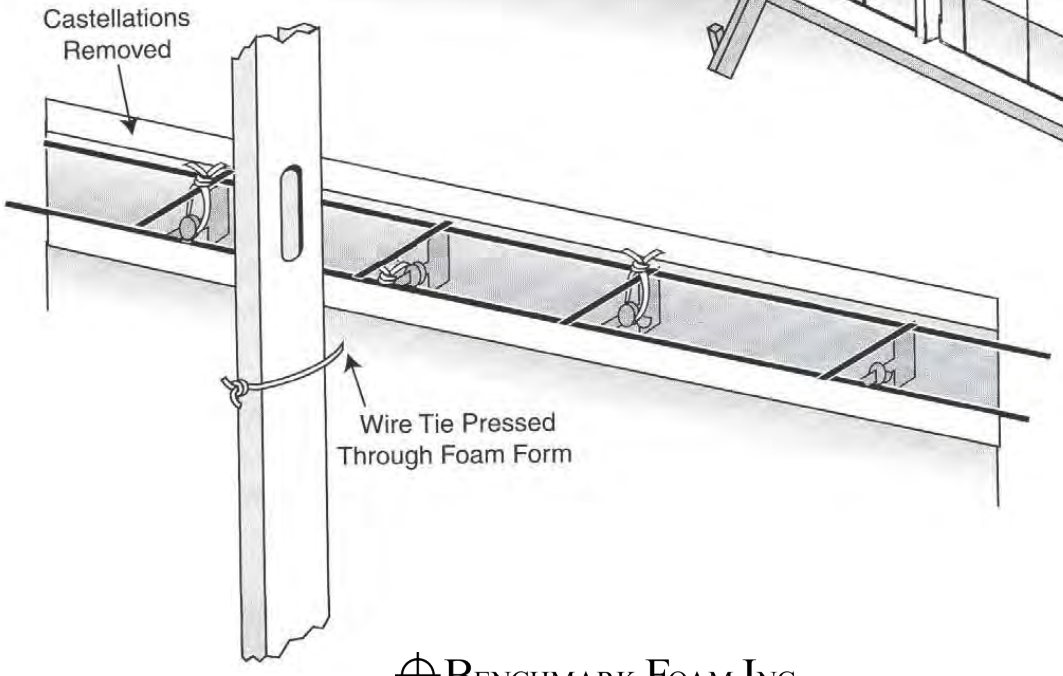


Form breaks rarely happen, but when they do, it's important to stop pouring the concrete as soon as possible. Remove the built-up concrete from the opening and reposition or replace the broken form pieces. Repair kit is placed over both sides of the break, as shown. Holes created by the break or blow-out should be filled with expandable insulation or fresh concrete to ensure against future water penetration.

8. Top Wall Assembly

When assembled wall reaches full height, vertical rebar is lowered in between the foam planks and inserted into the PVC collar up against the other rebar protruding from the footing or pad.
The vertical 2” x 4” braces are anchored to the form with lengths of wire through the form wall.
If wood frame structure will be constructed above the concrete wall, castellations should be removed with a sharp blade to ensure a smooth fit.

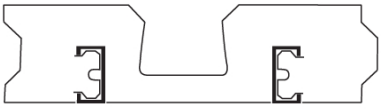




9. Roof Assembly with Lite-Deck®

The Lite-Deck® system described for the roof deck of the Safe Room Storm Shelter requires appropriate steel reinforcing to properly support the dead loads, live loads and clearspans required. This installation guide covers basic reinforcing and is not meant to replace job-specific requirements. Installer is responsible for placement of all reinforcing steel in accordance with latest codes and building requirements.

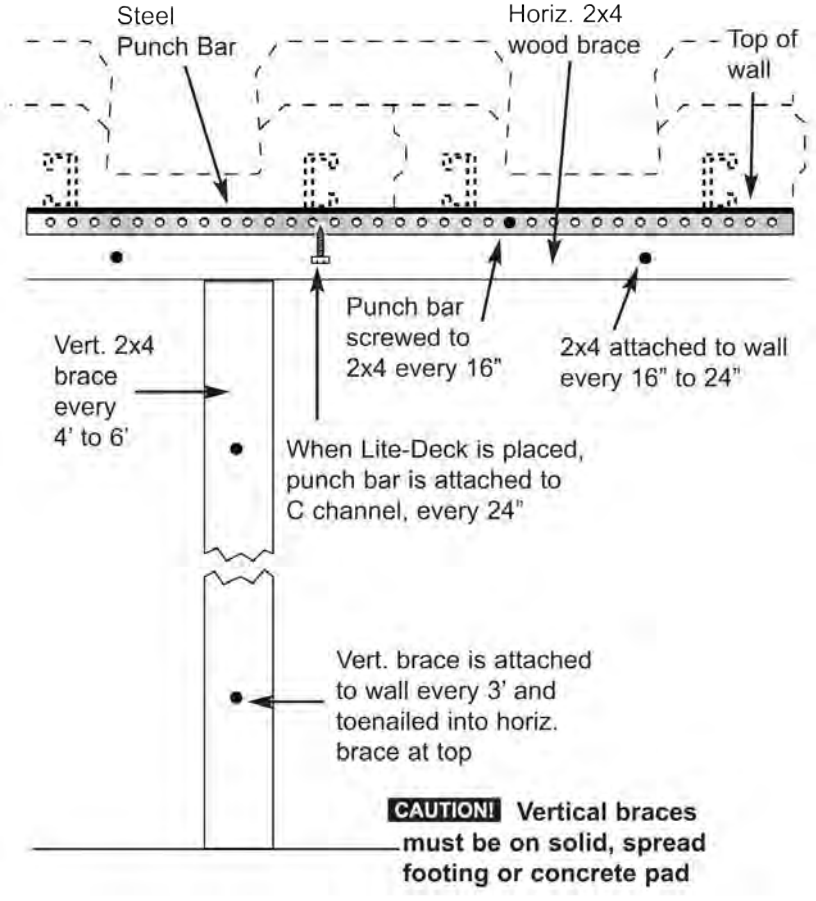
Benchmark Foam aims to deliver the roof panels as needed for installation, however if the custom-cut base sections for the roof assembly must be trimmed or cut, this can be done with a reciprocating saw.



10. Install Interior Perimeter Bracing

Interior Perimeter bracing is placed horizontally at the top of the interior sides of the walls, on both ends of the Lite-Deck sections, perpendicular to the Lite-Deck steel C channels.
DIAGRAM A and DIAGRAM B.
Attach lengths of 1.5" steel punch bar to 2" x 4" wood stud, using 1 1/4" long pan head screws, placed approx. 16" apart.

DIAGRAM A
Interior Perimeter Bracing



Place bracing flush with top of wall continuously on both ends. Anchor wood stud to wall, every 16" to 24" with masonary screws or nails when anchoring to masonry walls. Use drywall screws when anchoring to an insulating concrete form's furring strips or pads.

Reinforce the brace by installing good quality 2" x 4" wood studs vertically, every 4' to 6'.

Vertical studs will carry the weight of concrete placement! So, it must be securely anchored to the wall approx. 3' apart and toenailed to horizontal brace at top.

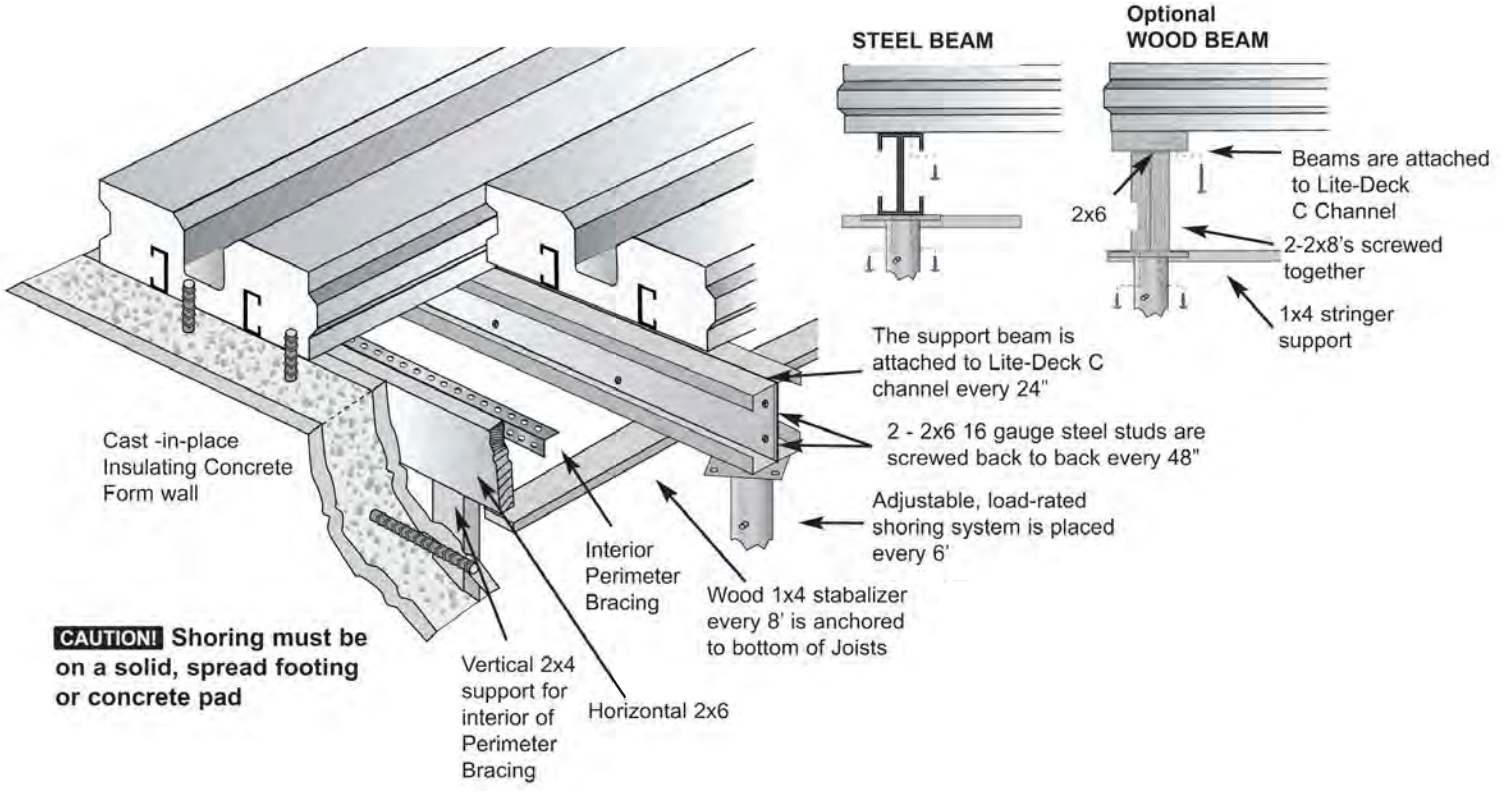
11. Temporary Shoring

Temporary shoring is used to carry the majority of the weight, as concrete is placed. It must be placed in accordance with a licensed Structural Engineers job-specific guideline or in accordance with the latest ACI (American Concrete Institute) 347R "Guide to Formwork for Concrete". Continuous shoring is placed perpendicular to the Lite-Deck sections and spaced 6 feet apart. Adjustable, pre-rated shoring systems are strongly recommended and can be purchased or rented, as needed . If non-rated shoring materials are used, a Structural Engineer can provide guidance on the load bearing capacities of various shoring materials. Two types of shoring techniques are illustrated. DIAGRAM B and DIAGRAM C.

- Any span farther than 6 ft must have temporary shoring supporting it
- Adjust shoring height to compensate for any required camber
- Shoring must be on solid, spreader footing or concrete pad
- If permanent joists will be supporting Lite-Deck sections, they must be certified by a structural engineer, to support the combined dead and live loads.

CAUTION! Diagrams in this manual do not show complete and proper reinforcing steel (rebar) placement. Project-specific engineering plans or local building codes must be followed.

DIAGRAM B
Temporary Shoring using adjustable, load-rated system



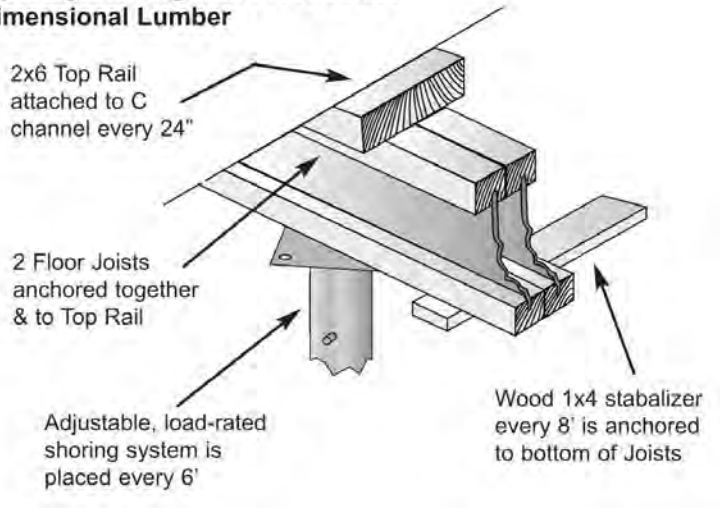
12. Placing Lite-Deck®

With bracing and shoring in place, sections can be placed snugly together. DIAGRAM B.
Anchor steel punch bar to Lite-Deck steel C channels with 1 1/4" self-tapping pan head screws every 24".

12. Placing Lite-Deck® con't

See DIAGRAM C for temporary shoring with floor joists and dimensional lumber illustrated.

DIAGRAM C
Temporary Shoring with Floor Joists & Dimensional Lumber

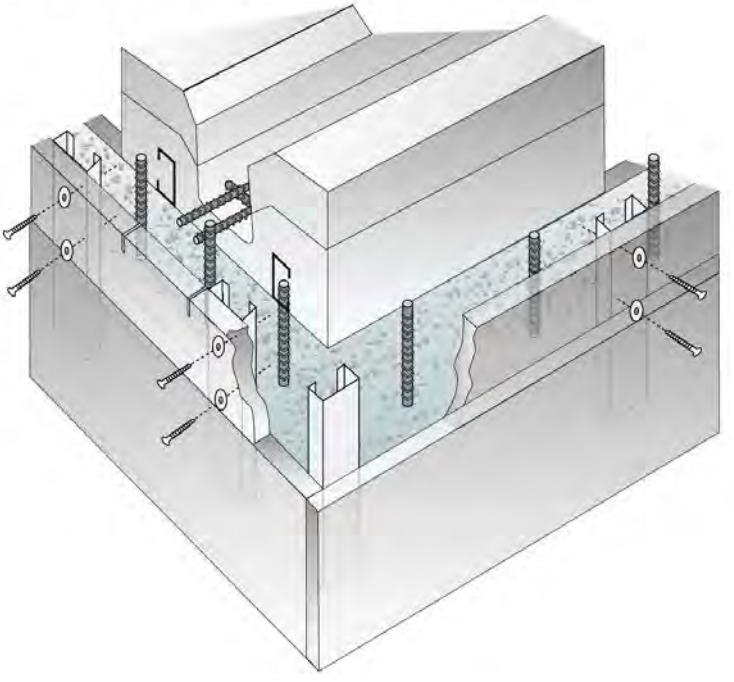


13. Outer Perimeter Bracing

Outer bracing is installed to contain the concrete during placement. To ensure proper alignment, cut a Benchmark ICF form in half to leave 2-4' half sections that will make up the outer rail of the Lite-Deck. Rigid insulation sections are attached with wood cleats, using drywall screws and insulation washers. Place cleats approximately 24" apart. Expandable foam can assist when placing the outer rail of foam.

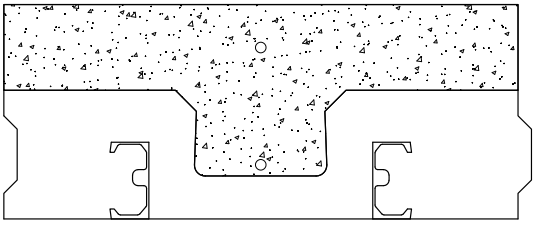
Each Safe Room Storm Shelter kit includes the necessary forms to complete the outer rail described above. However, your structural engineer or Lite-Deck supplier may suggest other anchoring systems.

DIAGRAM D
Outer Perimeter Bracing for Insulating Concrete Form Walls



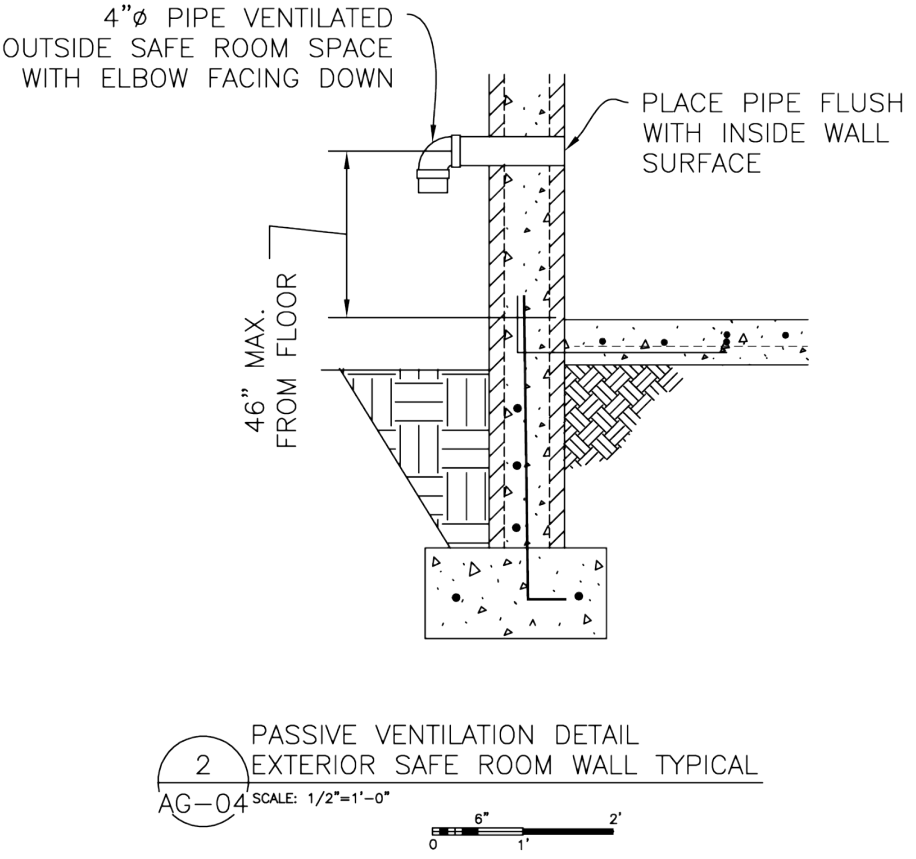
14. Install Rebar

Reinforcing steel (rebar) must be placed in accordance with a licensed structural engineer's job-specific guidelines while adhering to FEMA P-361: Design and Construction Guidance for Community Safe Rooms. See a licensed structural engineer in your state for more information.



15. Ventilation

Powered exhaust fans are only required for Safe Room Storm Shelters that are used as bathrooms. If alternate ventilation apparatus are used on the Safe Room Storm Shelter, the ducting of the ventilation must be hardened to prevent the passage of windborne debris into the Safe Room.

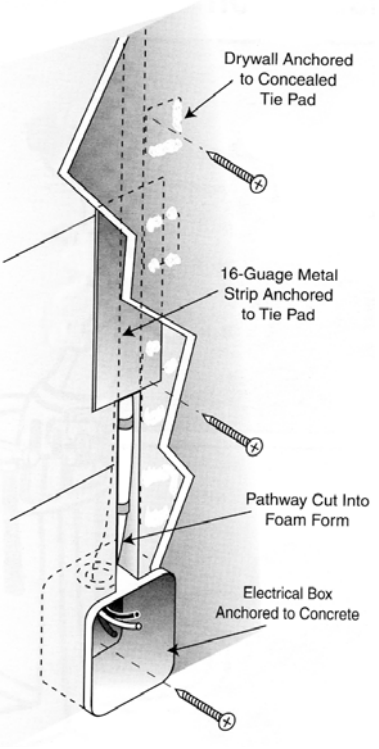


OPTIONAL: Electrical and Plumbing

Follow local codes for the types of electrical and plumbing components which are acceptable for your Safe Room Storm Shelter project.

Electrical and plumbing lines are concealed in the insulation by cutting or carving a pathway approximately 1 1/2" deep with a saw, router or electric hot knife. For junctions or switch boxes, insulation is completely removed and items are anchored directly into the concrete. Electric lines can be protected by running them inside approved metal or plastic conduit. Damage to lines can also be avoided by covering the pathway with a 16-gauge metal strip, approximately 2" wide, anchored to the concealed tie pads with a drywall screw.

Electric lines can be held to the back of the pathway by using approved electrical anchors or expandable insulation placed approximately 2' apart.

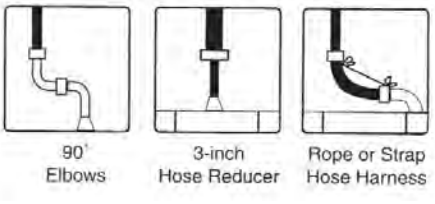


16. Pour Concrete

The following concrete specifications are only suggestions. Benchmark Foam recommends you have a local building code official or licensed structural engineer in your area validate the concrete specifications. Concrete is best placed with a concrete pump.

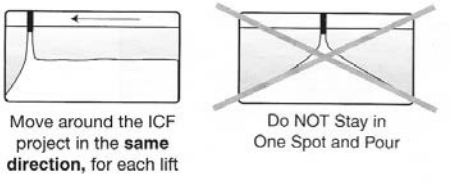
4-6 inch slump
3,500 to 4,000 psi
1/2 to 3/4 inch smooth aggregate

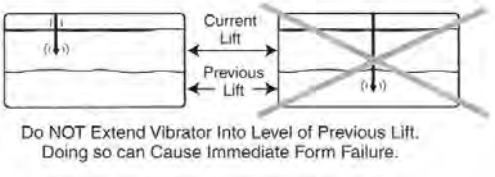
The discharge pressure from the pump hose should be reduced during concrete placement by using one of the following techniques. Most pump operators are familiar with these techniques and can provide the necessary accessories, if they are notified in advance.



90 Degree Elbow: This 2-elbow accessory is attached to the pump's delivery hose to reduce discharge volume and pressure.
Hose Reducer: A 3" reducer is attached to the pump's delivery hose. The 3" discharge hose reduces the concrete's discharge pressure.
Hose Harness: If the 90 degree elbow or hose reducer is not available, the discharge hose can be fitted with a rope or strap harness to bend it so that concrete is not discharged straight down into the form. The hose is diverted and allows the concrete to fall naturally.

Lifts: Place concrete in lifts not to exceed 4' high, with no more than 8' of concrete placed vertical in one hour. This rate must be followed, regardless of how concrete is placed into the Benchmark Foam form. Placing concrete in lifts over 4' per lift can cause immediate form failure (blow outs).





Concrete should be consolidated by vibrating. Only experienced operators should use an electric vibrator with 1" head. Concrete can also be consolidated by tapping the tie pads with a rubber mallet from the exterior.

CAUTION: Workers must not be under Lite-Deck® sections while concrete is being placed! Workers should observe placement from a safe distance.

If you have questions about the assembly and installation techniques in this guide, contact your supplier.

General Structural Notes

CONTRACT DOCUMENTS ARE INTENDED TO CONVEY THE STRUCTURAL DESIGN INTENT. THEY REPRESENT THE STRUCTURAL SYSTEMS, MATERIALS USED, TYPICAL DETAILS AND SPECIFIC DETAILS OF THE COMPLETED STRUCTURE. DETAILS MAY NEED TO BE ADAPTED BY THE CONTRACTOR, SUBCONTRACTOR, OR SUPPLIER IN SOME LOCATIONS. ANY DEVIATION FROM THESE DRAWINGS SHALL BE APPROVED BY THE ENGINEER OF RECORD AND SHALL BE CONSISTENT WITH THE DESIGN INTENT SHOWN.

1. GENERAL CONTRACTORS RESPONSIBILITIES INCLUDE BUT ARE NOT LIMITED TO:

   a. DETERMINE CONSTRUCTION SEQUENCE AND PROCEDURES.

   b. PROVIDE A SAFE JOBSITE FOR WORKERS, SUBCONTRACTORS, TESTING AND INSPECTION AGENCIES, AND DESIGN PROFESSIONALS.

   c. DESIGN AND INSTALLATION OF ALL SHORING AND TEMPORARY BRACING NECESSARY TO INSURE THE SAFETY OF THE BUILDING, IT'S COMPONENTS AND OCCUPANTS.

General Structural Notes con't

d. VERIFY AND COORDINATE DIMENSIONS AND ELEVATIONS SHOWN IN THE DRAWINGS. IF DISCREPANCIES EXIST THE CONTRACTOR SHALL NOTIFY THE ENGINEER PRIOR TO COMMENCING THAT PROCEDURE.

2. NOTIFY PROJECT MANAGER OF ALL CONFLICTS BETWEEN PLANS AND ACTUAL CONDITIONS.

3. DETAILS SHOWN IN TYPICAL LOCATIONS SHALL APPLY TO ALL LOCATIONS WITH THE SAME OR SIMILAR CONDITIONS.

REINFORCED CONCRETE

1. REFER TO DESIGN DATA.
2. ACI FIELD REFERENCE MANUAL, SP-15 SHALL BE FOLLOWED. AT LEAST ONE COPY SHALL BE AVAILABLE ON SITE DURING CONCRETING OPERATIONS.
3. PROVIDE CONTROL JOINTS IN SLAB ON GRADE AS INDICATED BY THE DRAWINGS. IF NO CONTROL JOINTS ARE SHOWN PROVIDE CONTROL JOINTS NO FURTHER THAN 36 TIMES THE SLAB THICKNESS (4" THICK SLAB = 12'-0). CONTROL JOINTS SHALL PROVIDE A SQUARE SECTION WITH THE LENGTH NO GREATER THAN 1 1/2 TIMES THE WIDTH.
4. ALL CIP AND CMU WALLS SHALL BE CONNECTED TO THE FOUNDATION WITH DOWELS THAT MATCH THE WALL REINFORCING SIZE AND SPACING.
5. REFER TO SCHEDULES FOR TYPICAL REINFORCING DETAILS.
6. REBAR SHALL BE SPLICED TO PROVIDE A MINIMUM LAP AS FOLLOWS. TOP BARS ARE HORIZONTAL REINFORCING THAT ARE PLACED WITH 12" OR MORE OF CONCRETE BELOW THE BAR.

BAR SIZE	TYP BAR	TOP BAR
#3	14"	18"
#4	19"	24"
#5	23"	30"
#6	30"	40"
#7	41"	54"
#8	55"	71"
#9	69"	90"
#10	88"	114"
#11	108"	140"

7. PROVIDE CONCRETE COVER FOR ALL REINFORCING AS FOLLOWS
   a. CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH _ 3"
   b. EXPOSED TO EARTH OR WEATHER
      #6 BAR AND LARGER _____ 3"
      #5 BAR AND SMALLER _____ 1 1/2"
   c. INTERIOR EXPOSURE
      BEAMS & COLUMNS _____ 1 1/2"
      WALLS _____ 1 1/2"
      SLABS AND JOISTS _____ 3/4"
8. PROVIDE AN ADDITIONAL 2- #5 BARS AROUND ALL RECTANGULAR OPENINGS IN CIP WALLS AND 1- #5 BAR AROUND ALL RECTANGULAR OPENINGS IN CIP SLABS. ADDITIONAL BAR SHALL EXTEND 24" MINIMUM BEYOND THE OPENING.
9. CONTRACTOR SHALL EMPLOY AN INDEPENDENT TESTING AGENCY TO SAMPLE AND TEST CONCRETE CAST FOUR SAMPLES SHALL BE TAKEN PER CONCRETE POUR AND TESTED AT 7 DAYS, TWO AT 28 DAYS, AND THE FOURTH RETAINED AND TESTED AT 56 DAYS AS REQUIRED. PROVIDE TEST REPORTS TO OWNER AND EOR
10. CONCRETE SHALL RECEIVE A NON-SKID LIGHT BROOM FINISH.
11. CONCRETE SHALL BE CURED WITH LIQUID-TYPE MEMBRANE-FORMING CURING COMPOUND COMPLYING WITH ASTM C309, TYPE I, CLASS A OR B. CURING COMPOUND SHALL BE APPLIED IN STRICT ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

DESIGN DATA

GOVERNING CODE: _____ 2009 INTERNATIONAL BUILDING CODE

FOUNDATION SUBRADE:

A SOILS INVESTIGATION HAS NOT BEEN PERFOMED ON THIS SITE. THE CONTRACTOR SHALL ENGAGE A GEOTECHNICAL ENGINEER TO VERIFY THAT THE FOUNDATION SUBGRADE IS SUITABLE TO SUPPORT THE STRUCTURE BASED ON THE ASSUMED BEARING PRESSURE. THE GEOTECH SHALL SUBMIT A REPORT TO THE ARCH / E.O.R. WITH HIS FINDINGS AND RECOMENDATIONS IF THE SUBGRADE IS FOUND TO BE UNACCEPTABLE.

ASSUMED ALLOWABLE NET BEARING PRESSURE _____ 1500 psf

DESIGN LOADS:

BUILDING CATEGORY _____ II

LIVE LOADS:
ROOF:

GROUND SNOW (Pg) _____ 30 PSF
FLAT ROOF SNOW (Pf) _____ 25 PSF
SNOW EXPOSURE (Ce) _____ 1.0
THERMAL FACTOR (Ct) _____ 1.0
RAIN ON SNOW @ SLOPES < 1/2:12 _____ 5 PSF
UNBALANCED SNOW LOADS _____ ASCE 7 SEC. 7.6

WIND LOADS:

WIND SPEED _____ 90 MPH
EXPOSURE _____ C
NET UPLIFT ON STL JOIST _____ 15 PSF

FEMA 361 2ND EDITION:

CAPACITY _____ 7
WIND ZONE _____ IV
WIND SPEED _____ 250 MPH
GC_{pi} _____ .55
K_d _____ 1.0
K_{zt} _____ 1.0
I _____ 1.0
DEBRIS IMPACT
MISSILE SIZE _____ 2x4x12'-0 15PSF
HORIZ SPEED _____ 100 MPH
VERT SPEED _____ 67 MPH
ROOF WIND PRESSURE
DOWNWARD _____ 102 PSF
UPLIFT _____ 197 PSF

MATERIALS:

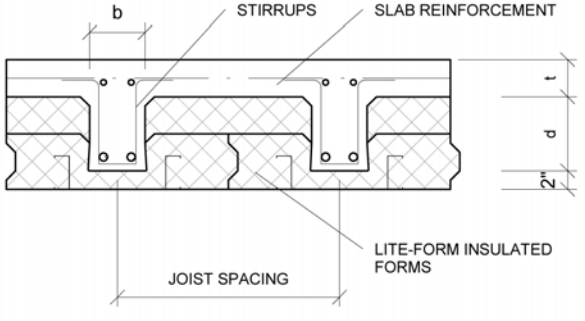
CONCRETE:

28 DAY CONCRETE STRENGTHS (MINIMUM):

FOOTINGS _____ 4000 PSI
SLAB ON GRADE _____ 3500 PSI
SUPPORTED SLABS AND STOOPS _____ 4000 PSI
WALLS _____ 4000 PSI

REINFORCING BARS _____ ASTM A615 GRADE 60
WELDED BARS AND ANCHORS _____ ASTM A706 GRADE 60
WELDED WIRE FABRIC _____ ASTM A185, CSA G30.5

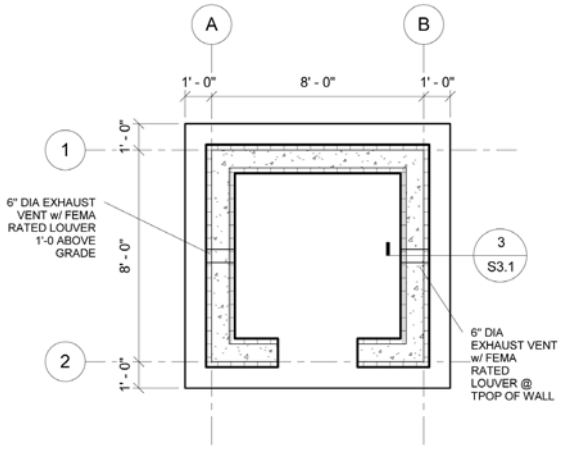
					REINFORCING			
MARK	JOIST DEPTH d	JOIST WIDTH b	TOPPING DEPTH t	JOIST SPACING s	TENDONS	BOTTOM BARS	TOP BARS	STIRRUPS
J-1	4"	6"	4"	24" OC	NA	1-#4	1-#4	NOT REQ'D



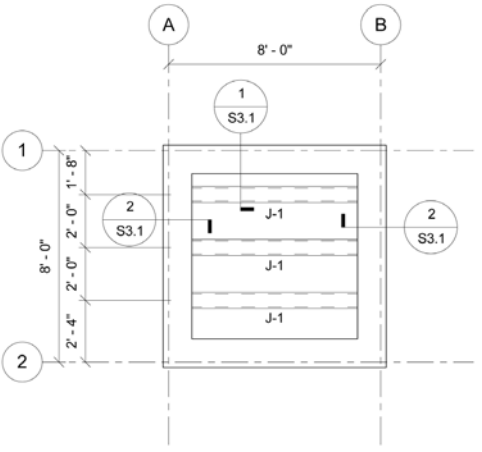
NOTES:

1. PROVIDE 11/2" CLR COVER FOR REINF.
4. #3 @ 1'-0 OC EA WAY SLAB REINF

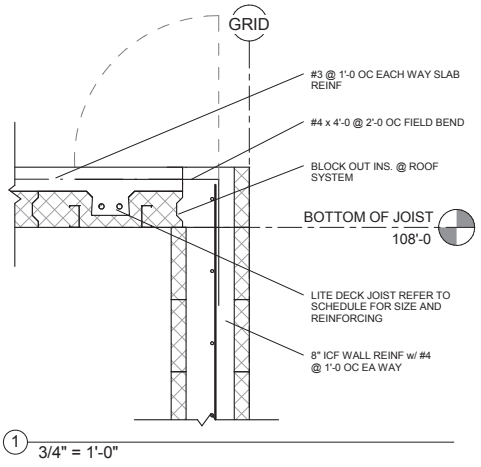
General Structural Notes con't



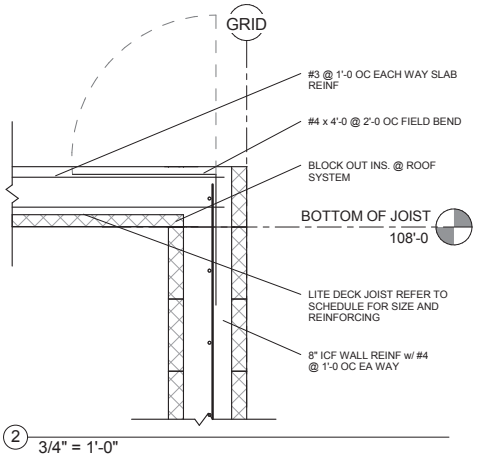
1 FOUNDATION FRAMING PLAN
1/4" = 1'-0"



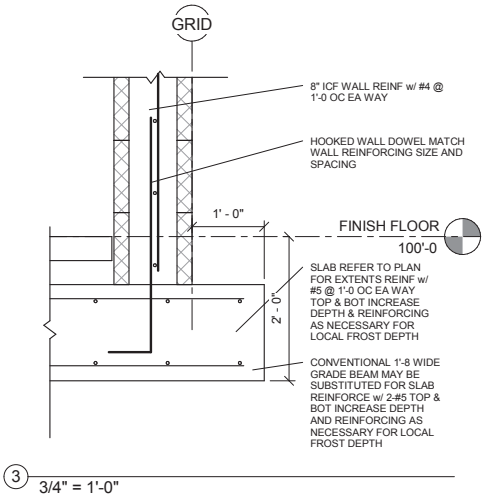
2 ROOF FRAMING PLAN
1/4" = 1'-0"



1 3/4" = 1'-0"



2 3/4" = 1'-0"



3 3/4" = 1'-0"

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JAMES F. LANGE
26310
8/15/13
OKLAHOMA

The 8' x 8' Safe Room Storm Shelter design by Benchmark Foam, Inc. has been reviewed and approved by licensed Structural Engineer, Jim Lange of Lange Structural Group.