American Safe Room's

Underground Blast Resistant Bomb/Fallout Shelter System

File: TM-Underground-Shelter-Kit.pdf
Revision: 2F
Date: January 14, 2015

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Description

The American Safe room Shelter System is comprised of a series of individual kits that can be supplied together to build a complete shelter or separately for use in your own shelter design.

There are four series of shelters: 100, 200, 300, and 400. They correspond to different widths of shelters. The width is the span distance that the load rating is caclulated — side to side, not end to end.

The ceiling trusses span the width and support the ceiling concrete while it is curing. After it cures, these trusses reinforce the concrete, adding a significant amount of steel right where it can be best used to resist the high pressures of a nearby detonation.

All of the necessary penetrations can be through the ceiling — ingress/egress riser hatch, air ventilation pipes, electrical, plumbing, and communication. These penetrations can be installed before the ceiling pour and cast into place.

The walls of the shelter can be built using the block construction shown in this manual or conventional steel reinforced concrete construction. Either construction method is made easier because of the lack of requiring the penetrations to be through the walls.

As an option, an American Safe Room blast door can be installed in a wall of the shelter when one or more walls are exposed. Blast doors greatly increase the usability of a shelter by eliminating the need to get supplies, pets, or elderly and infirmed people up and down a ladder.

Notes and cautions

The construction techniques described in this manual are intended as a guide for experienced professionals.

The ceiling trusses and riser assembly are heavy and require the use of heavy lifting equipment and qualified operators. The proper equipment should be used for every operation.

This kit is designed to be easily installed by a licenced general contractor utilizing subcontractors as necessary. The skills and certifications necessary to build a complete underground shelter include excavation, concrete forms and pouring, masonry, electrical, plumbing, and structural skills. An experienced, licensed general contractor is highly recommended to oversee this project.

All of the items in these kits have been designed to conform to the Uniform Building Code. Local building codes and ordinances do vary by location. It is the responsibility of the builder and owner to insure that all construction techniques and practices meet all building code requirements before construction begins. This includes all permits and inspections.

Ordering a shelter kit

Getting a quotation
The first step is to determine exactly what shelter you need. See the worksheet on page 6 that shows all of the options available. Next, contact our shelter sales department for a quotation — see page 2 for contact information. You will need to give us the details from the worksheet, a shipping address, and an e-mail address so we can send you a quotation.

Terms
All items are shipped prepaid. Special order items require a 50% deposit at time of order and the balance due before shipping. When you order is complete, a proof picture will be e-mailed to you, you arrange payment for the balance due, and we ship your order right out by truck line and send you the tracking number. Most locations will see about one week shipping time.

Payment options
American Safe Room accepts checks (held until cleared), certified checks, and wire transfers for shelter kits.

Availability
The shelter kit is considered a special order item. We build them to order — first come, first serve. We can usually ship a shelter order in about five weeks.

Custom engineering
We can custom engineer shelter modifications if we have enough bandwith in our engineering department. At times, we may decide to not bid on custom jobs. Please contact our shelter sales department to find out if we are able to provide custom engineering and the costs involved.

What is included with every kit

- Seven each steel trusses with brackets and fasteners (nuts, bolts, and washers)
- Complete cut and formed rebar kit
- One each riser hatch with ladder (other options available)
- One each complete blast protected NBC air filtration system that includes:
  - one each ASR-100-AV-NBC Safe Cell NBC air filter
  - one each ASR-50-BB emergency hand pump
  - two each ASR-101-BV blast valves
  - one each ASR-50-OP overpressure valve
- Two each 48 inch ceiling ventilation pipes — one each for air intake and outflow
- One each ceiling electrical penetration, water penetration, and waste water penetration kit

Optional items

- French drain — see page 45
- Blast door — see page 46
- Automatic ventilation system — see page 48
- Differential pressure gauge — see page 49
- Electrical system — see page 51
- Toilet installation kit — see page 54

What is not included

- Concrete blocks
- Form boards
- Concrete, mortar, and gravel
- Rebar safety caps
- External plumbing and wiring
- Anything else not explicitly listed above in the “included” list

Shelter kit order worksheet

We will need the information below and a shipping address to accurately quote your kit. Please fill in the quantities below and return this information by e-mail to shelters@AmericanBombShelter.com or by FAX to 503-212-6695. Manuals referenced below are available at www.AmericanBombShelter.com

Shelter size

___ 100 series, 8'8" x 20' inside dimensions, total shielding: ___ feet, see page 11
___ 200 series, 10' x 20' inside dimensions, total shielding: ___ feet, see page 13
___ 300 series, 12' x 20' inside dimensions, total shielding: ___ feet, see page 15
___ 400 series, 14' x 20' inside dimensions, total shielding: ___ feet, see page 17

Doors and hatches

___ Single leaf blast door, part number: _____, see pages 46 – 48
___ Riser blast hatch, part number: _____, see pages 37 – 39
see the respective manuals for information how to generate the part number

Ceiling penetration kits

___ Ventilation pipes — 48" ceiling penetration pipes without sleeve kit, see page 34
see the vent pipe manual for more information and options
___ Electrical penetration kit, see pages 32 and 33
___ Water supply penetration kit, see pages 32 and 33
___ Waste (septic) penetration kit, see pages 32 and 33

Filtration and ventilation — see the respective manuals for information about these parts

___ Complete blast protected NBC air filtration system, see pages 43 and 44
Includes: one ASR-100-AV-NBC Safe Cell NBC air filtration system
one ASR-50-BB backup hand pump
two ASR-101-BV blast valves
one ASR-50-OP overpressure valve

Or, choose your components individually:

___ ASR-100-AV-NBC — AC and DC Safe Cell NBC air filter
___ ASR-100-XX-NBC — DC only Safe Cell NBC air filter, please specify 12 or 24 volt
___ ASR-50-BB backup hand pump
___ ASR-101-BV blast valve
___ ASR-50-OP overpressure valve
___ ASR-50-FILTERS complete filter replacement for all Safe Cell models
___ ASR-100-AB automatic ventilation system, see page 49
___ ASR-XX-DPG differential pressure gauge, specify range: ___, see pages 49 and 50

Optional kits

___ French drain system, see page 45
___ Electrical connection kit, see pages 51 — 53
___ Toilet installation kit, see pages 54 – 56

Choosing the shelter size based on occupancy ratings

There are two constraints to occupancy in a shelter: space and airflow. FEMA publication number 453, *Safe Rooms and Shelters - Protecting People Against Terrorist Attacks*. Here are some excerpts. For additional context, see this entire document:

> 1.6 Occupancy Duration, Toxic Free Area (TFA) Floor Space, and Ventilation Requirements
>
> a. *Less Than 24 Hours*. An occupancy duration of less than 24 hours does not require sleeping areas. The occupant load will generally be a net 1.86 m2/person (20 square feet/person), depending upon the classification of occupancy.
>
> b. *More Than 24 Hours*. An occupancy duration greater than 24 hours requires sleeping areas. The minimum floor area, with the use of single size beds, is approximately 5.6 m2/person (60 square feet/person). With the use of bunked beds, the minimum floor area is approximately 2.8 m2/person (30 square feet/person).

The recommended occupancy ratings based on floor space are:

100 series — 6 adults
200 series — 7 adults
300 series — 8 adults
400 series — 9 adults

The recommended occupancy rating based on air supply is 12 occupants per Safe Cell air filtration system. This is using the ASHRE standard of 5 cubic feet of air per minute, per person. It is common practice to install more than one NBC air filter in a shelter to supply the required airflow. To ensure adequate airflow, each Safe Cell should have it's own air intake and outflow ventilation pipe and blast valve.

Choosing the location

Careful planning should be given before an underground structure is started. The shelter should be accessible for quick entry while being hidden from view. There are some other considerations:

1. The shelter, or its foundation, may not be lower than the high water table.
2. The location should have sufficient slope to allow for surface water drainage.
3. The allowable compaction ratio of the soil at the footing should not be less than a 10,000 pounds per square foot — otherwise a thicker footing may be required.
4. location must comply with all required local building permits.
5. With fully or partially buried shelters make sure that you have sufficient space and access for needed construction equipment for excavating and lowering the pallets of loaded block into the finished excavation.

   Caution — do not attempt to construct your under ground shelter below the high water table. Be sure to consult with a local soil expert or drill appropriate test holes before excavation.

Excavation overview

The following eight pages have the dimensions of the shelters and the required excavation.

The drawings show the size for both a 3 foot and a 4 foot total shielding — ceiling slab plus back filled earth, with adequate slope to relieve surface water. Note that the ventilation pipes are shown at two feet off of the surface — as per the US Army Corps of Engineers guidelines.

Be sure and read "Choosing the Location" on the previous page.

To guard against cave-in of the excavation, American Safe Room drawings depicts a bench side wall slope of 45 degrees. This is considered sufficient slope for A and B soil types. The drawings show an end elevation of the shelter with the bench shown on the long side of the hole. The short sides (ends) of the holes also require this bench. The safe slope or bench for the banks of an excavation varies with different soil types, and must be determined on each individual project by the excavation contractor.

If your excavating contractor is in doubt of your soil type, consult with OSHA regulations Safety and Health Regulations for Construction, part 1926, Subpart P sloping and benching and soil classifications in appendix A.

Excavate the floor of the hole as level as possible without disturbing the compaction. Care must be taken not to disturb the soil compaction at the bottom of the excavation. At the recommended 10 to 11 foot depths, the soil is usually compacted sufficiently — unless it is disturbed in the excavation process. If it is disturbed, you must compact the soil with a vibra-plate compactor before constructing the floor slab forms and a footer may be required to carry the load.

> **Caution —** excavating a large hole can be dangerous. A qualified equipment operator with the proper equipment is recommended.

Series 100 shelter dimensions and quantities

Maximum recommended occupancy: 6 persons

Dimensions

Inside dimensions: 8.7 feet wide x 20 feet long x 7.3 feet high
Inside area: 173.2 square feet
Inside volume: 1,264.4 cubic feet
Outside square footage (walls and top) for sealant: 650 square feet

Block count — local purchase

8 inch x 16 inch blocks
Blocks per course: 45
Standard: 290 each
Bond: 205 each
Total: 495 each

Concrete requirement — local purchase

4000 PSI concrete
Floor slab: 4.0 cubic yards
Walls: 5.5 cubic yards
Ceiling: 7.7 cubic yards

Rebar requirement — see page 57

Notes:

Be sure and order extra concrete. The truck may be short, the ground uneven below the floor slab, or the blocks you use may have larger cavities. It is standard practice to order 10% extra.

The standard block count includes 20 blocks that are to be made into bond blocks by cutting channels in them. They are for the corners of the five bond block courses so the ends of the rebar channels are not exposed.

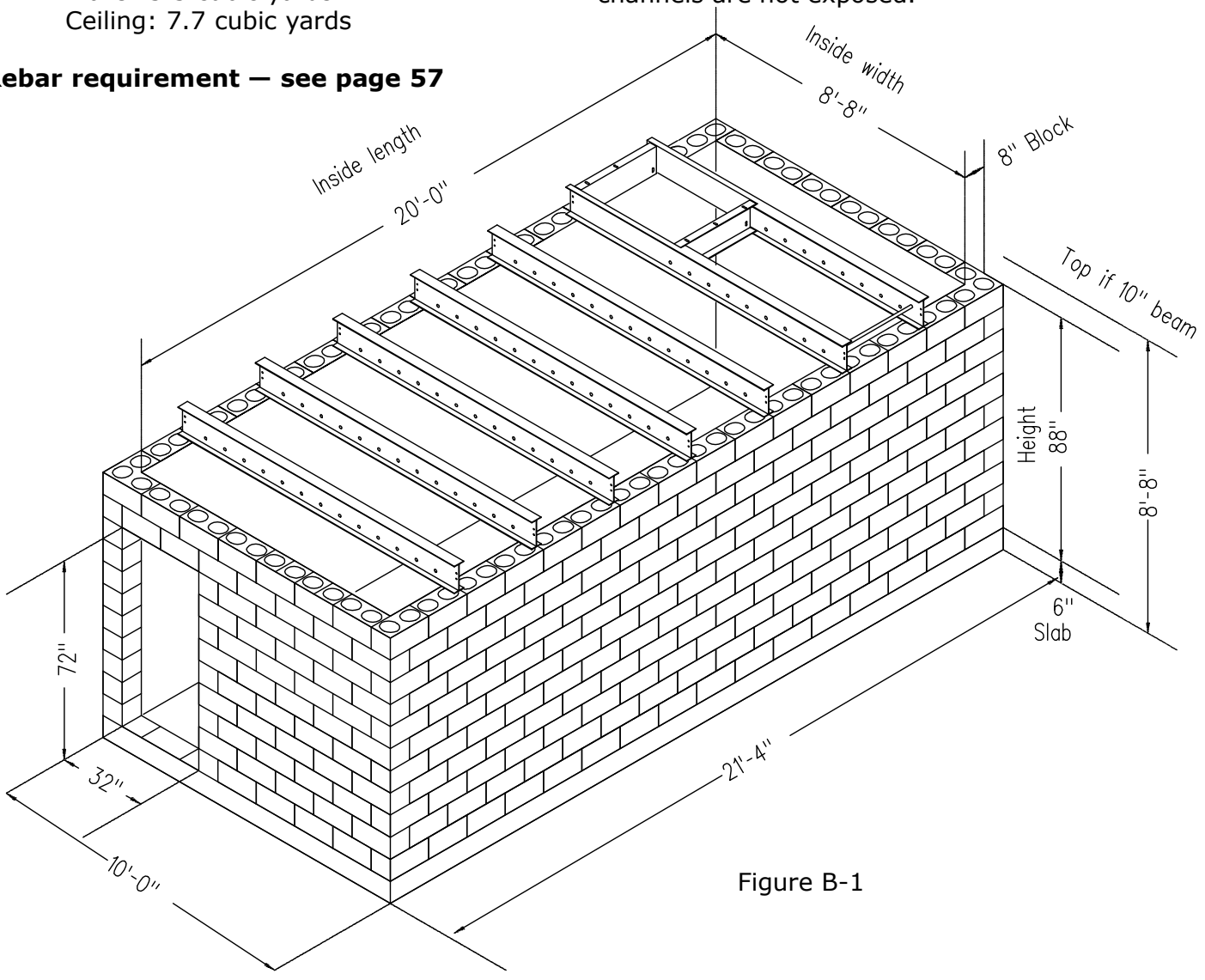
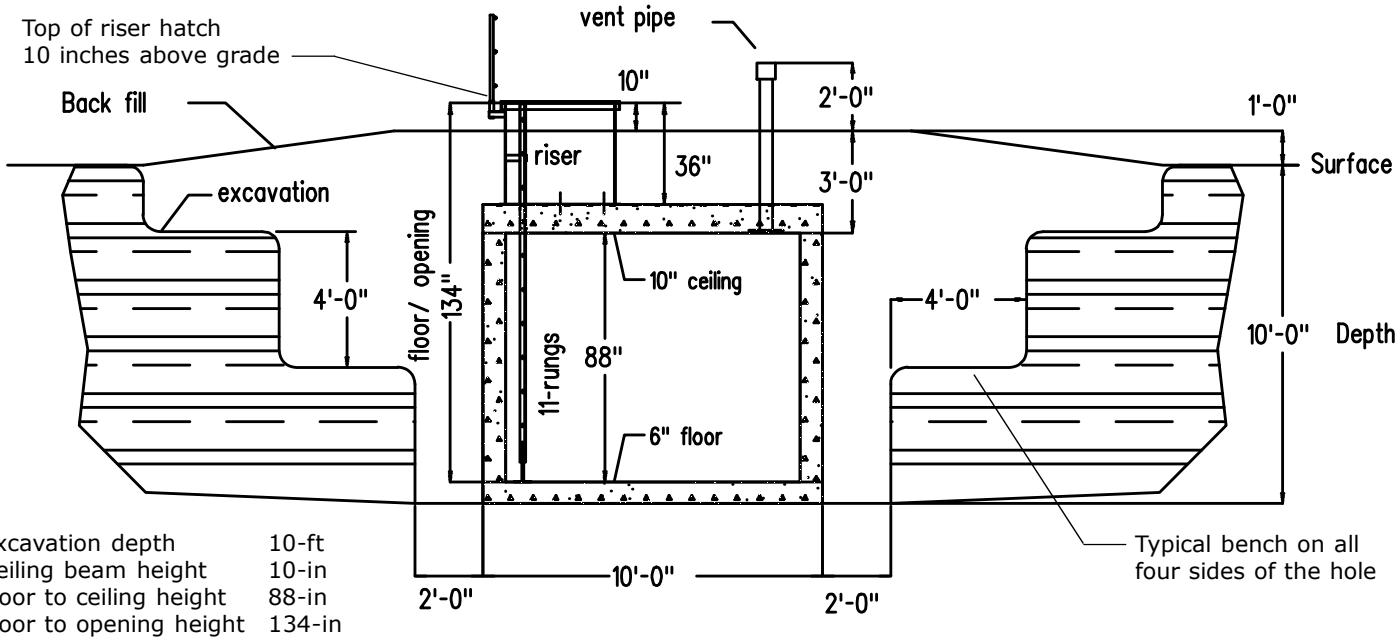


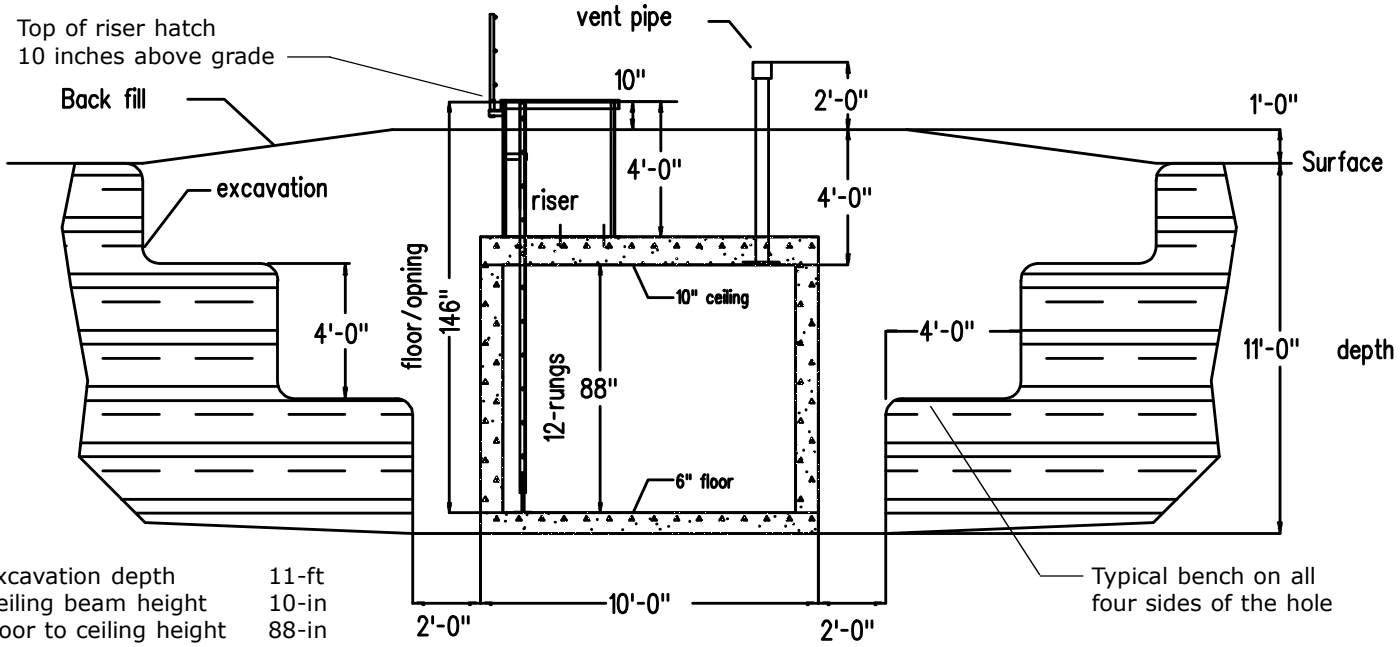
Figure B-1

Series 100
Required excavation depth, riser, ladder and vent pipe lengths



Excavation depth	10-ft
Ceiling beam height	10-in
Floor to ceiling height	88-in
Floor to opening height	134-in
Riser height	36-in
Vent pipe length	60-in
Ladder length	128-in
Ladder rungs	11

Figure B-2
3 feet of total top shielding
(ceiling plus backfill)



Excavation depth	11-ft
Ceiling beam height	10-in
Floor to ceiling height	88-in
Floor to opening height	146-in
Riser height	48-in
Vent pipe length	72-in
Ladder length	140-in
Ladder rungs	12

Figure B-3
4 feet of total top shielding
(ceiling plus backfill)

Series 200 shelter dimensions and quantities

Maximum recommended occupancy: 7 persons

Dimensions

Inside dimensions: 10 feet wide x 20 feet long x 7.3 feet high
Inside area: 200 square feet
Inside volume: 1,460 cubic feet
Outside square footage (walls and top) for sealant: 700 square feet

Block count — local purchase

8 inch x 16 inch blocks
Blocks per course: 47
Standard: 302 each
Bond: 215 each
Total: 517 each

Concrete requirement — local purchase

4000 PSI concrete
Floor slab: 6.0 cubic yards
Walls: 5.6 cubic yards
Ceiling: 10.4 cubic yards

Rebar requirement — see page 57

Notes:

Be sure and order extra concrete. The truck may be short, the ground uneven below the floor slab, or the blocks you use may have larger cavities. It is standard practice to order 10% extra.

The standard block count includes 20 blocks that are to be made into bond blocks by cutting channels in them. They are for the corners of the five bond block courses so the ends of the rebar channels are not exposed.

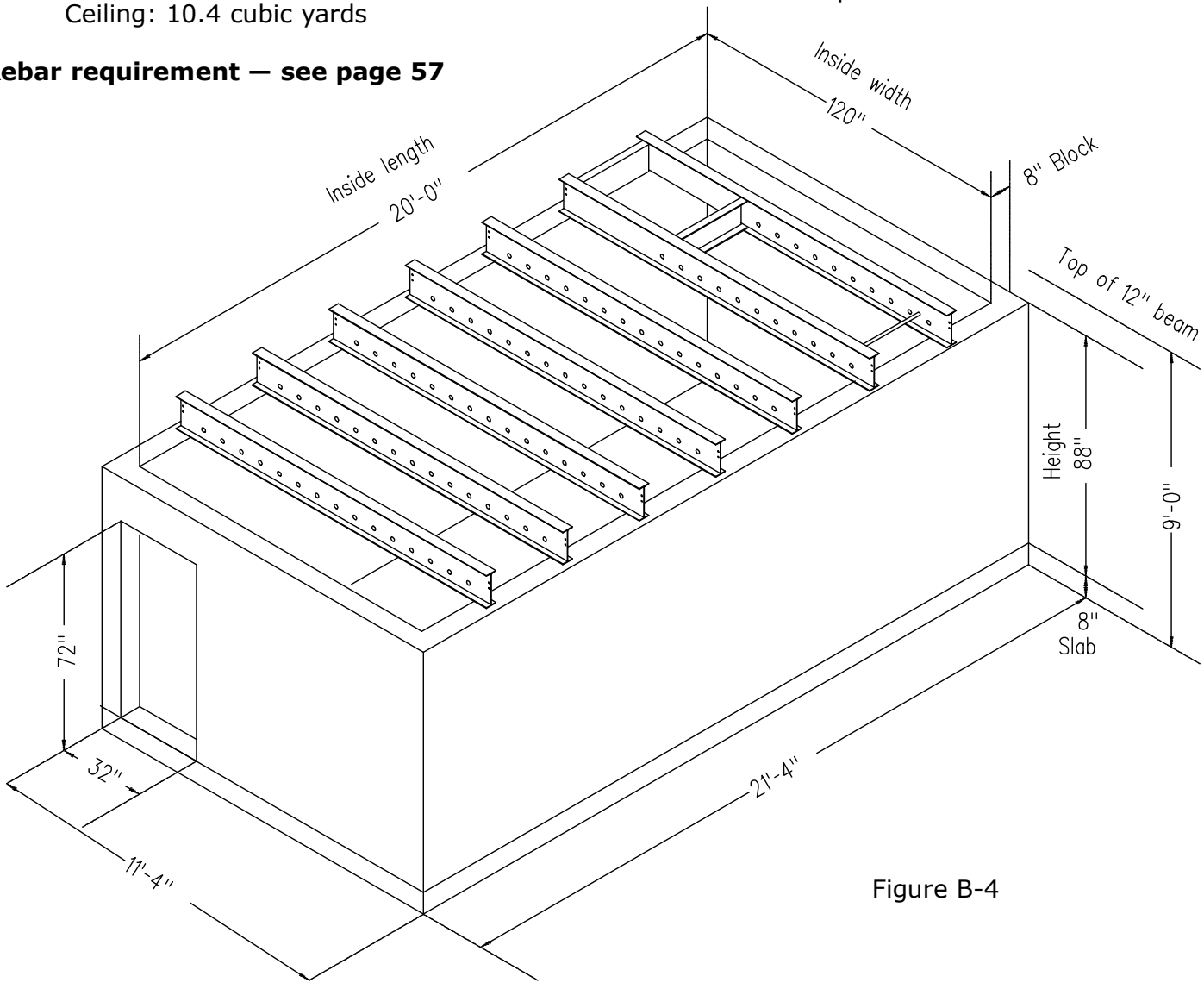
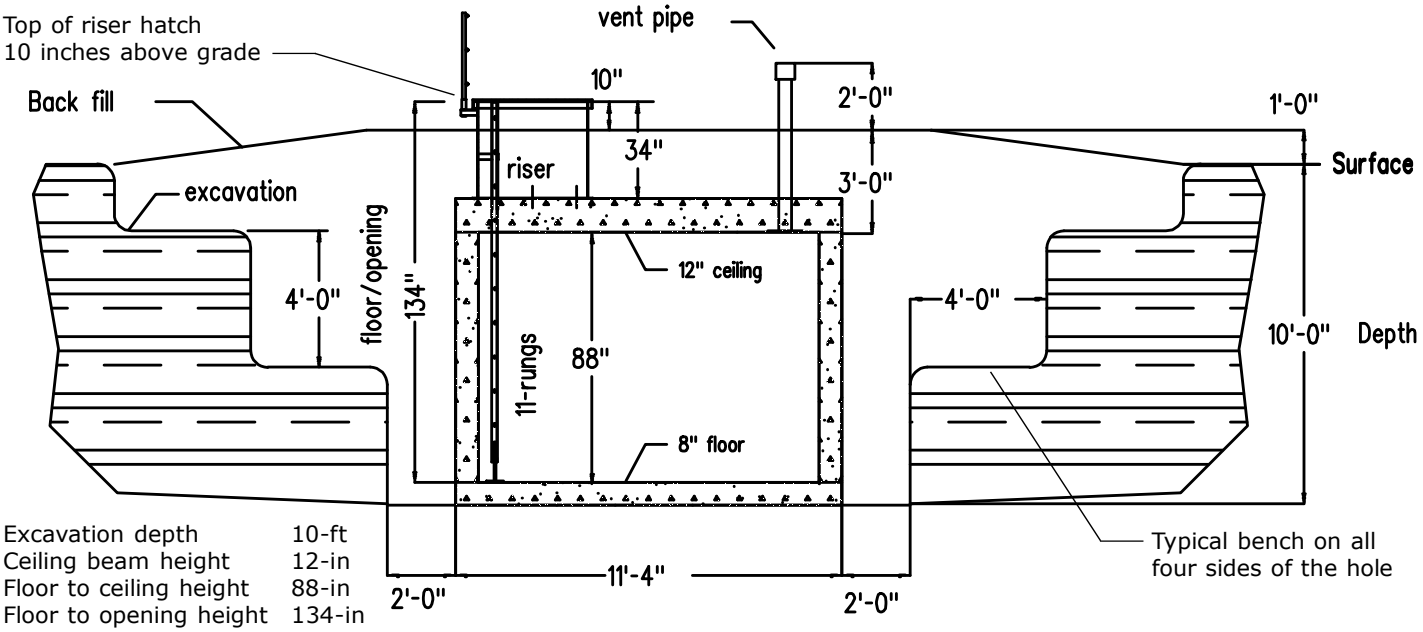


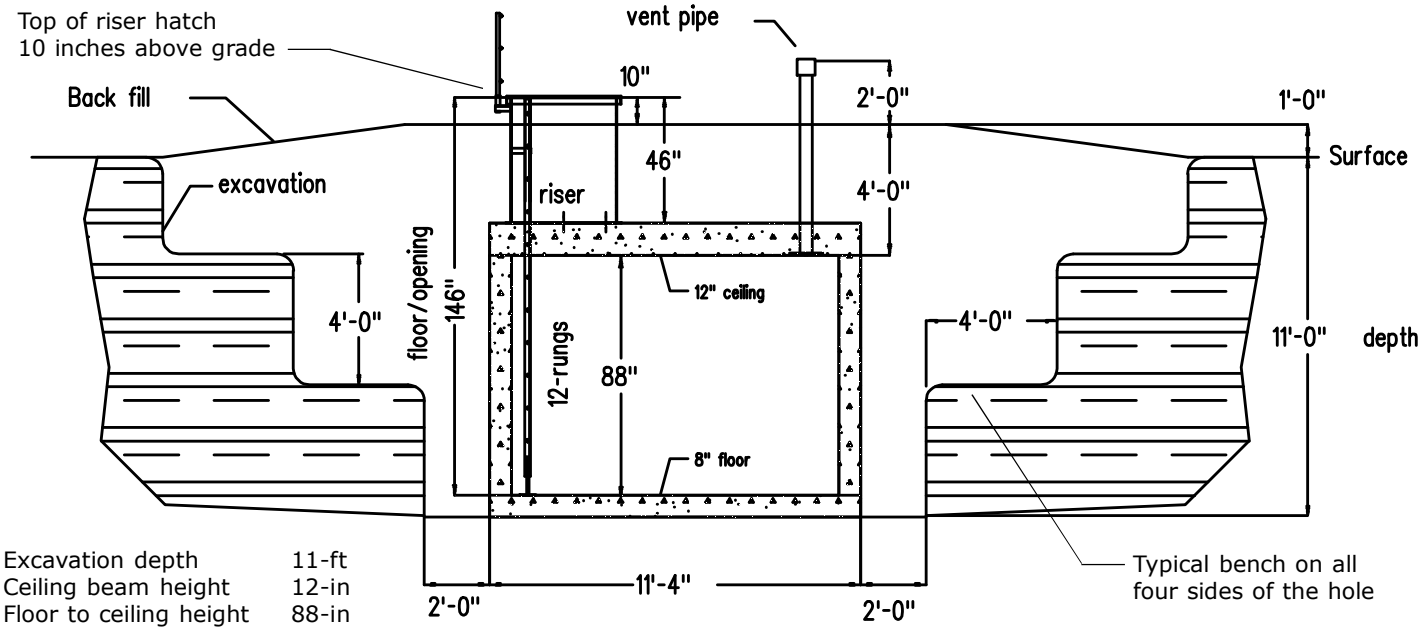
Figure B-4

Series 200
Required excavation depth, riser, ladder and vent pipe lengths



Excavation depth	10-ft
Ceiling beam height	12-in
Floor to ceiling height	88-in
Floor to opening height	134-in
Riser height	34-in
Vent pipe length	60-in
Ladder length	128-in
Ladder rungs	11

Figure B-5
3 feet of total top shielding
(ceiling plus backfill)



Excavation depth	11-ft
Ceiling beam height	12-in
Floor to ceiling height	88-in
Floor to opening height	146-in
Riser height	46-in
Vent pipe length	72-in
Ladder length	140-in
Ladder rungs	12

Figure B-6
4 feet of total top shielding
(ceiling plus backfill)

Series 300 dimensions and quantities

Maximum recommended occupancy: 8 persons

Dimensions

Inside dimensions: 12 feet wide x 20 feet long x 7.3 feet high
Inside area: 240 square feet
Inside volume: 1,752 cubic feet
Outside square footage (walls and top) for sealant: 775 square feet

Block count — local purchase

8 inch x 16 inch blocks
Blocks per course: 50
Standard: 320 each
Bond: 230 each
Total: 550 each

Concrete requirement — local purchase

4000 PSI concrete
Floor slab: 7.1 cubic yards
Walls: 5.9 cubic yards
Ceiling: 14.0 cubic yards

Rebar requirement — see page 57

Notes:

Be sure and order extra concrete. The truck may be short, the ground uneven below the floor slab, or the blocks you use may have larger cavities. It is standard practice to order 10% extra.

The standard block count includes 20 blocks that are to be made into bond blocks by cutting channels in them. They are for the corners of the five bond block courses so the ends of the rebar channels are not exposed.

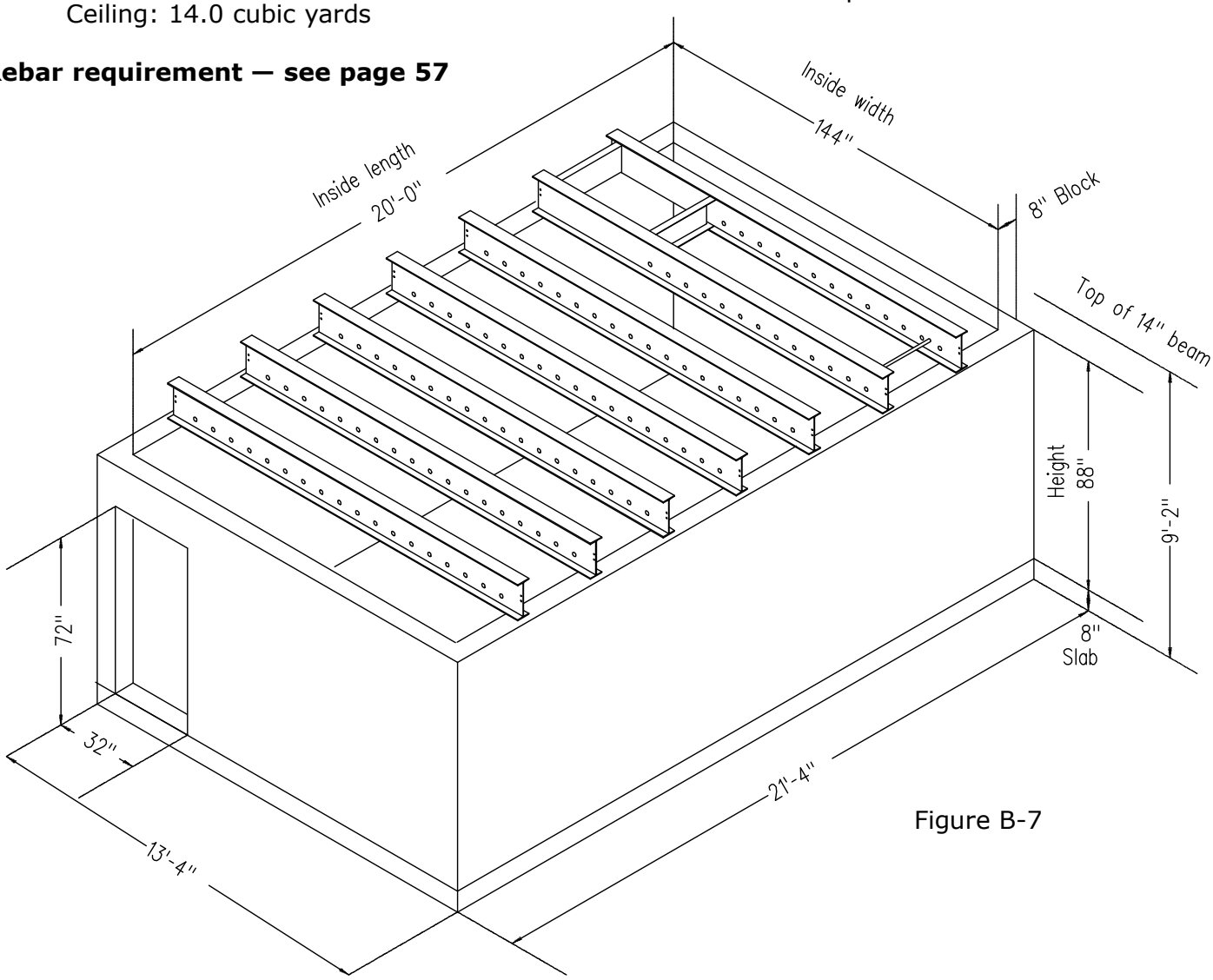
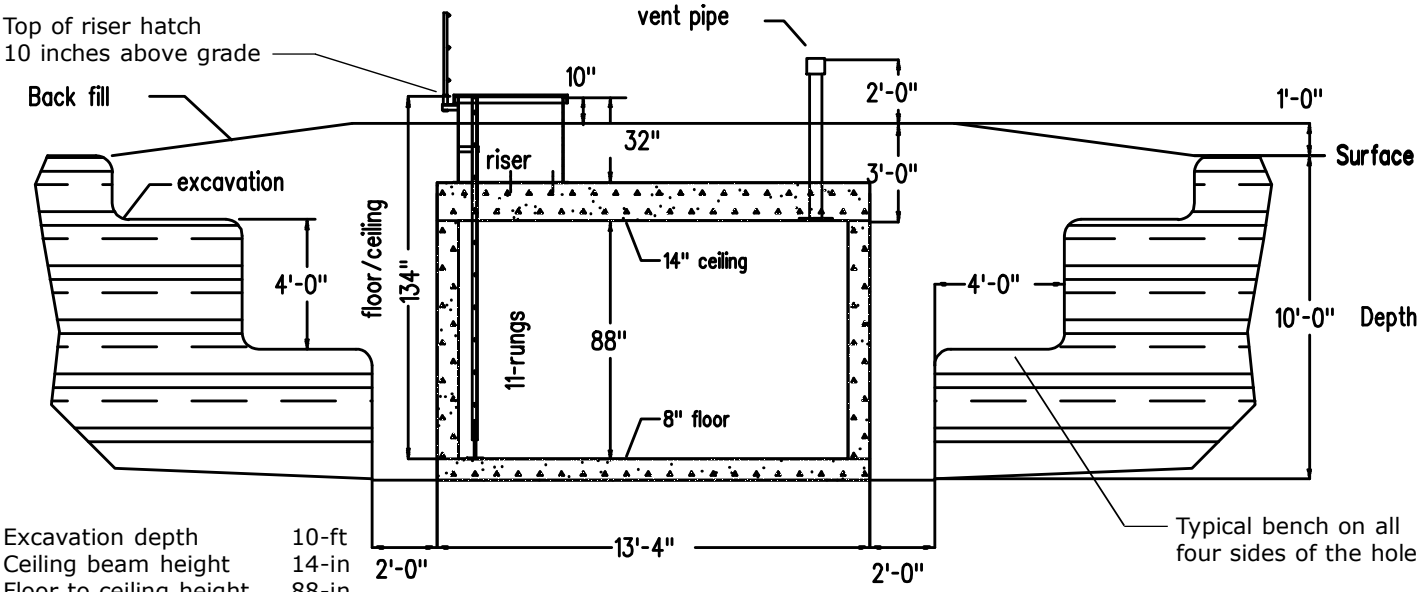


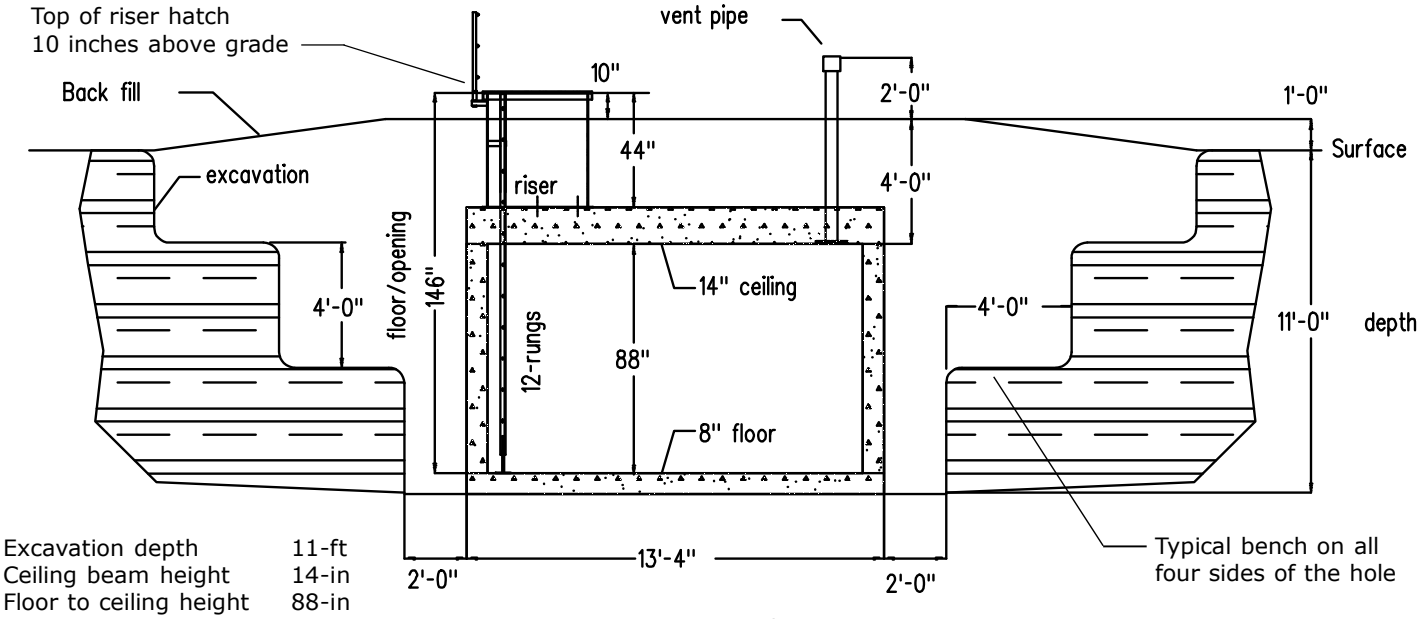
Figure B-7

Series 300
Required excavation depth, riser, ladder and vent pipe lengths



Excavation depth	10-ft
Ceiling beam height	14-in
Floor to ceiling height	88-in
Floor to opening height	134-in
Riser height	32-in
Vent pipe length	60-in
Ladder length	128-in
Ladder rungs	11

Figure B-8
3 feet of total top shielding
(ceiling plus backfill)



Excavation depth	11-ft
Ceiling beam height	14-in
Floor to ceiling height	88-in
Floor to opening height	146-in
Riser height	44-in
Vent pipe length	72-in
Ladder length	140-in
Ladder rungs	12

Figure B-9
4 feet of total top shielding
(ceiling plus backfill)

Series 400 shelter dimensions and quantities

Maximum recommended occupancy: 9 persons

Dimensions

Inside dimensions: 14 feet wide x 20 feet long x 7.3 feet high
Inside area: 280 square feet
Inside volume: 2044 cubic feet
Outside square footage (walls and top) for sealant: 850 square feet

Block count — local purchase

8 inch x 16 inch blocks
Blocks per course: 53
Standard: 338 each*
Bond: 245 each**
Total: 583 each

Concrete requirement — local purchase

4000 PSI concrete
Floor slab: 10.1 cubic yards
Walls: 6.3 cubic yards
Ceiling: 18.2 cubic yards

Rebar requirement — see page 57

Notes:

Be sure and order extra concrete. The truck may be short, the ground uneven below the floor slab, or the blocks you use may have larger cavities. It is standard practice to order 10% extra.

The standard block count includes 20 blocks that are to be made into bond blocks by cutting channels in them. They are for the corners of the five bond block courses so the ends of the rebar channels are not exposed.

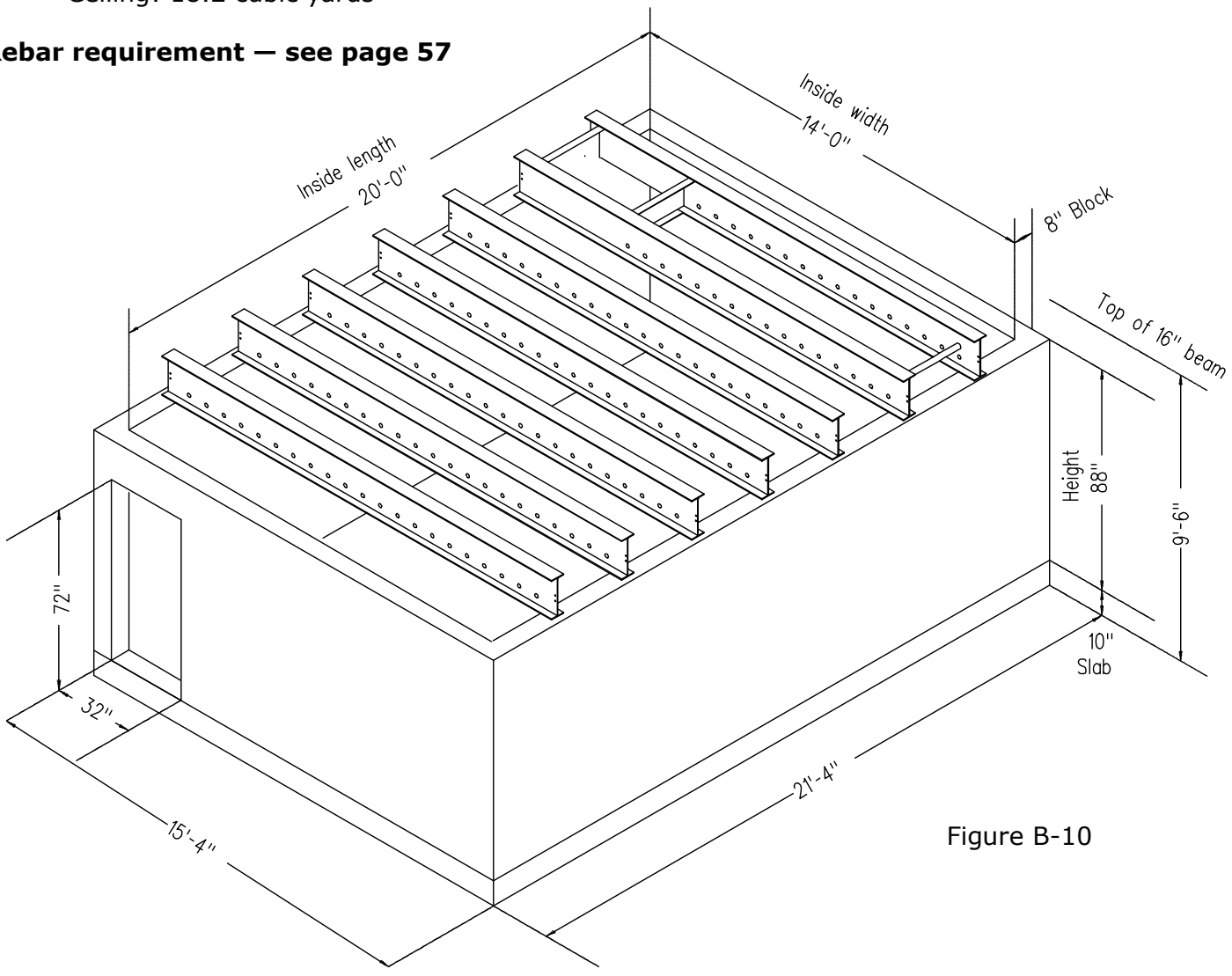
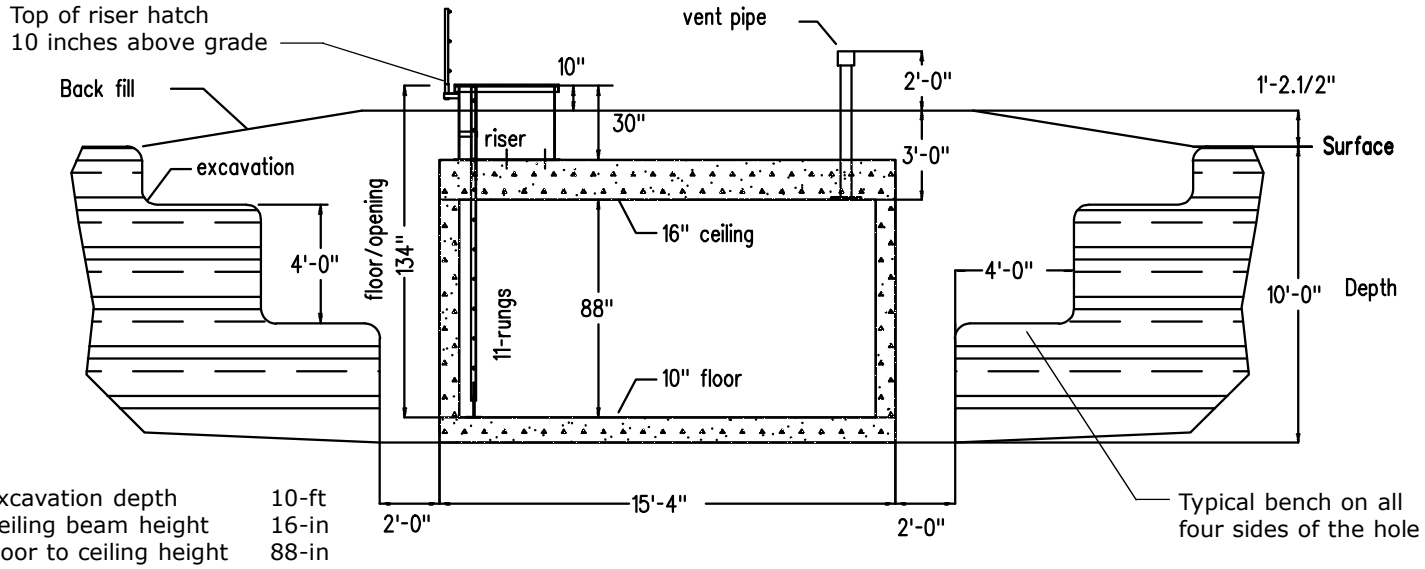


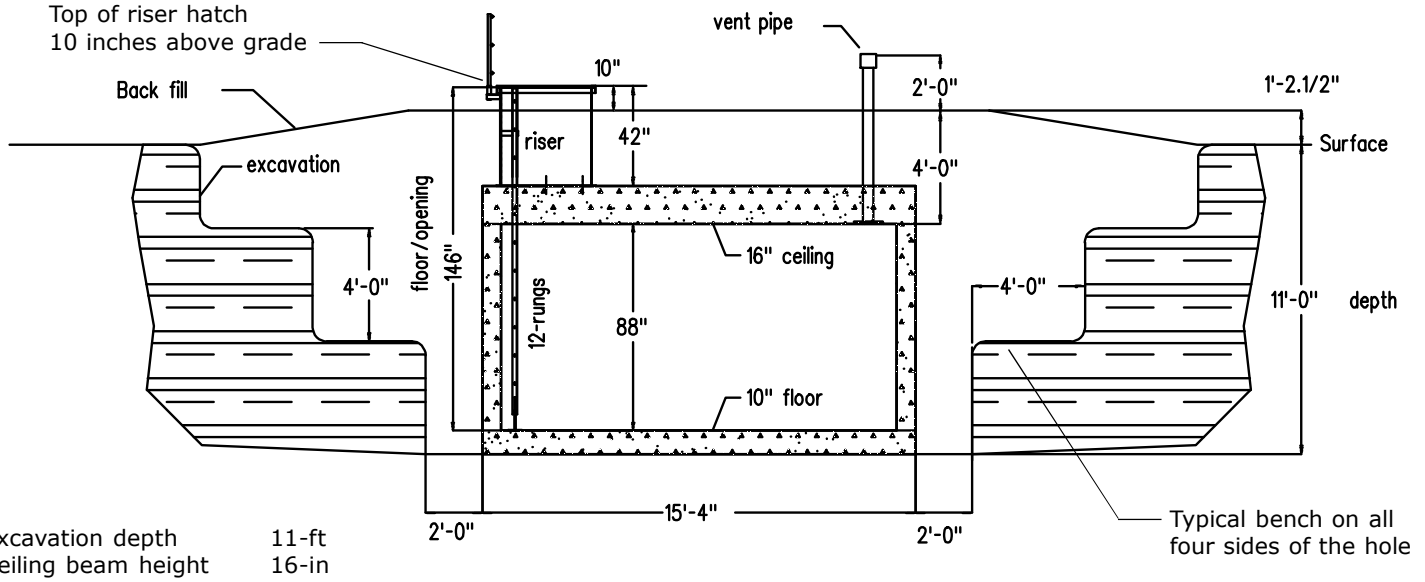
Figure B-10

Series 400
Required excavation depth, riser, ladder and vent pipe lengths



Excavation depth	10-ft
Ceiling beam height	16-in
Floor to ceiling height	88-in
Floor to opening height	134-in
Riser height	30-in
Vent pipe length	60-in
Ladder length	128-in
Ladder rungs	11

Figure B-11
3 feet of total top shielding
(ceiling plus backfill)



Excavation depth	11-ft
Ceiling beam height	16-in
Floor to ceiling height	88-in
Floor to opening height	146-in
Riser height	42-in
Vent pipe length	72-in
Ladder length	128-in
Ladder rungs	12

Figure B-12
4 feet of total top shielding
(ceiling plus backfill)

Shelter floor overview

The floor constructed of 6 to 10 inches of 4,000 PSI minimum concrete with ¾ inch minus aggregate and a 5 to 6 inch slump. It should be poured at one time and allowed to cure for a minimum of seven to ten days. See pages 10, 12, 14, or 16 for the amount of concrete needed.

> **Note -** see page the Excavation Overview on page 9 for information on soil compaction and the need to not disturb the soil at the bottom of the excavation.

Building the forms

Construct the proper size forms as shown in figures C-3. Lay a 6 mil plastic vapor barrier down inside the forms. Trim the plastic so it lays flat inside the forms and does not curl up onto the form boards. When completed, the vapor barrier should not extend out past the floor slab or it will funnel water under the slab.

Setting the rebar

Lay the rebar in place as per the drawing C-2 on page 20. The horizontal rebar in the floor form should be set at a height of 3 inches off of the ground. Use dobies (small blocks of concrete with embedded wire) to hold the rebar at this height.

> **Caution** — because the rebar is at the bottom of a hole, all exposed ends should be capped as soon as they are laid in place or cut to length. Anyone who looses their balance in the hole is in danger of falling on an exposed rebar end.

Installing the Ufer grounding system

This is a special grounding system that complies with NEMA code and enhances the EMP resistance of the shelter. It needs to be installed before the floor is poured. See page 22 for more information.

Pouring the concrete

It is recommended to use a concrete pump to deliver the concrete down in the hole. After the form is full of concrete, rod it off, bull float it, and apply a trowel or broom finish.

Note:

Be sure and order extra concrete. The truck may be short, the ground uneven below the floor slab, or the blocks you use may have larger cavities. It is standard practice to order 10% extra.

Floor slab size

Reference the drawing below when constructing the forms. The outside length at the bottom and the outside widths on the left side are the dimensions of the floor slab. The inside of the form boards should hold these dimensions. The ceiling trusses are shown for reference.

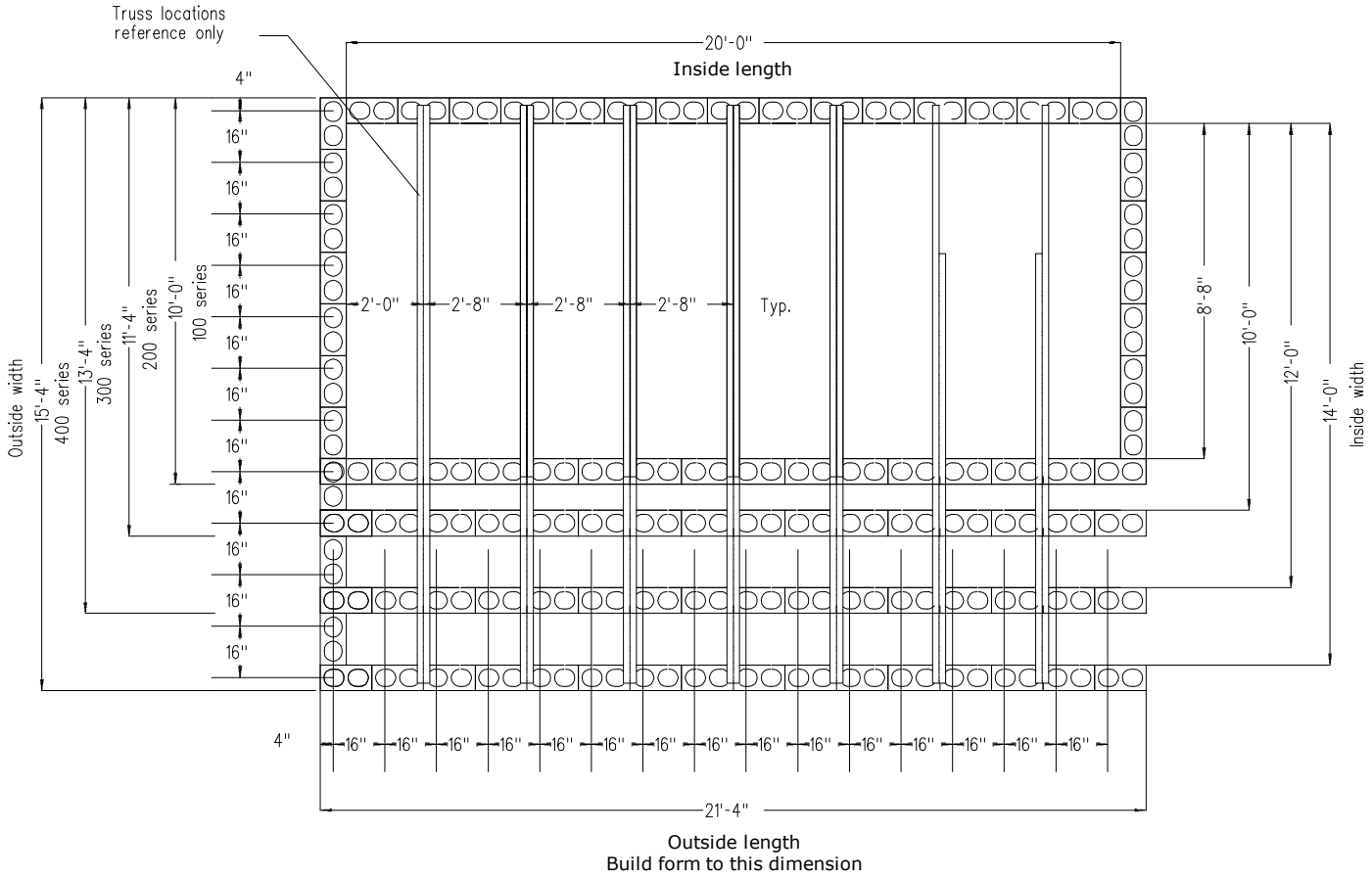


Figure C-1
Floor slab dimensions

Floor slab horizontal rebar placement

Lay the rebar in the floor forms as shown below. The perimeter rebar is doubled and placed 4 inches from the edge so it is centered under the walls.

For rebar counts and lengths, see page 57.

All rebar connections and intersections must be properly tied with two ties at least 12 inches apart.

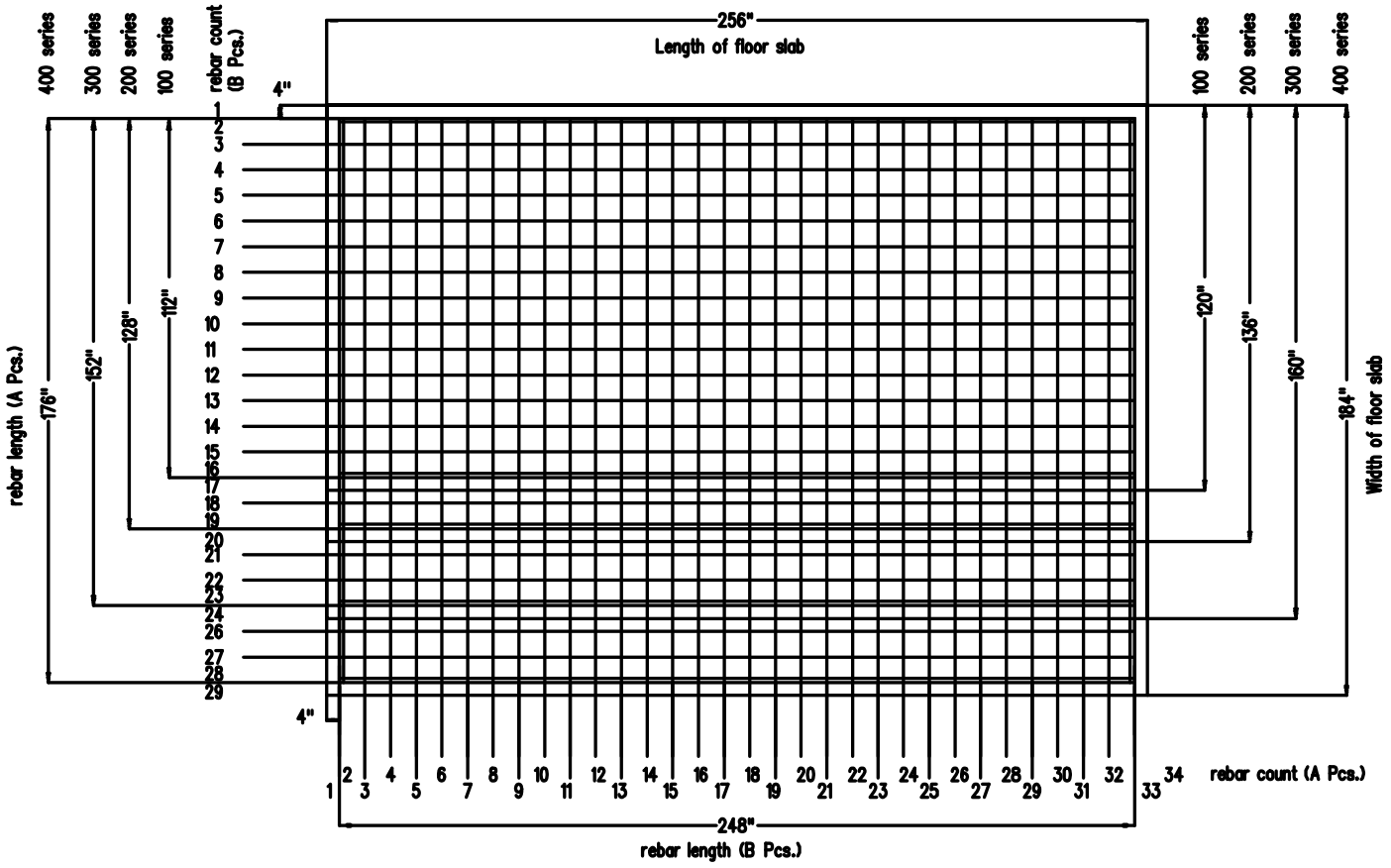


Figure C-2
Floor slab horizontal rebar placement

Floor slab vertical rebar placement

Ensure that the exposed vertical rebar studs are properly located to extend up into the center of the blocks.

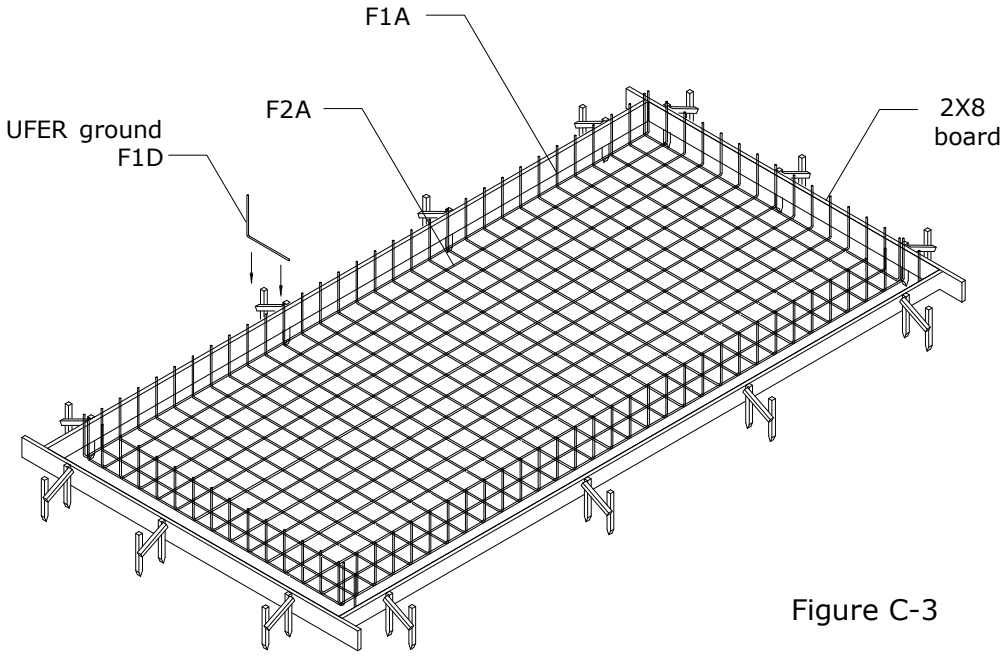


Figure C-3

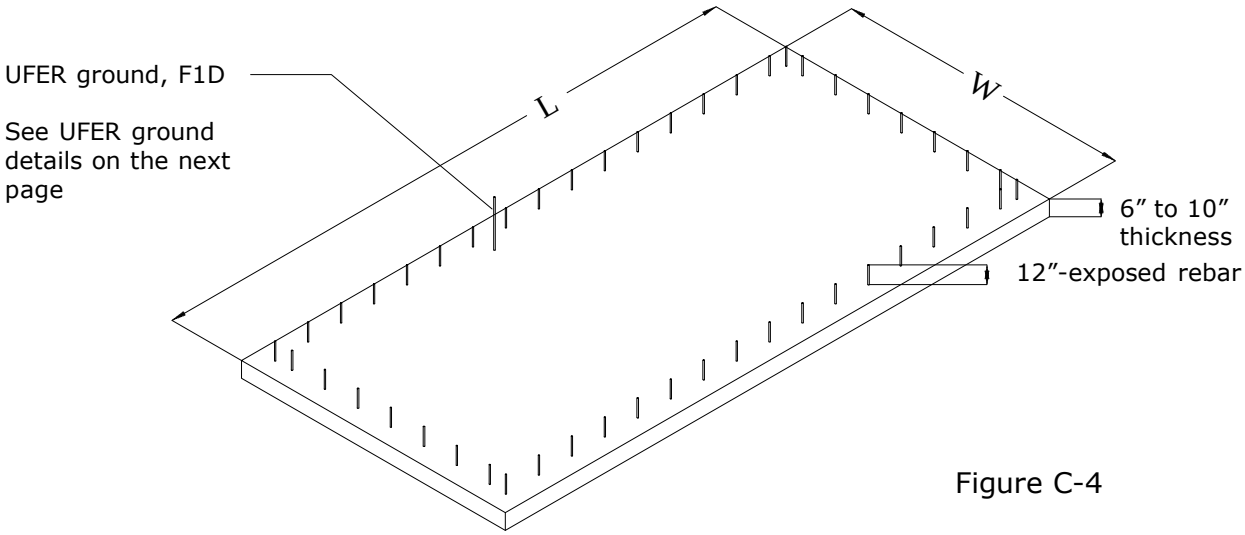


Figure C-4

Shelter grounding system

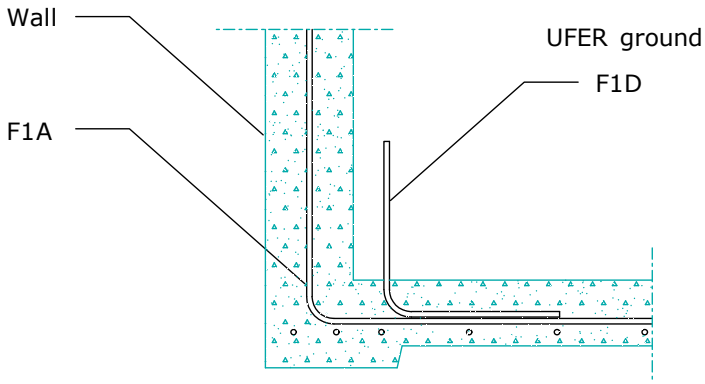


Figure C-5

This shelter kit utilizes the Ufer Ground.
The Ufer Ground is an electrical earth grounding method named after Herbert Ufer. It is a concrete encased ground electrode. It is installed by connecting the ground wire to the rebar in foundation concrete. Proper grounding is essential to comply with NEMA code and mitigate the effects of electromagnetic pulses (EMP).

A piece of bent rebar is attached to one of the F1A rebar pieces with wire ties. Place this Ufer ground rod in a location near where you plan on placing the electrical box — see pages 52 and 53.
A grounding wire is connected to the box and this Ufer grounding rod.

The National Electrical Code (NEC) Section 250.52(A) (3) requires the electrical service to be grounded to the footer reinforcing steel. This grounding is known as the Ufer Ground.

This requirement only applies to footers having at least 20 feet continuous ½ inch diameter or larger reinforcing steel.

This NEC requirement began January 1, 2005 for commercial buildings, and May 27, 2006 for residential buildings.

1) The contractor shall use a standard electrical ground rod or ½ inch or larger reinforcing steel rated for external use such as but not limited to (galvanized rod).

Standard steel reinforcing rod wrapped with metallic tape will not be accepted. This ground rod or reinforcing steel shall be wire tied to the 20 ft of reinforcing steel in the footer with a minimum of two wire ties.

This Ufer Ground can extend beyond the inside or the outside of the footer enough to make a future connection.

The building inspectors shall mark the location of the Ufer Ground on the approved set of plans, and sign building card under UFER GROUND heading.

2) Ufer Ground extensions installed toward the inside of the footer shall be long enough to go above the finished floor.

Constructing the walls

After the floor slab has cured for at least seven days, the walls are built from industry standard concrete 8 x 8 x 16 inch 1,000 PSI two hole blocks using a 3/8 inch mortar bead. The completed wall assembly is 88 inches and 11 courses high. See section B for the block counts.

Horizontal rebar is laid in every other layer. Course 1 (shown below) is standard block. Course 2 (shown below) is the horizontal rebar bond course, see fig D-3 below. All rebar connections and intersections must be properly tied with two ties at least 12 inches apart. Vertical rebar pieces are placed in the wall at the time of the ceiling kit assembly. See the rebar cut and forming chart in the reference section at the end of this manual for dimensions of the rebar shown below.

The corner blocks on course 2 (the rebar courses shown below) are made from regular blocks so the ends of the rebar channels are not exposed.

If you are installing a 32 x 72 inch blast door in a wall, you will need 8 half blocks that can be made from regular blocks.

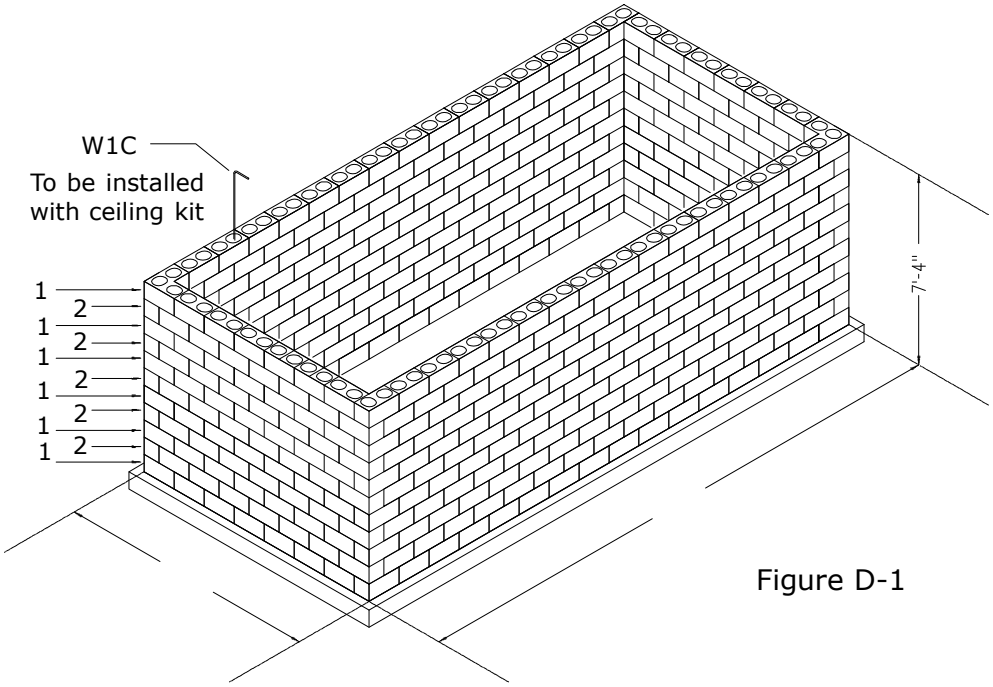


Figure D-1

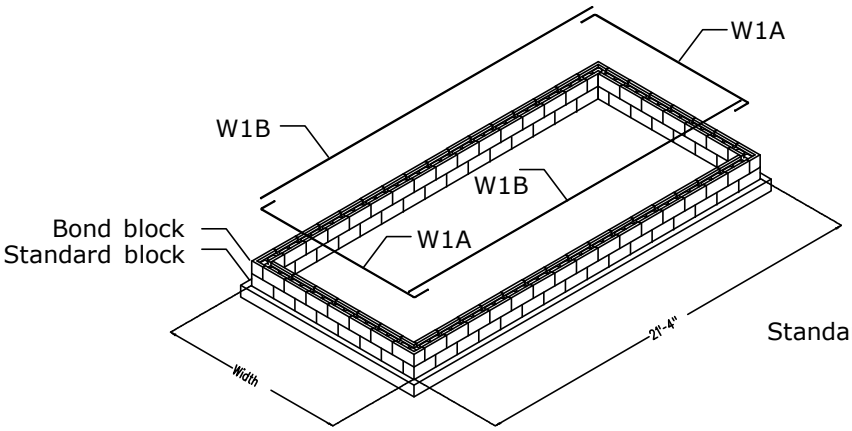


Figure D-2

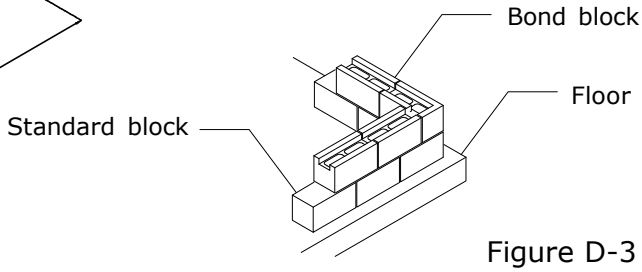


Figure D-3

Ceiling truss overview

The ceiling trusses are set on the tops of the walls. There are standard trusses and riser trusses which are shipped assembled as shown below. The standard trusses are shipped and installed individually. The riser trusses are shipped and installed as a pair (shown below). They are designed to reinforce the structure under the riser hatch. If no riser hatch is installed, standard trusses are used for the entire ceiling.

Place and center the riser truss pair (T-2) as shown below and on the next page.

Place and center the remaining five standard trusses (T-1) as shown below and on the next page.

All trusses are centered over block pairs as shown in figures E-2 and GE-3 and centered between the walls as shown in figure E-4, leaving room for the ceiling perimeter form boards.

> **Caution —** The ceiling trusses and riser assembly are heavy and require the use of heavy lifting equipment and qualified operators. The proper equipment should be used for every operation.

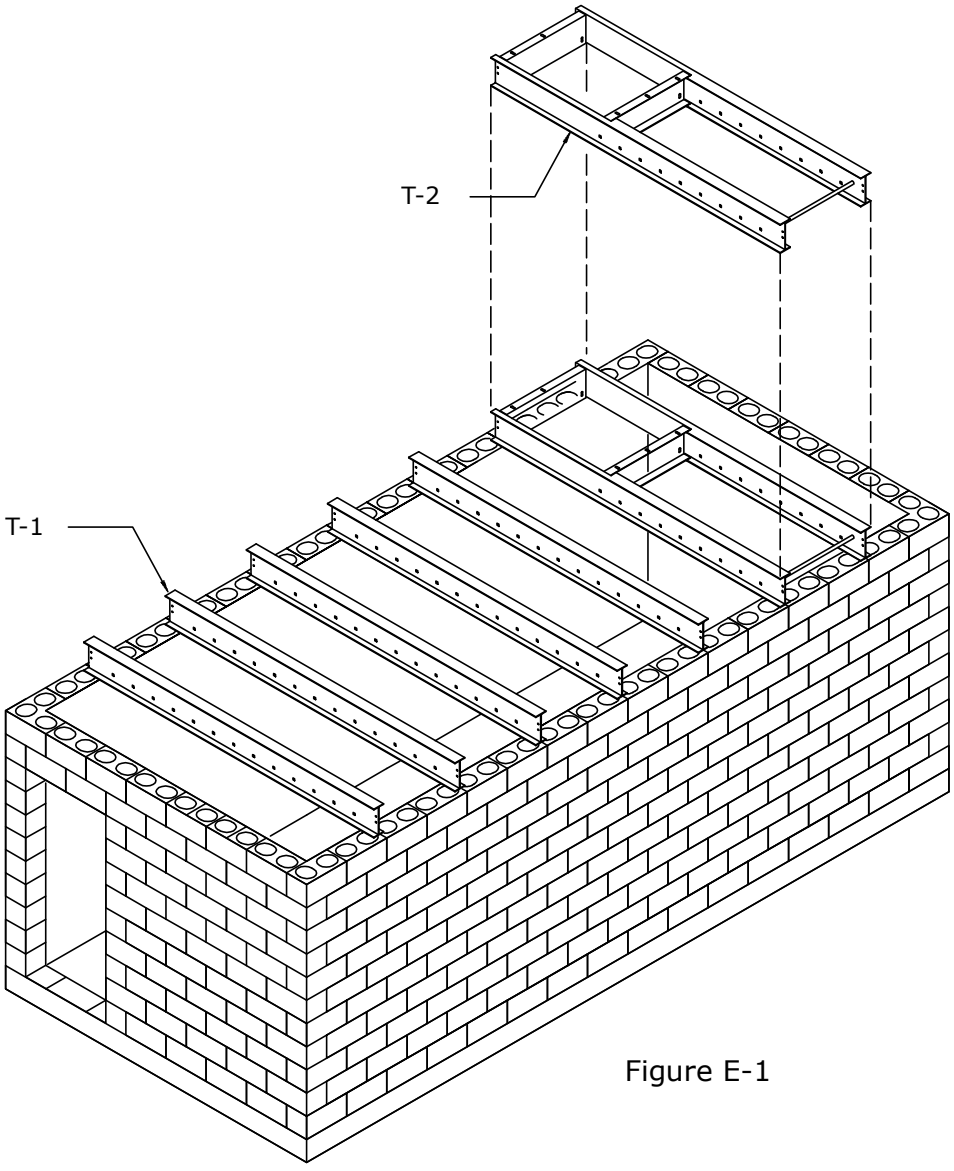


Figure E-1

Ceiling trusses — setting and centering

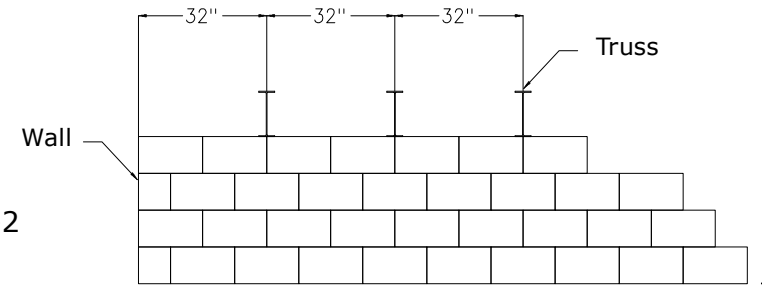


Figure E-2

Side (elevation) view — all trusses are located on 32” centers

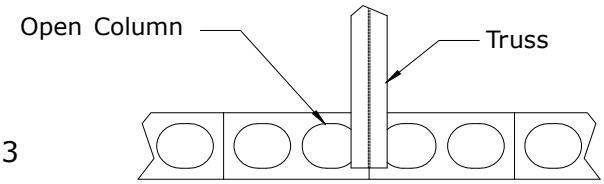


Figure E-3

Top (plan) view — all truss centers fall between the vertical columns in the block

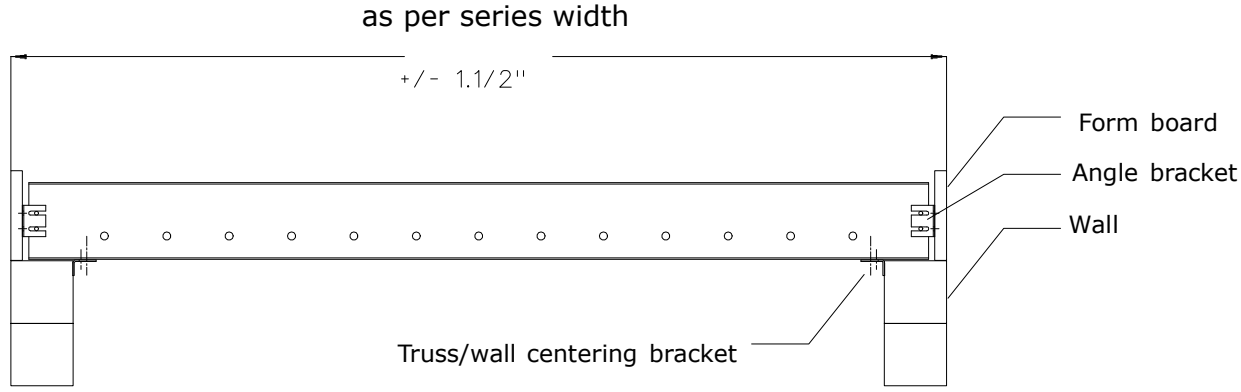


Figure E-4

End view — all trusses are centered on their long axis as shown above

Ceiling form boards overview

Once the trusses are set, the perimeter form boards for the ceiling are cut and placed around the trusses.

Then the bottom form boards are cut and placed between the bottom flanges of the trusses.

The form boards are to be supplied by the concrete contractor and made up onsite from $1^{1}/_{8}$ thick CDX plywood.

All finished form boards should be painted with a weather proof primer before the concrete pour.

Caution — the form system is designed to carry the wet pour load, if the pour thicknesses in this manual are exceeded, the forms may fail, allowing the ceiling concrete drop down onto the floor slab.

There are 3 types of form boards.

1. The long side form boards are cut in two different heights to accommodate the required roof drainage slope of ¼" per foot. The high side is placed on the hatch-riser side of the roof.

2. The short end forms are taper cut to properly fit the side forms difference of ¼" per ft. The end boards are not installed until placement of the longitudinal rebar.

3. The bottom form boards are cut to 30.3/4" widths to nest between the trusses, and made up in rows in sufficient lengths to be 4-inches longer than the inside shelter width, as not to cover the block openings. If the block openings are covered, the walls cannot be filled with concrete during the ceiling pour. See figure F-8 on page 30.

Dimensions of form boards

100 Series
10'-0" X 21'-4"
Side perimeter group, see figure F-1
Low side h=12", high side h=14.1/2"

End perimeter group, see figure F-2
h1=12", h2=14.1/2"

End bottom group, see figure F-3
h= 25.1/2", L=108"

Center bottom group, see figure F-4
h=30.3/4", L=108"

200 Series
11'-0" X 21'-4"
Side perimeter group, see figure F-1
Low side h=14", high side h=17"

End perimeter group, see figure F-2
h1=14", h2=17"

End bottom group, see figure F-3.
h= 25.1/2", L=124"

Center bottom group, see figure F-4
h=30.3/4", L=124"

300 Series
13'-4" X 21'-4"
Side perimeter group, see figure F-1
Low side h=16", high side h=19.1/4"

End perimeter group, see figure F-2
h1=16", h2=19.1/4"

End bottom group, see figure F-3
h= 25.1/2", L=148"

Center bottom group, see figure F-4
h=30.3/4", L=148"

400 Series
15'-4" X 21'-4"
Side perimeter group, see figure F-1
Low side h=17.3/4", high side h=21.1/2"

End perimeter group, see figure F-2
h1=17.3/4", h2=21.1/2"

End bottom group, see figure F-3
h= 25.1/2", L=172"

Center bottom group, see figure F-4
h=30.3/4", L=172"

Ceiling form boards — dimension drawings and quantities

Reference the dimensions on the previous page

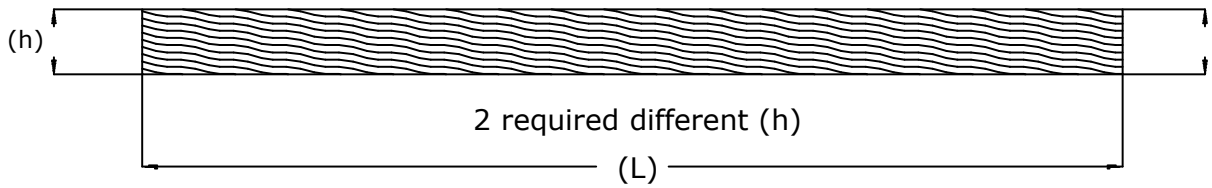
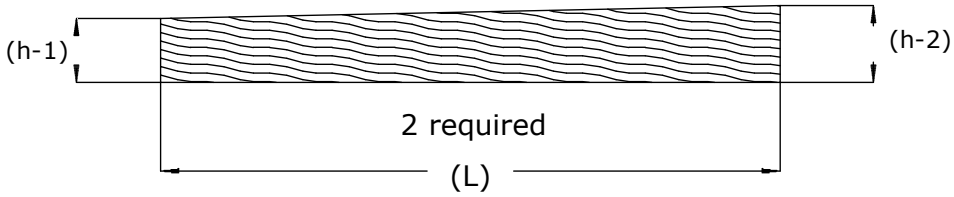


Figure F-1
Side perimeter
form boards

Figure F-2
End perimeter
form boards



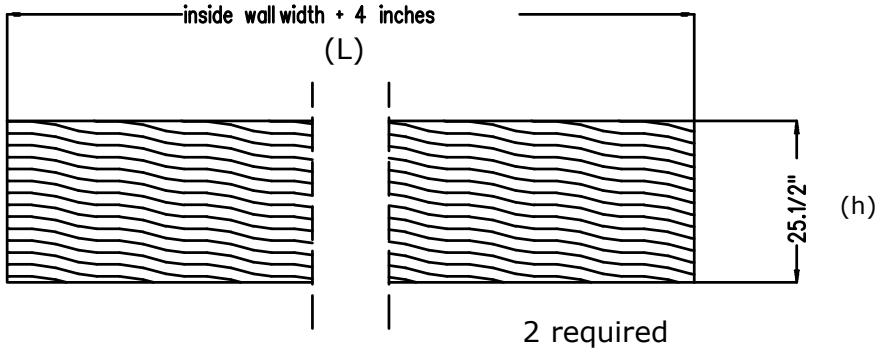


Figure F-3
End bottom
form boards

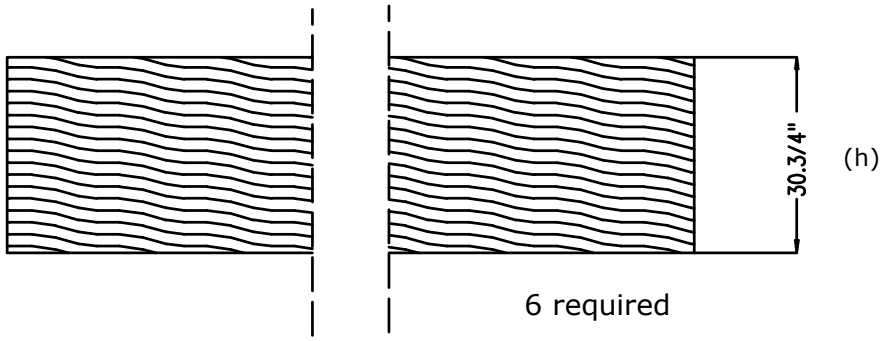


Figure F-4
Center bottom
form boards

Ceiling form boards — installing the long perimeter form boards

The perimeter side boards serve two functions, first to secure the trusses from movement along the long axis of the shelter and secondly to provide the perimeter form for the poured concrete ceiling.

> **Caution —** it is critical that the distance between the truss centers on **both ends** of the trusses is correct as per figures E-3 and E-4.

Using the fasteners provided with your truss kit:

1. Install all board brackets to the ends of the centered trusses as shown in fig. F-6, and F-7 but do not yet tighten the board bracket securely to the truss.
2. Set the long form boards on top of the wall and against the face of the board brackets as shown in figure F-7.
3. Using the board brackets as a template, mark and drill the 3/8-inch holes for the perimeter long form board bolts, and fasten the long form boards to the brackets.
4. Adjust the long perimeter form boards so that the outside face of the board is flush with the outside face of the wall, and tighten the board bracket truss bolts, as per figure F-7.

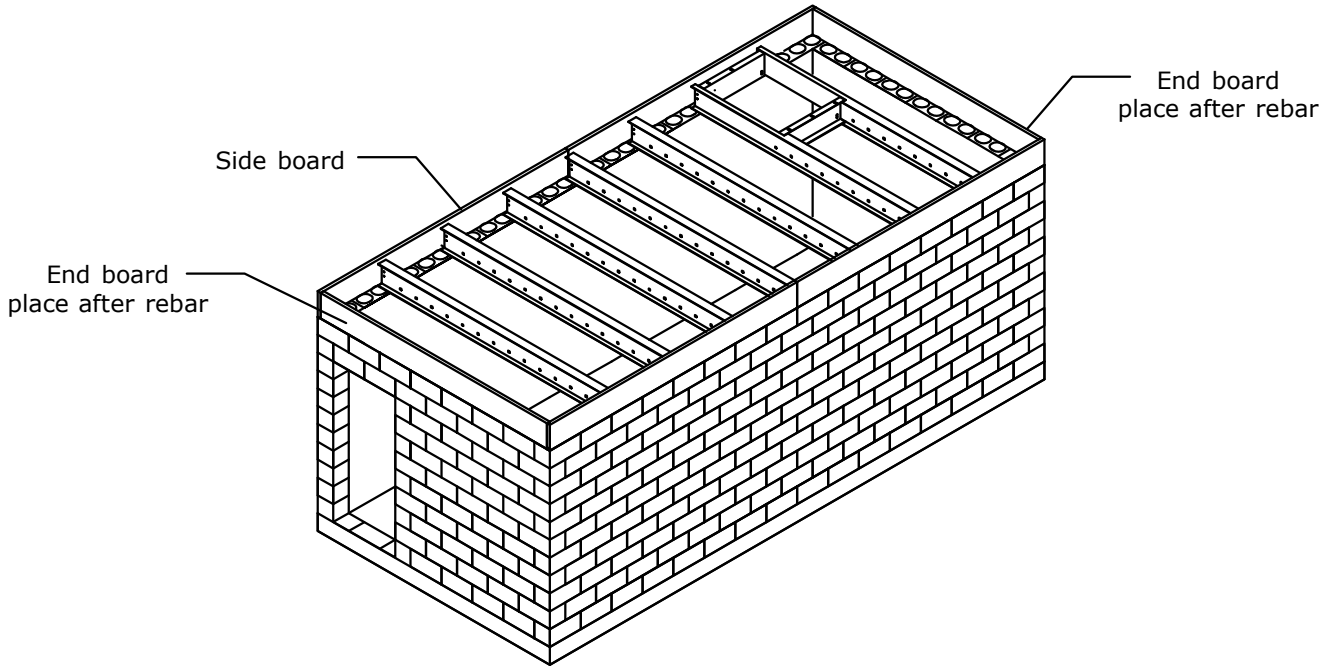


Figure
F-5

Ceiling form boards — installing the short perimeter form boards

1. Install the two short form boards over the end walls with the outside face of the board flush with the outside face of the wall just as the long form boards.
2. Use the corner board brackets as a drill template and fasten the corners with the provided bolts.

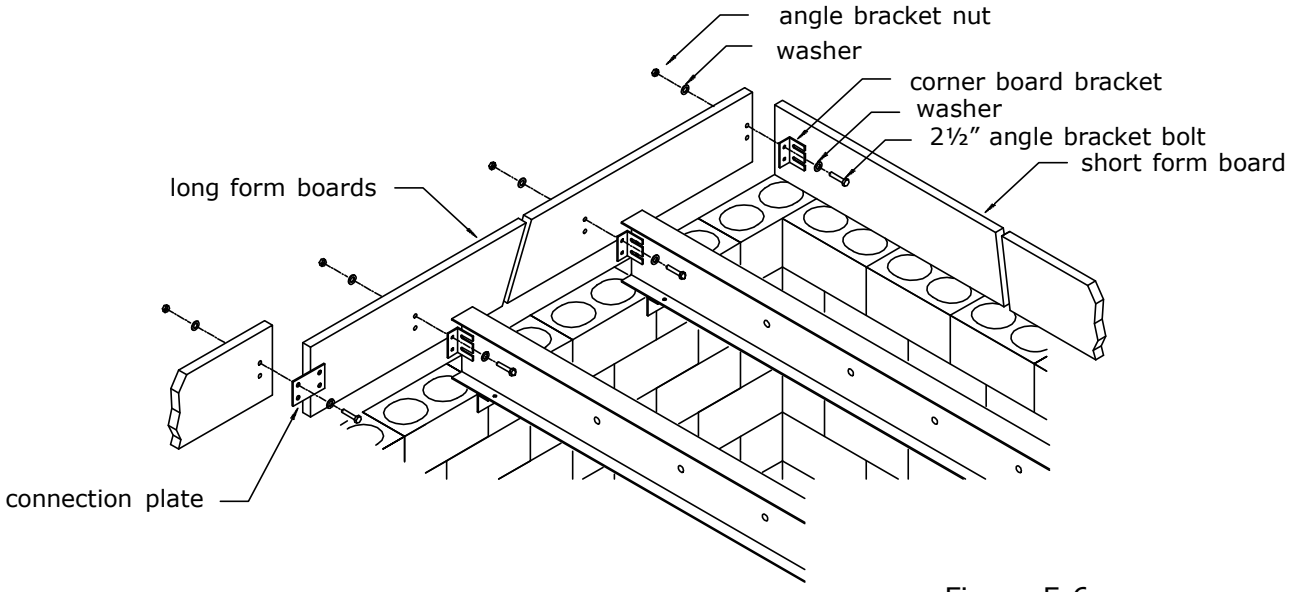


Figure F-6

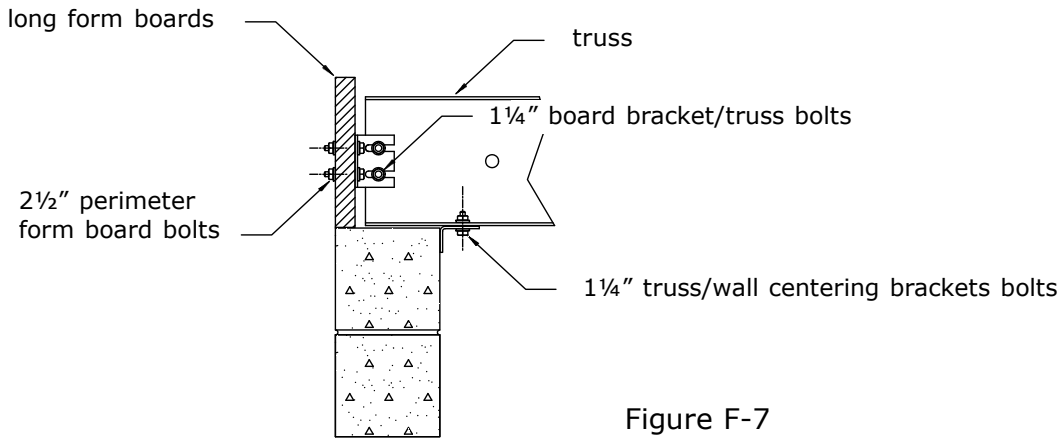


Figure F-7

Ceiling form boards — installing the bottom form boards

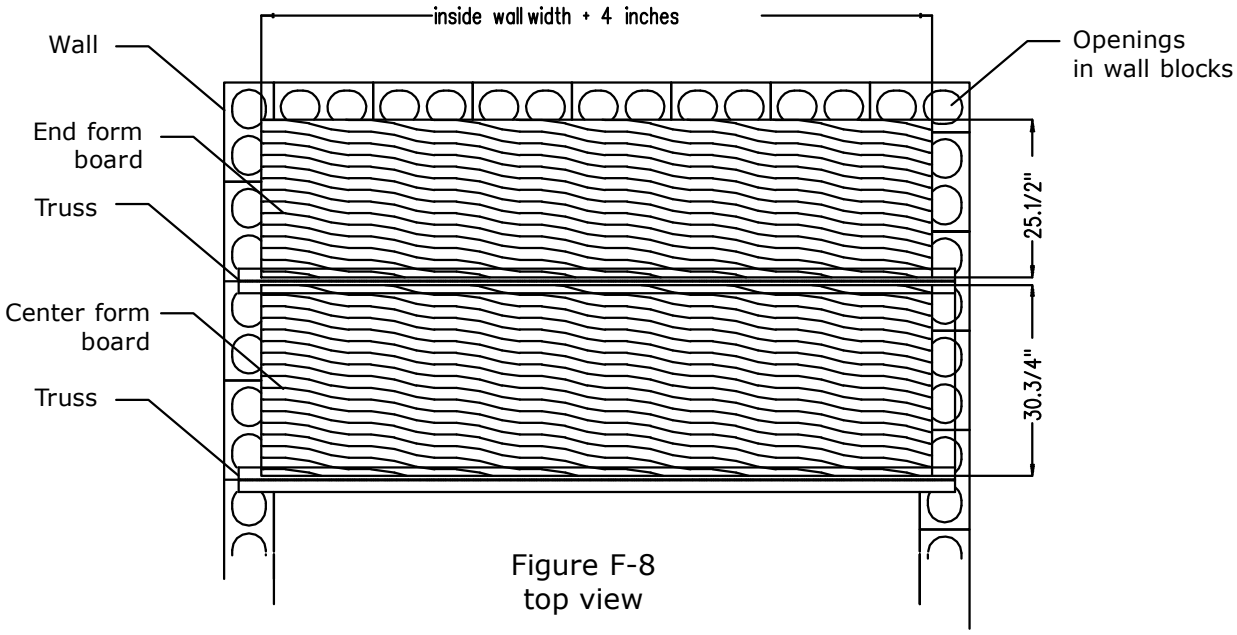


Figure F-8
top view

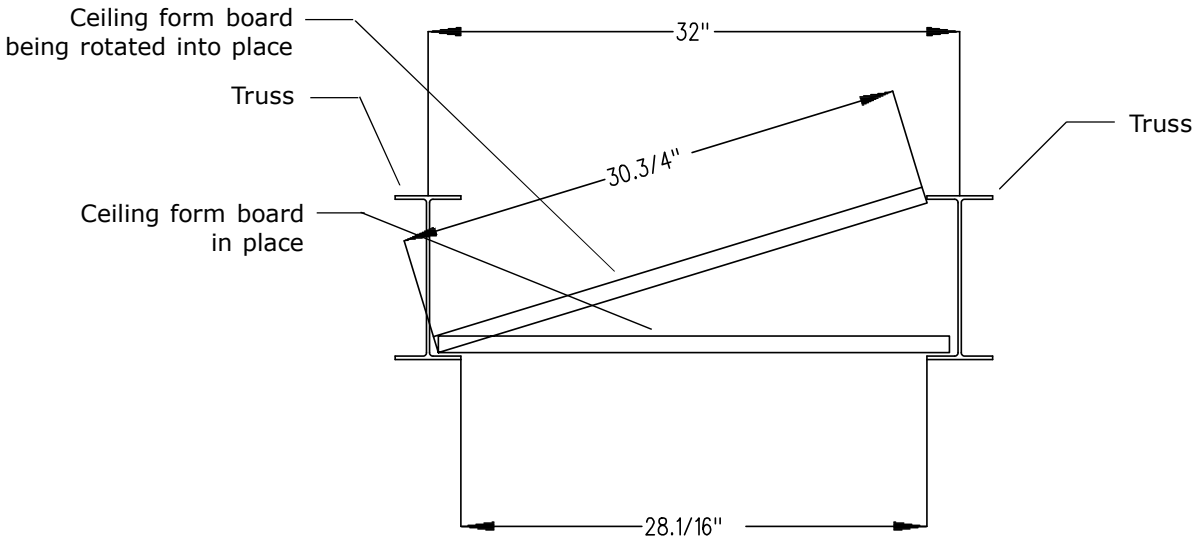


Figure F-9
side view

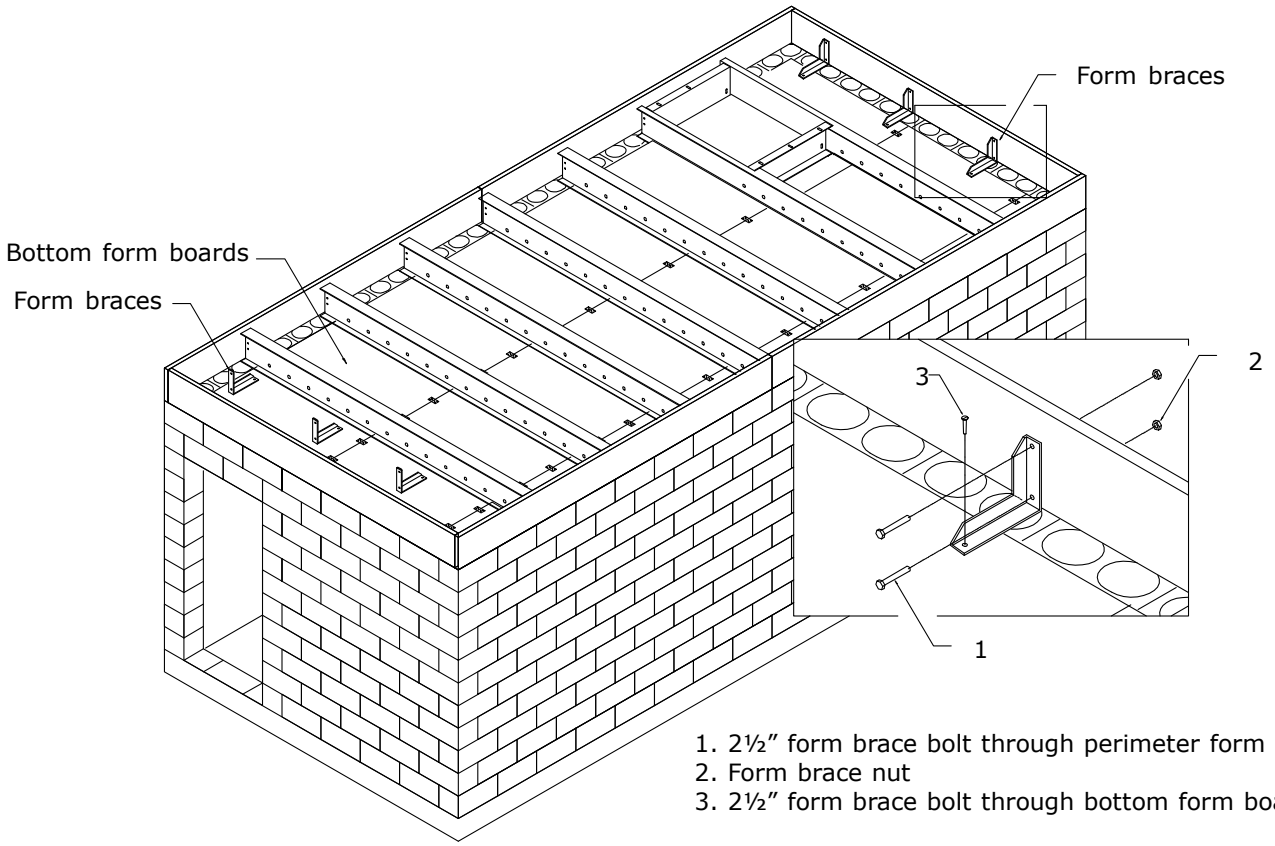
Ceiling form boards — securing the perimeter boards

It is necessary to secure the perimeter side boards to the bottom boards to insure that they do not bulge or bow during the pour.

Using the form brace as a template, mark and drill bolt locations for fasteners 1 and 2, and then install fasteners.

Using a power screwdriver mark and drill bolt locations for fasteners 3, and then install fasteners.

Using a good caulking compound, seal any gaps or openings around the trusses and wall edges.



1. 2½” form brace bolt through perimeter form board
2. Form brace nut
3. 2½” form brace bolt through bottom form board

Figure F-10

Ceiling penetration kits overview

There are four individual penetration kits.

They are designed for quick and simple installation through the bottom concrete form board before the pouring of the concrete.

1. Electrical 1-inch, figure G-2.
2. Water 1-inch, figure G-3.
3. Waste (septic) water 2-inch, figure G-4.
4. Air ventilation 4-inch, figure G-5.

The bulkhead connection kits work by capturing both sides of the bottom form board by sandwiching or clamping the board between the upper and lower elements of the kit.

Place the kit gasket at the desired penetration location and use as hole template for drilling through the form board.

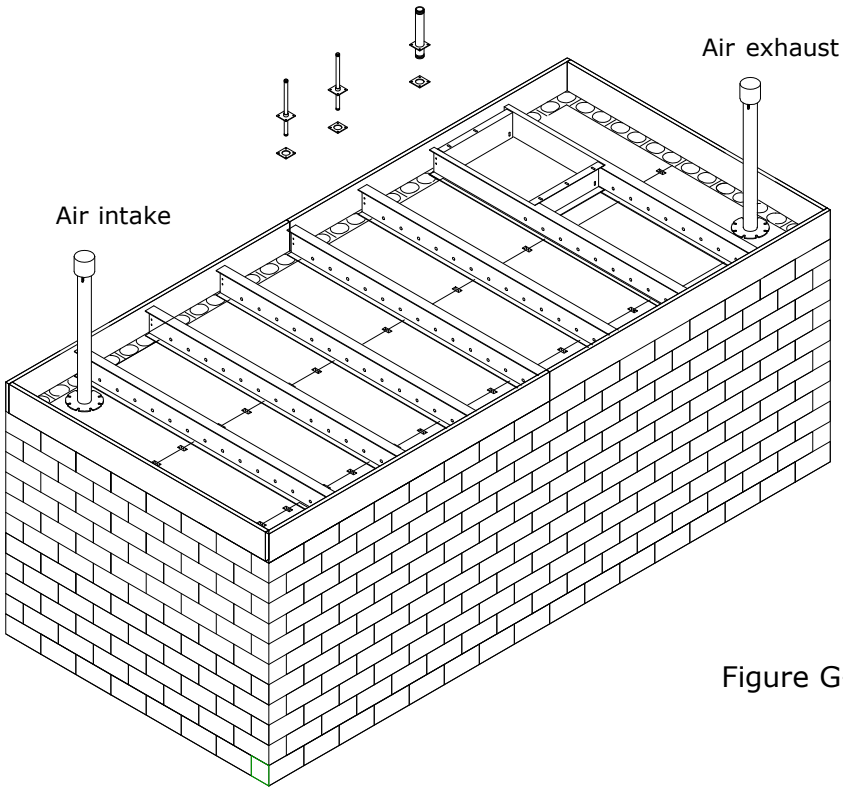


Figure G-1

Ceiling penetrations - electrical, water, and waste water

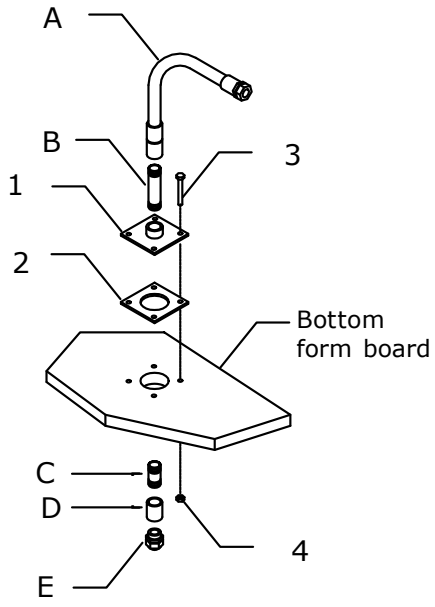


Figure G-2
Electrical penetration

1. Mounting plate
2. Gasket
3. ¼"-20 x 2-inch length bolt – 4 each
4. Hex nut ¼"-20 – 4 each

A. Conduit 90 – 1 each
B. Close nipple 1" x 3" – 1 each
C. Close nipple 1" x 1" – 1 each
D. Coupling 1" female/female – 1 each
E. Adaptor – 1 each

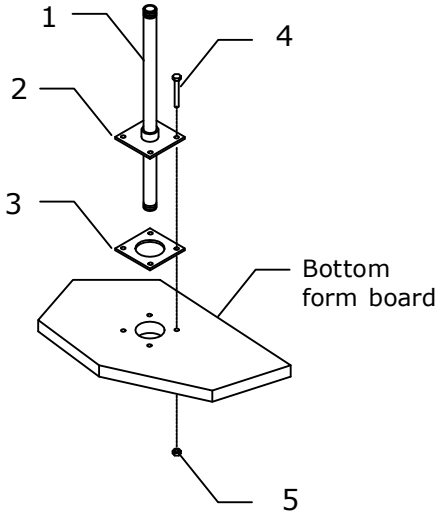


Figure G-3
Water penetration

1. 1½" x 20" pipe nipple
2. Mounting plate
3. Gasket
4. ¼"-20 bolts – 4 each
5. ¼"-20 nuts – 4 each

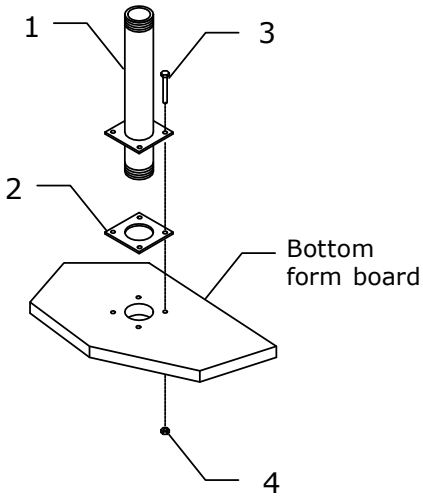


Figure G-4
Waste water penetration

1. 2" x 20" pipe nipple
2. Gasket
3. ¼"-20 bolts – 4 each
4. ¼"-20 nuts – 4 each

Ceiling penetrations - ventilation pipes and blast valves

The ventilation pipes are bolted down to the bottom form boards before the ceiling pour. The mounting flange for the ventilation pipes exactly matches the mounting flange for the blast valve. These two mounting flanges sandwich a gasket, the bottom form board, and then another gasket as shown below.

Note: this part list is for one ventilation pipe. Two ventilation pipes are required for each shelter for the air intake and the air outflow.

Included with this installation

A. 1 each ceiling style ventilation pipe
G. 1 each rubber gasket
1. 8 each HHCS ½"-13 x 3"
2. 16 each flat washer ½"
3. 8 each hex nut ½"-13

Note: this installation can also be used for steel shelters with flat ceilings.

Installation steps:

1. After the bottom form board of the ceiling is in place, locate and cut a 4½ inch hole where the vent pipe is to be mounted.
2. Using the blast valve as template, locate and drill bolt circle for valve, ½ inch holes in all 8 locations.
3. Using the 8 each ½ inch X 3 inch length bolts, sandwich the assembly together as shown in figure G-5.

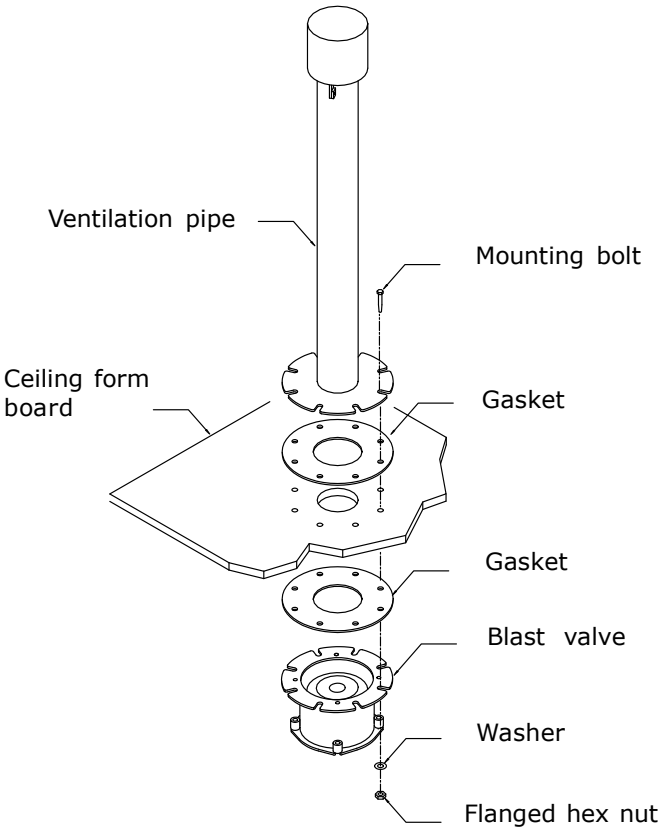


Figure G-5
Detail of pipe system

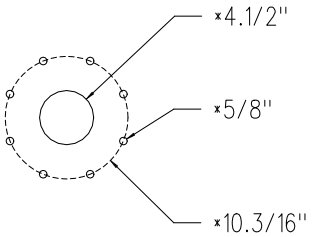


Figure G-6
Mounting bolt pattern and dimensions

Ceiling — rebar layout

The rebar is laid down as shown below.

For length information see the rebar cut and forming chart on page 57.

> **Note —** all rebar connections and intersections must be properly tied with at least two ties at least 12 inches apart.

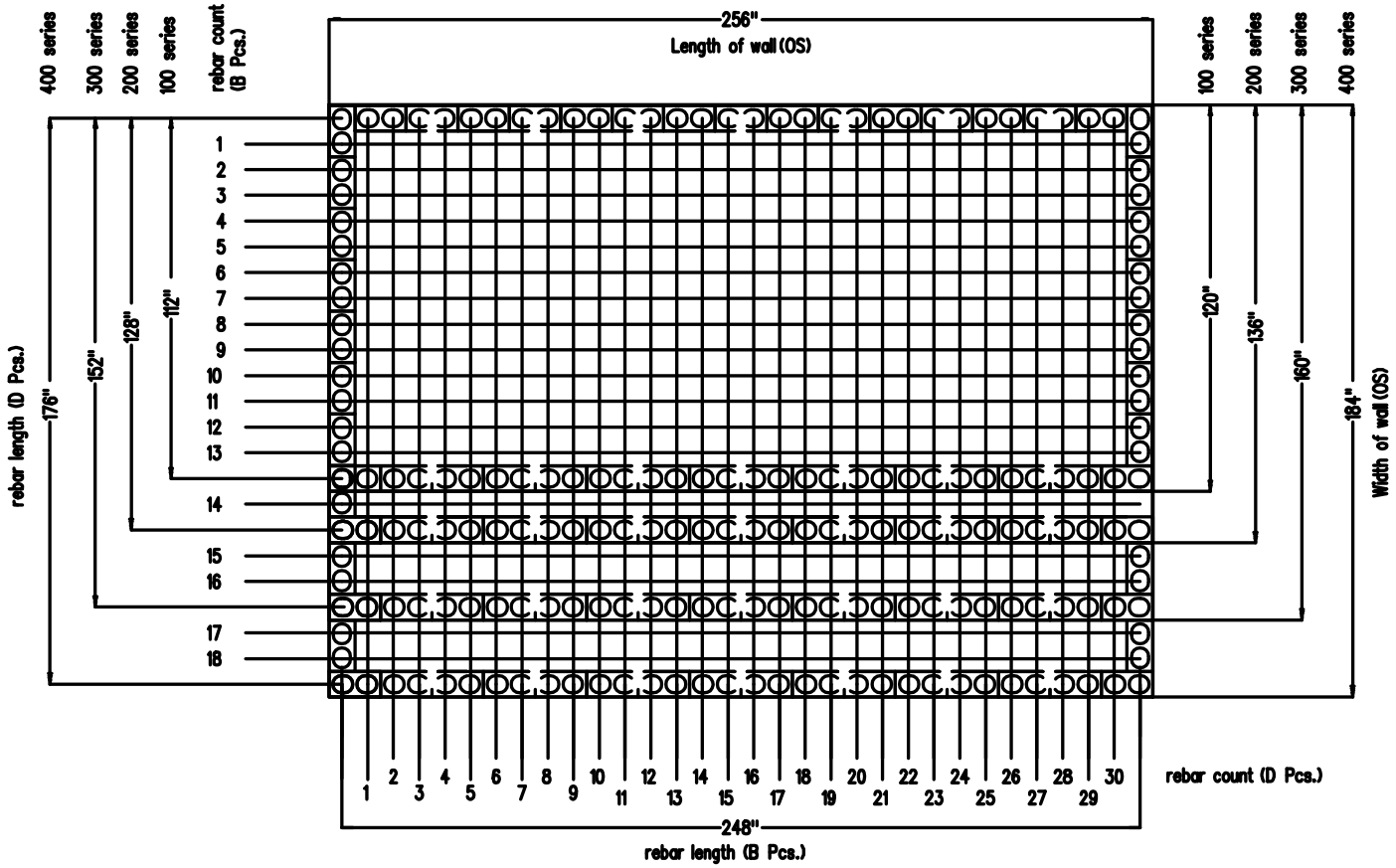


Figure H-1

Ceiling — installing the rebar

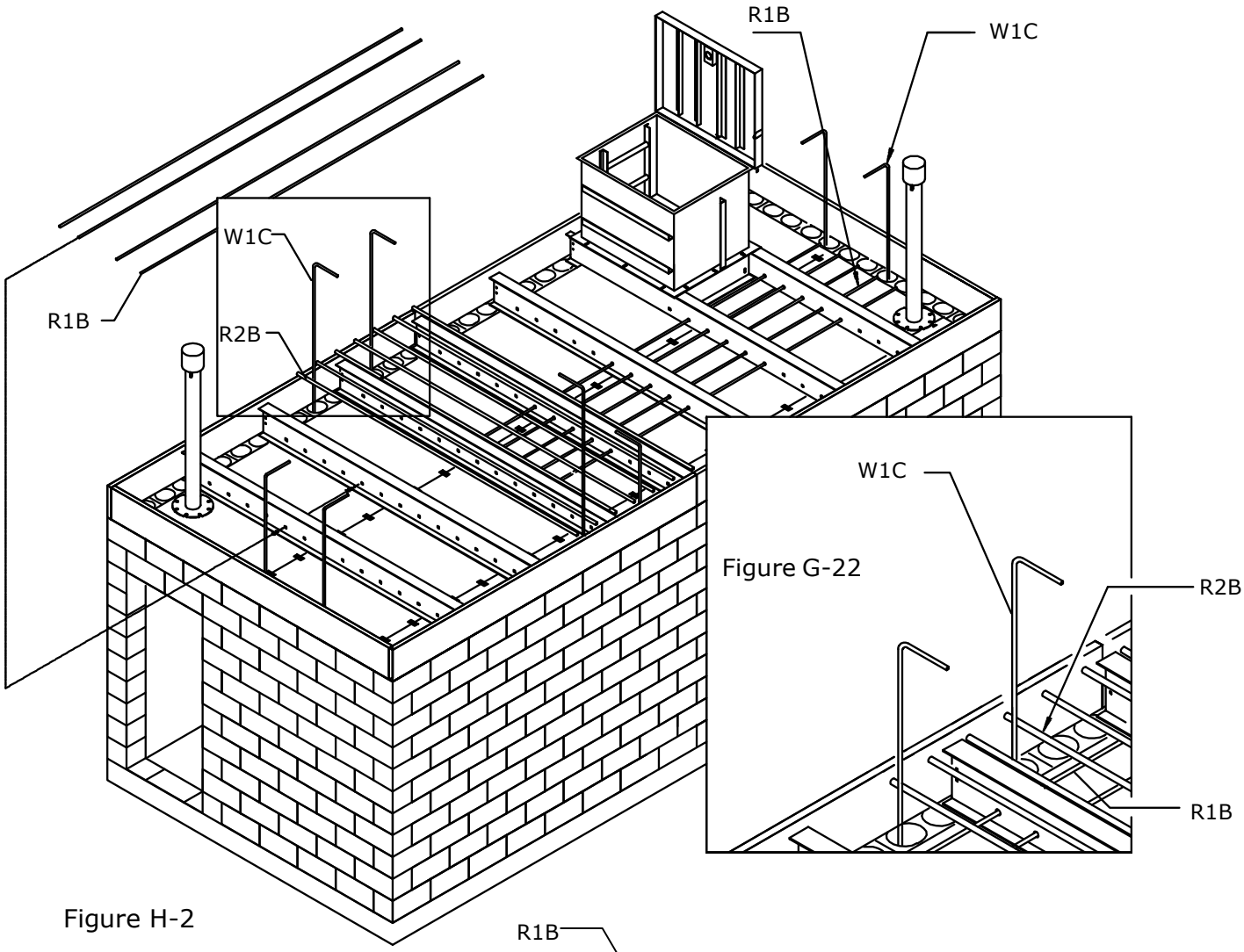


Figure H-2

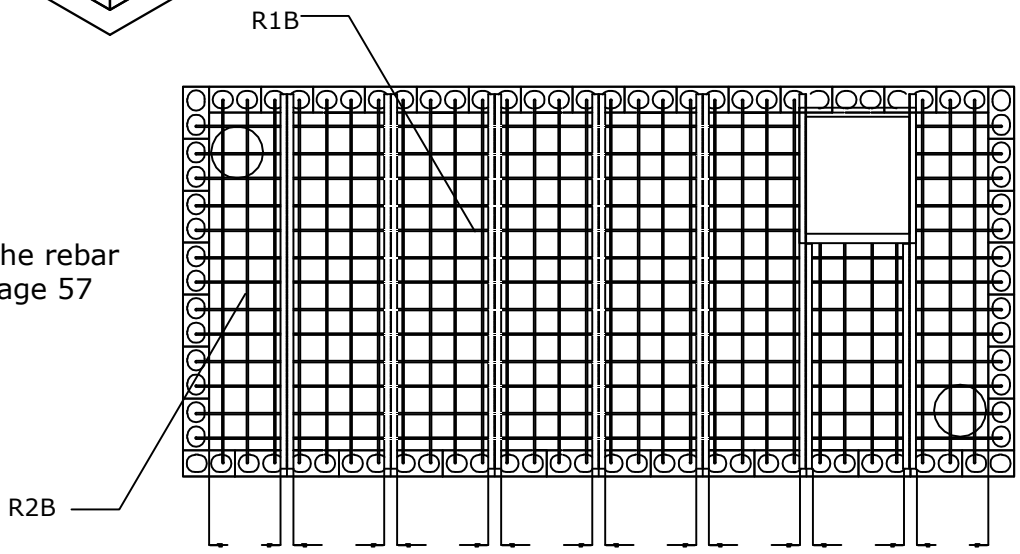


Figure H-3

Note — letters refer to the rebar cut and form chart on page 57

Riser hatch and ladder assemblies

The riser hatch should be installed prior to the ceiling pour.

Caution — the riser hatch and ladder assembly weighs several hundred pounds. It is the responsibility of the installer that proper lifting equipment be used for these procedures and that the installer has sufficient experience skill and knowledge to accomplish these tasks safely.

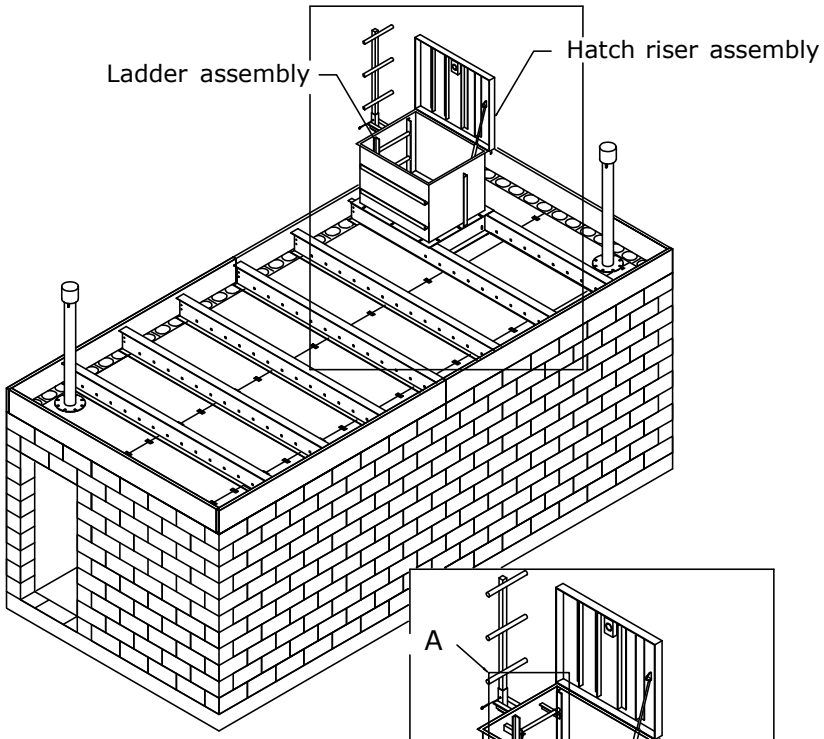


Figure I-1

Hatch riser installation
See figures I-3

Ladder installation
See figures I-5, I-6

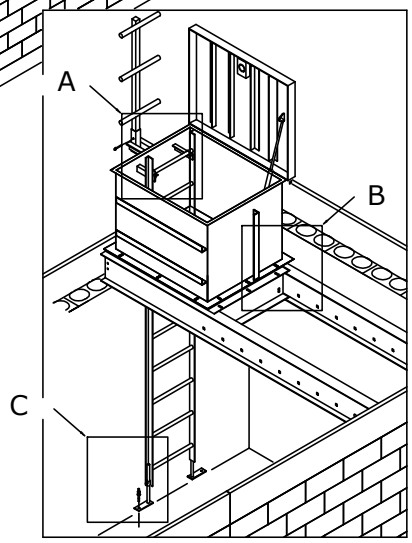


Figure I-2

Mounting the riser on the ceiling trusses

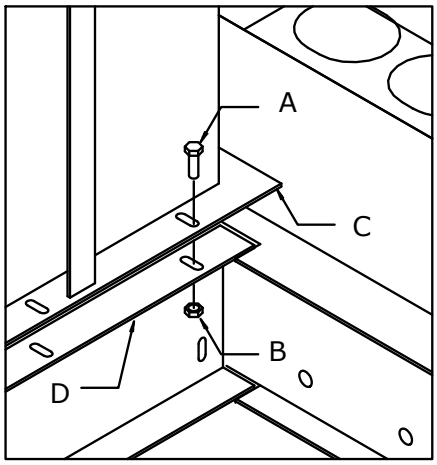


Figure I-3

This installation is for the special riser truss kit, provided with this shelter.

1. Apply a liberal coat of weather resistant silicone sealant over the edges of the openings surface face where the riser mounting flange bottom face will mate.
2. Install and tighten the provided hex bolts, washers and nuts as shown.

A. 12.ea. Bolt 3/8-16 X 1.3/4” lg.
B. 12. ea. Hex nut 3/8-16.
C. Riser mounting flange.
D. Truss mounting flange.

Mounting the riser over conventional concrete openings

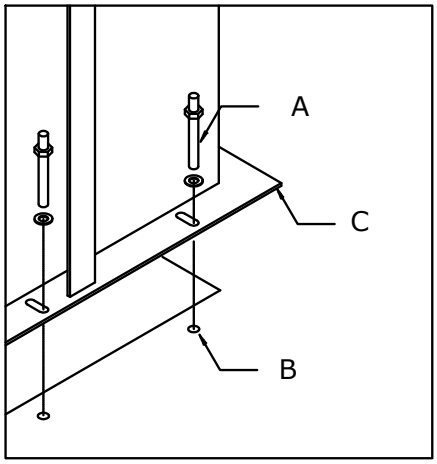


Figure I-4

A. 12.ea. Concrete anchor studs 1/2” X 6” lg.
B. 12. ea. 1/2” drilled hole w/provided drill bit.
C. Riser mounting flange.

Note:
Concrete opening may not exceed 32” X 38”

This procedure will require the concrete stud anchor kit provided with your concrete style riser and ladder kit order.

1. Using the riser base as a temple, locate the drill hole locations for the anchors of the provided stud anchor kit.

2. Remove the riser and drill the holes for the stud anchors.

3. Apply a liberal coat of weather resistant silicone sealant over the edges of the openings surface face where the riser mounting flange bottom face will mate.

4. Replace the riser assembly squarely over the opening and insert the stud anchor assemblies through the riser bottom flange into the drilled hole in the concrete.

5. Tighten all anchor stud nuts to (60 ft-lbs) in a cross pattern.

Ladder assembly — installation

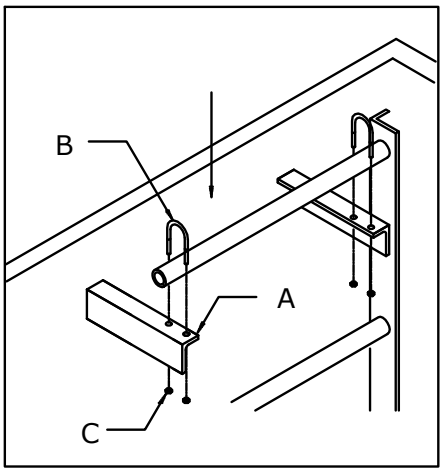


Figure I-5

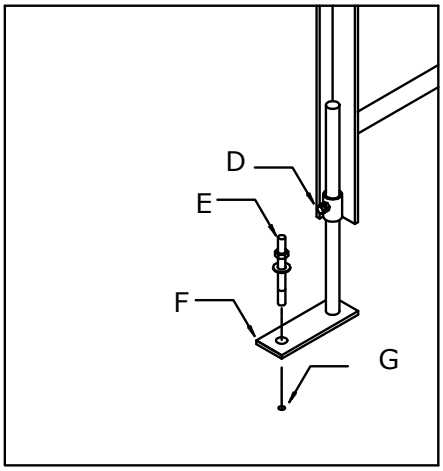


Figure I-6

1. Pass the ladder down through the riser opening and rest the second rung on the top support brackets as shown.

2. Insert the provided U-bolts over the ladder rung into and through the support bracket holes and install and tighten provided hex nuts.

3. With the ladder hanging straight loosen the bottom foot locking bolt and lower the mounting foot to the floor and retighten the locking bolt, repeat this procedure for the opposite side.

4. Insure that the ladder is positioned in a true vertical attitude and using the foot as a drill template install the provided anchor stud kit using the same procedure as described above.

A. 2 ea. Support bracket

B. 2 ea. U-bolt

C. 4 ea. Hex nuts

D. 2 ea. Locking bolt

E. 2 ea. Concrete anchor stud

F. 2 ea. Drilled hole w/provided bit

Pouring the ceiling and wall concrete

The block wall cavities and the ceiling are poured as single "pour." More than one truck load of concrete may be required. See the concrete requirements on pages 10, 12, 14, and 16. Add the requirements for the walls and ceiling together when ordering the concrete. All concrete is minimum 4,000 psi strength, ¾-inch minus aggregate, and a 5-inch to 6-inch slump.

A concrete pump is required. Fill the block cavities first, then the ceiling slab. Tamp the concrete down into the block cavities and finish the ceiling slab with a trowel or broom using the proper slope and expansion grooves shown below and on the following page.

Note:
Be sure and order extra concrete. The truck may be short, the ground uneven below the floor slab, or the blocks you use may have larger cavities. It is standard practice to order 10% extra.

Roof expansion groove detail

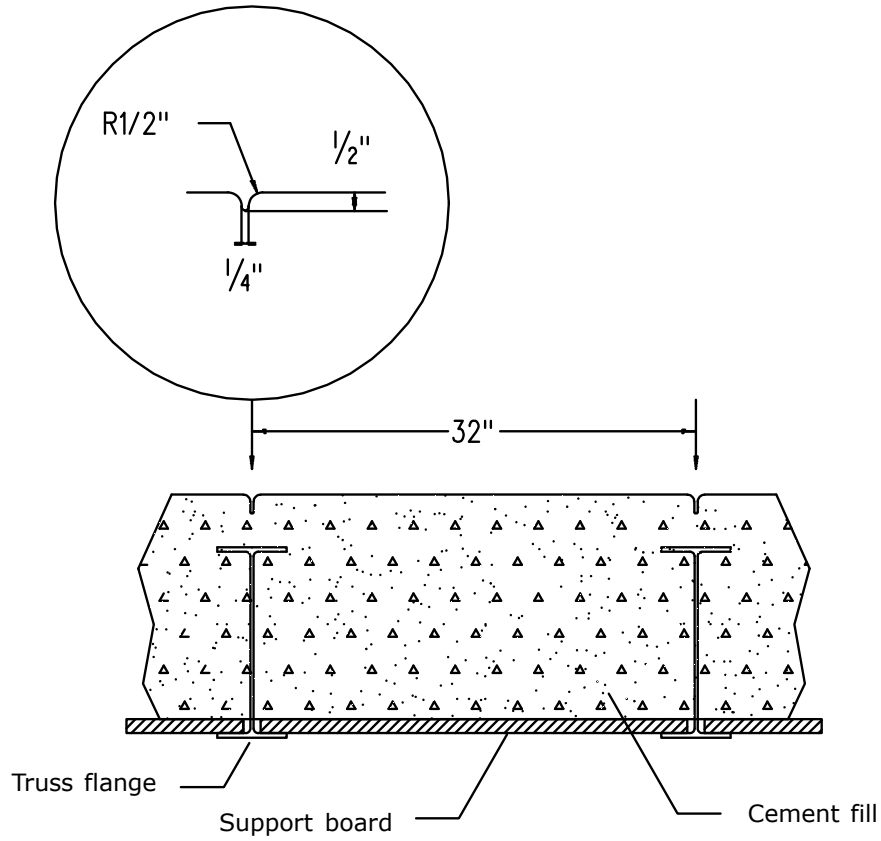
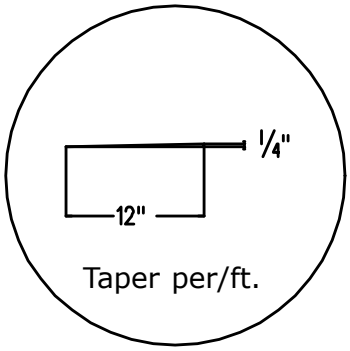


Figure J-1

To avoid excessive fractures in the roof slab, the installation of an expansion groove is recommended.

Ceiling slab slope

These drawings show the end elevation view



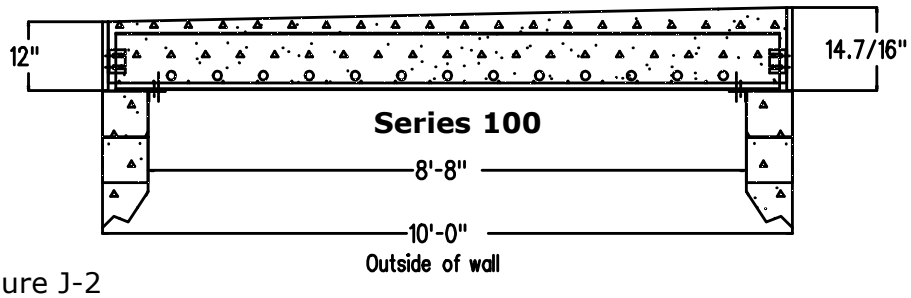


Figure J-2

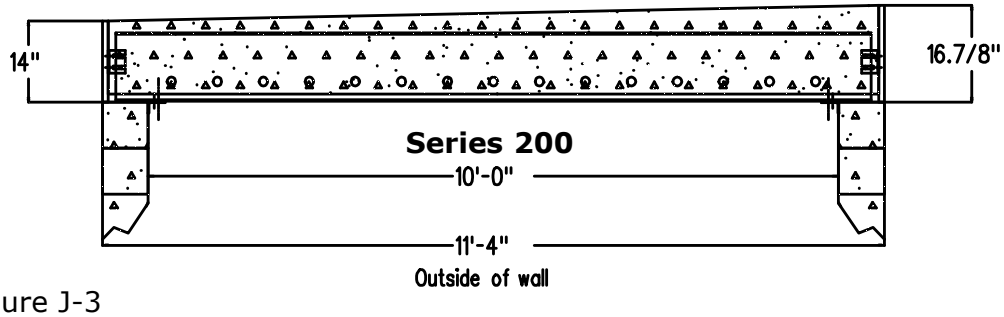


Figure J-3

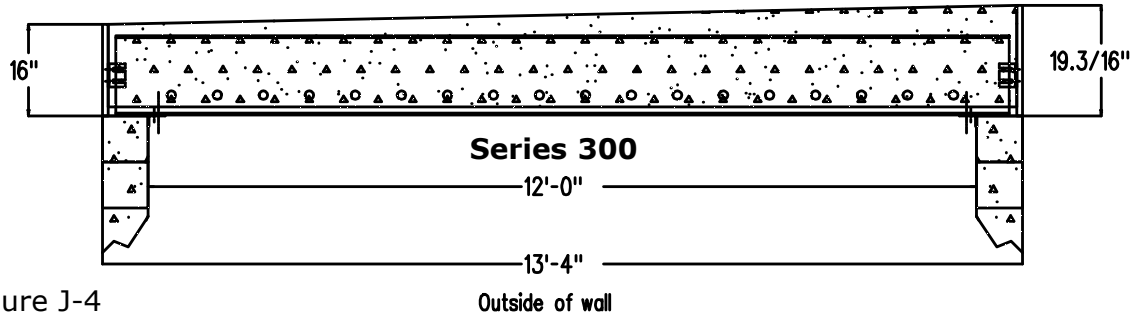


Figure J-4

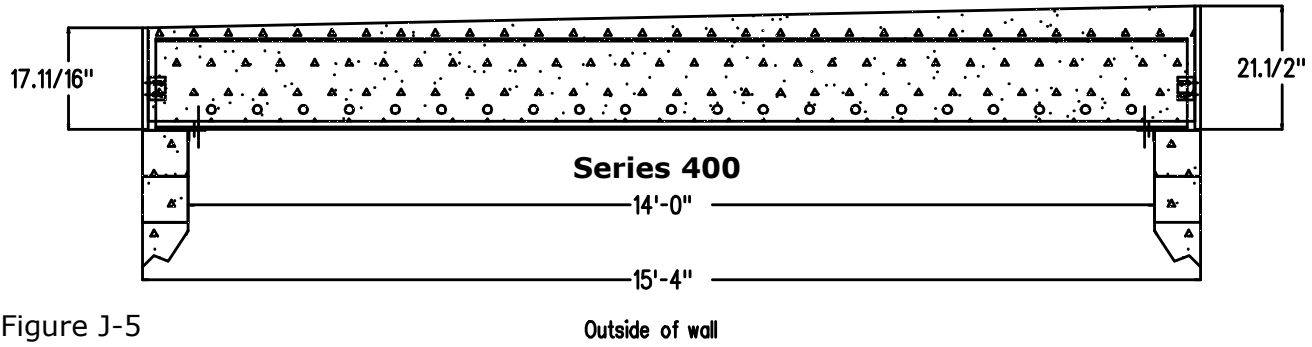


Figure J-5

Exterior sealant

The recommended sealant is Ames Blue Max Liquid Rubber Coating. It can be purchased at this website: www.AmesResearch.com/bluemax.htm

The manufacturer's recommended application:

> "Apply Ames' Blue Max to the surface. We recommend two gallons per 100 sq. ft. or two coats as needed for walls, and three gallons per 100 sq. ft. or three coats for cisterns and tanks, or as needed."

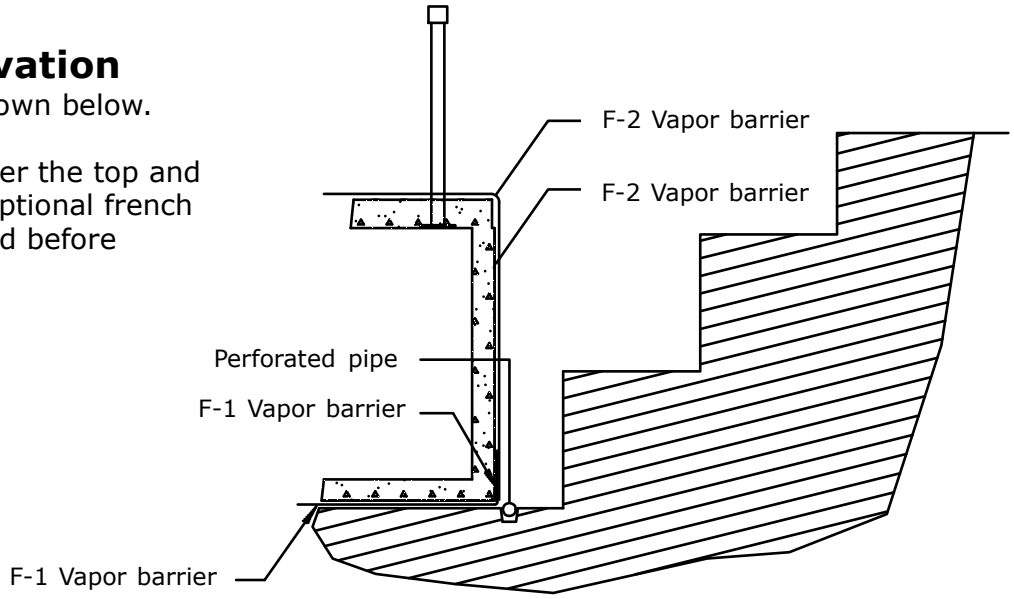
See the outside square footage dimensions listed on pages 10, 12, 14, and 16 to determine how much sealant you need to order.

Follow the manufacturer's recommendation for application.

Back filling the excavation

The shelter is back filled as shown below.

A 6-mil vapor barrier is laid over the top and extends down the sides. The optional french drains system must be installed before backfilling.



Wrap F-1 vapor barrier up side under F-2 vapor barrier

Figure K-1

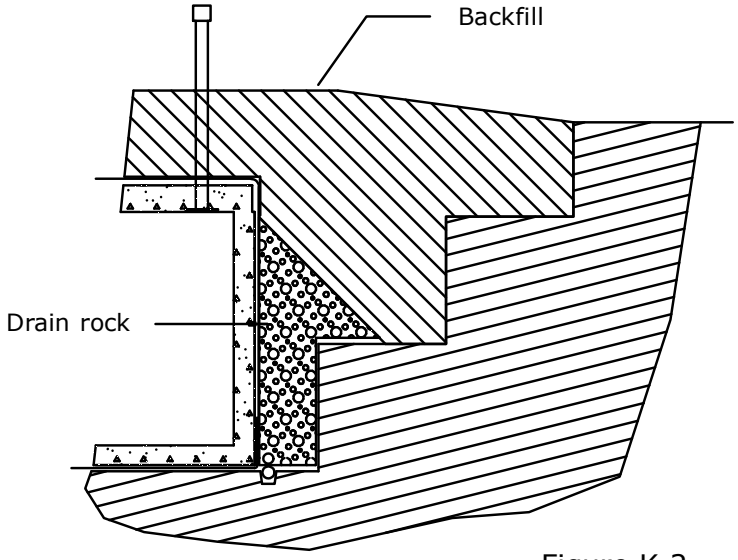


Figure K-2

NBC air filtration system overview

The shelter air filtration system is divided into two groups, the intake group for drawing outside air into the NBC filtration unit, and the outflow group for expelling the CO^2 laden air out.
This arrangement provides for true positive pressure air filtration.

AC electrical power
Connect the power cord to the control panel power socket and plug into a working power source (electrical outlet). Switch on the lighted main power switch on the front control panel.

Automatic battery back up
Connect the 12-VDC cable connector to the control panel socket and connect the clip leads (jumper cable style clips) to a user supplied 12-volt DC automotive or marine type battery — ensure that the polarity is correct; red is positive, black is negative.

For more detailed information regarding the components comprising this system, you may refer to the individual technical manuals available at www.AmericanBombShelter.com:

1. TM-50-VP, blast resistant ventilation pipes.
2. TM-101-BV, blast valve
3. TM-100-AV-NBC, air filtration system
4. TM-50-BB, emergency hand pump
5. TM-50-OP, overpressure valve
6. ASR-100-AB auxiliary ventilation system
7. TM-05-DPG, differential pressure gauge

NBC air filtration system parts

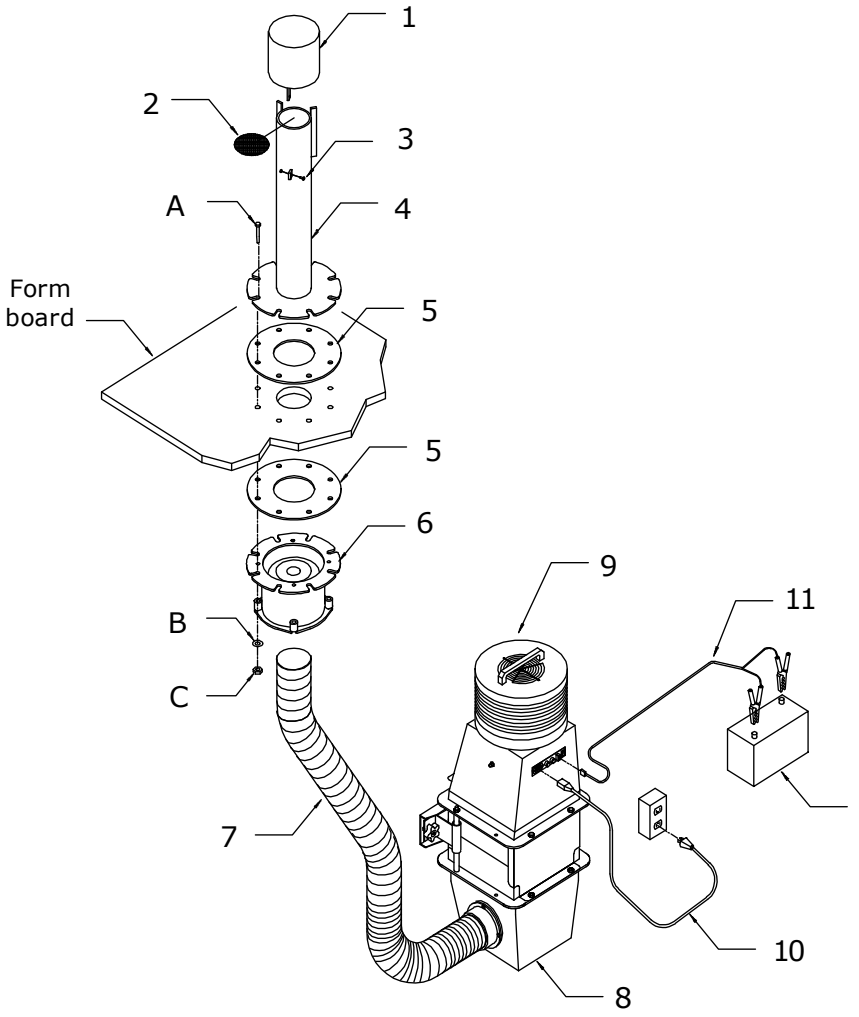


Figure L-1
Intake group

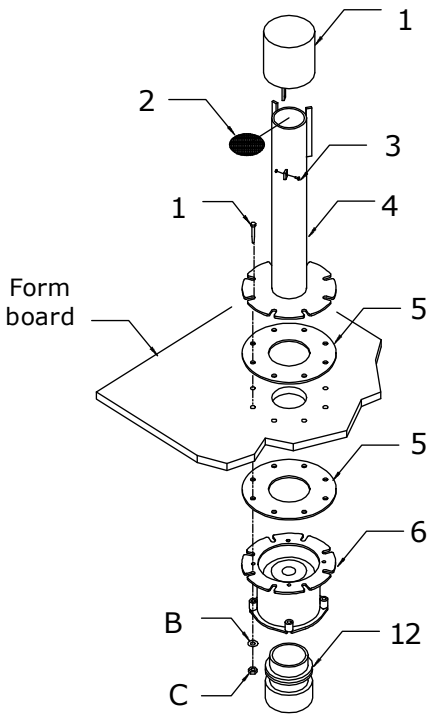


Figure L-2
Output group

1. Heavy steel rain cap
2. EMP/insect screen
3. Locking lug
4. Heavy steel vent pipe
5. Gasket
6. Heavy steel blast valve
7. Intake hose
8. Filtration unit
9. Emergency backup hand pump
10. Power cord
11. Battery jumpers
12. Over pressure valve

A. Hex bolt ½-13 X 3”
B. Flat washer
C. Hex nut ½-13

Optional french drain system

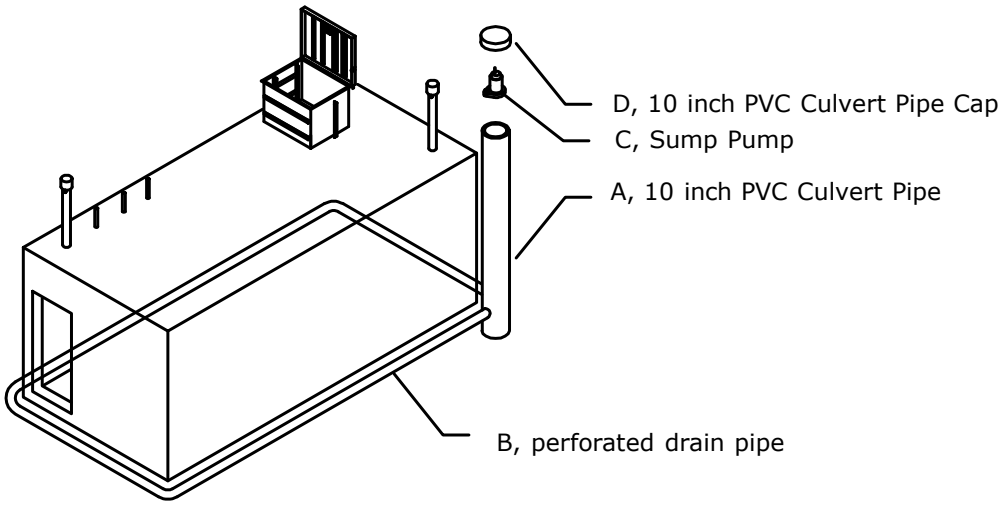


Figure M-1

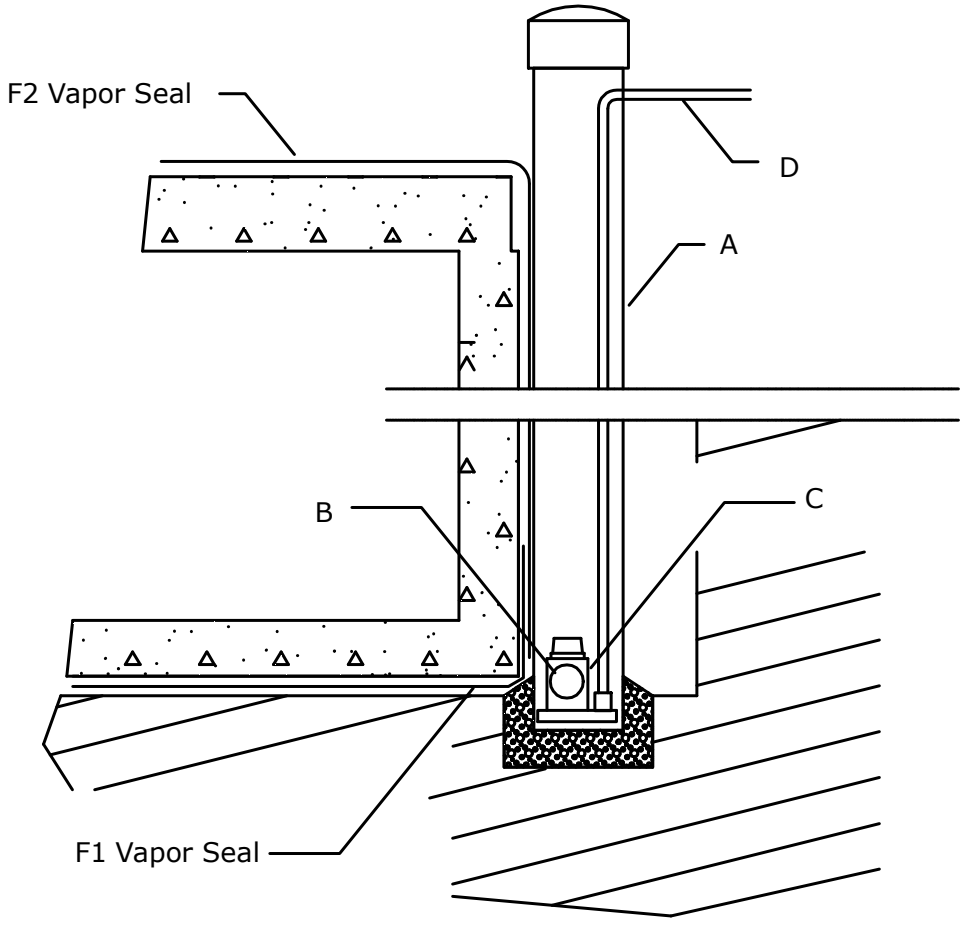


Figure M-2

Optional vertical blast door

ASR-50-BD Blast Door is a pre-hung, explosion resistant blast door that offers excellent protection from extremely high pressure blast waves like those produced by a large conventional or nuclear device detonated in relatively close proximity. This door is rated to withstand high pressure waves up to 7,200 pounds per square foot — that is 50 pounds per square inch (PSI). Additionally, the step over threshold option (page 8, blast door manual) offers a compression seal between the door and the frame allowing for the use of a positive pressure NBC filtration system inside the shelter. See the complete manual available at www.AmericanBombShelter.com

Lift the door into place

Lift door frame assembly into the wall opening and push the door so that the frame lip is fully captured inside the boundaries of the opening. Brace or otherwise secure the door frame assembly so that it can not fall out of the opening.

> **Caution —** take care to not pinch body parts between the door and any obstructions as a severe pinch injury will occur. When swinging the door closed use only the provided door handles. Read and understand these instructions thoroughly before attempting to hang this blast door. American Safe Room strongly recommends that this door be installed by a qualified installer with the proper tools and equipment. A licenced general contractor should be able to follow these directions and complete the installation properly.

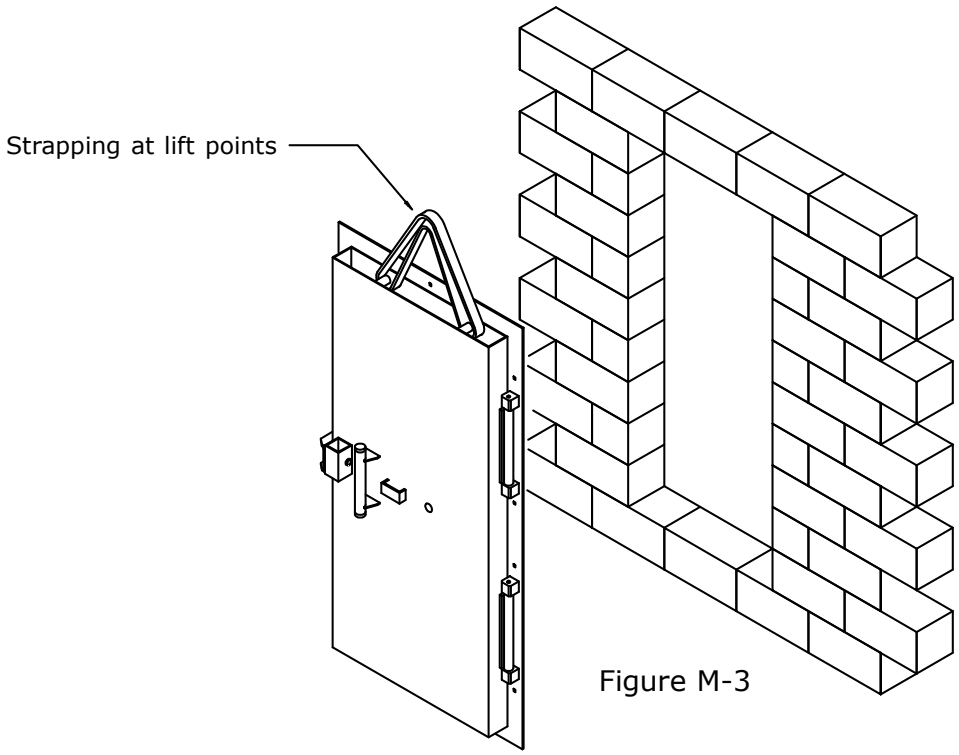


Figure M-3

Optional vertical blast door installation

If the wall is not perfectly straight, the door frame will bend when the nuts are tightened on the wedge anchors, so it is imperative that the wall be grouted to the frame, not the frame tightened to the wall.

In order for the door to close, latch and seal correctly it is necessary for the outer door frame flange to nest flat against the wall surface (C).

In cases where the wall is not square or flat with the door frame it will be necessary to use cement grout to create a flat surface between the frame and well.

This is accomplished by creating a ½-inch wide void between the door frame and wall surface and filling it with wet cement grout.

Using the door frame and wall surface as a vice evenly clamp a number of ½-inch thick shims or spacers between the door frame and wall surface by lightly tightening the anchor bolts.

When the cement grout is dry remove the shims and tighten the anchor bolts to full torque, this will provide the door frame with a flat mounting surface.

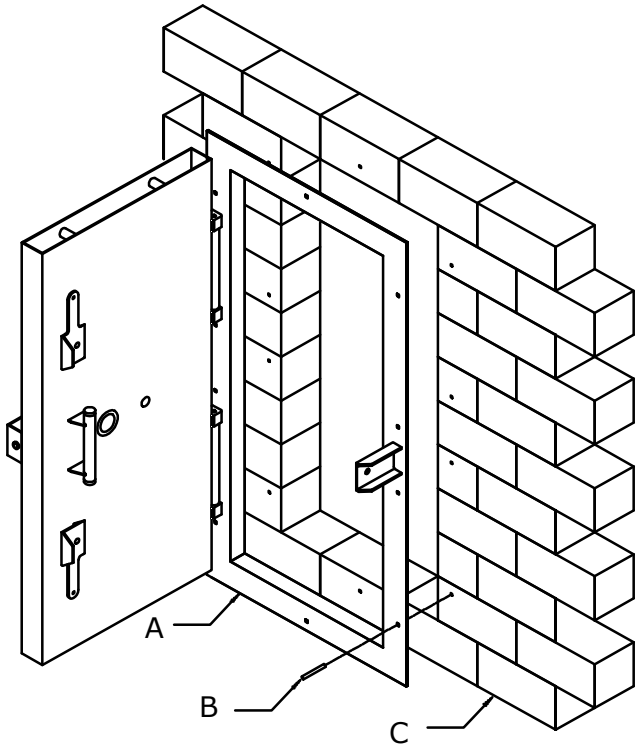


Figure M-4

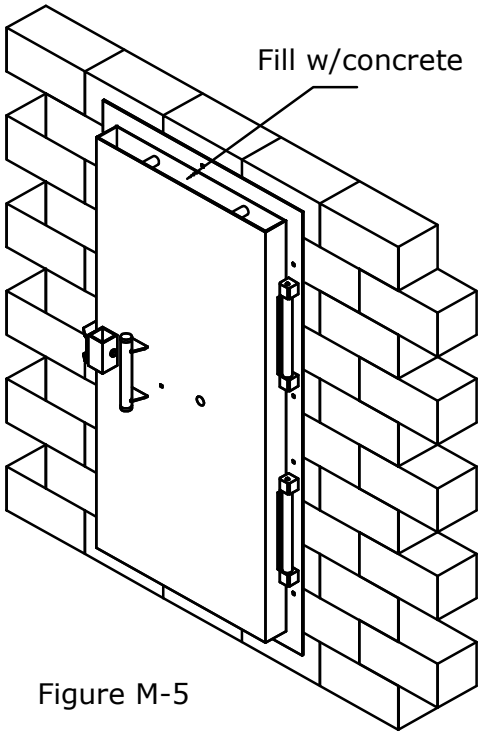


Figure M-5

Optional automatic ventilation system

The ASR-100-AB auxiliary ventilation blower system provides 100 CFM of fresh unfiltered air into your shelter.

It may be used in ventilation mode only during non threat times when no outside toxins are present to purge your shelter of unwanted stale air, relieve moisture, and prevent anaerobic mold spores from growing.

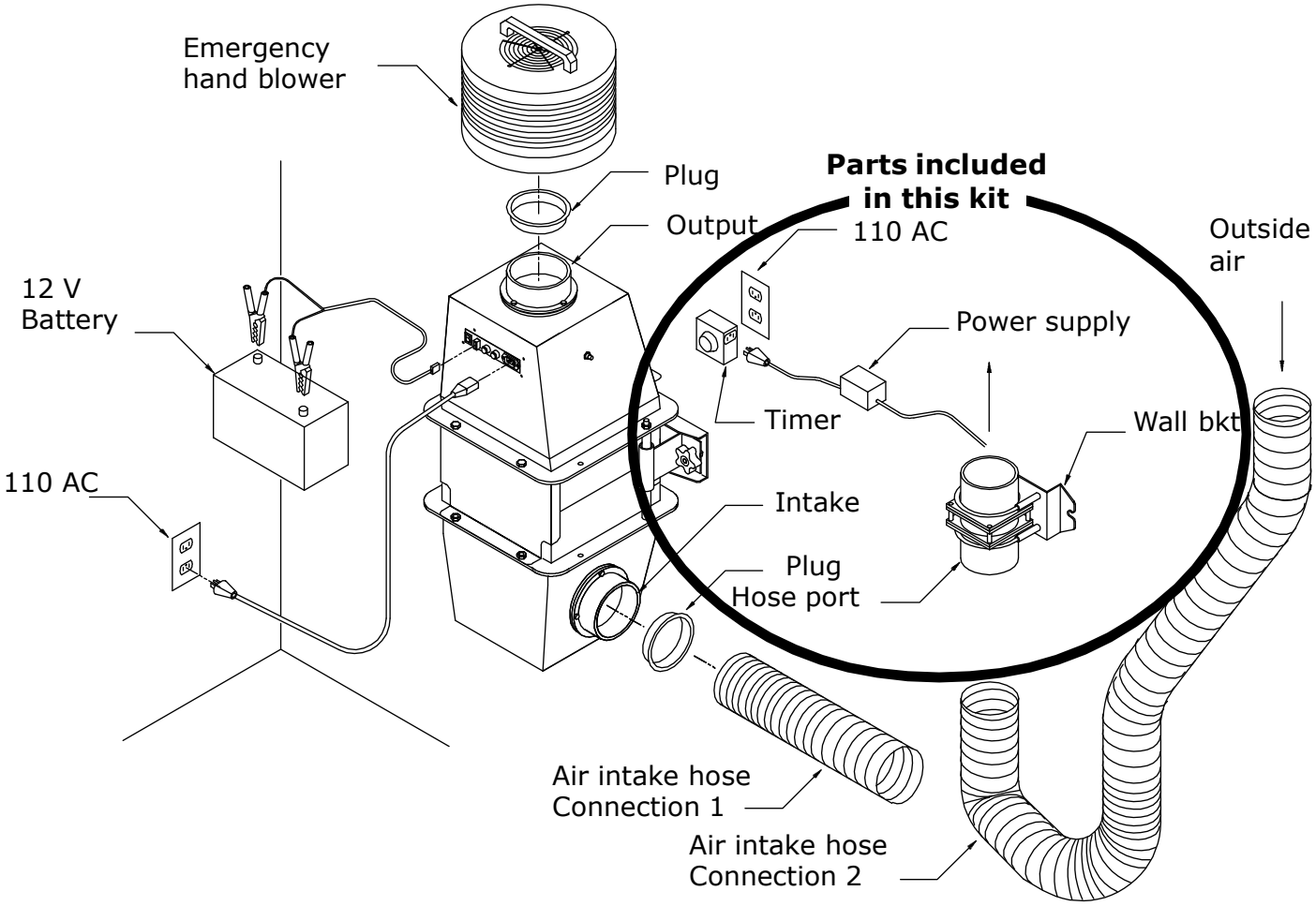


Figure M-6

Optional differential pressure gauge overview

The American Safe Room Differential Pressure Gauge displays the difference in air pressure between the inside and outside of a shelter to constantly verify that you have positive pressure inside your shelter. It has a sampling tube that goes through the wall or ceiling in order to read the outside air pressure. Another sampling tube is inside the housing and the difference in air pressure is displayed by a needle on a dial gauge.

When you do not have the Safe Cell NBC overpressure air filter on, a properly installed differential pressure gauge will read zero because there is no difference in the air pressure inside, and outside of the shelter. When you start the Safe Cell, the gauge will read a higher pressure.

The unit of measure displayed is inches of water column (wc). There are 27.67 inches of water in one pound per square inch (PSI).

Air flow and air pressure are two properties of forced air that are linked together. As a general rule, the more air pressure, the less air flow. An airflow of 5 cubic feet per minute per person at 0.3-inch (7.62-mm) of water column is recommended by the United States Army Corps of Engineers in the technical letter ETL 1110-3-498. See www.AmericanSafeRoom.com to view this document.

There are three ranges of gauges available that displays positive overpressures:

1. zero to 0.5-inches of water column — part number ASR-05-DPG
2. zero to 1-inch of water column — part number ASR-10-DPG (special order item)
3. zero to 25-mm of water column — part number ASR-25-DPG (special order item)

The Differential Pressure Gauge is designed for easy installation into any protected space. The kit includes all of the required components for installation inside of the protected space.

Please see the manual for the Adjustable Overpressure Relief Valve to set up your shelter at the proper pressure. It is available at www.AmericanSafeRoom.com.

Specifications
Range: 0 to .5-inches/wc (12.7 mm/wc) or 0 to 1-inch/wc (25.4 mm/wc)
Accuracy: +/- 5% of full scale
Absolute pressure limit: 30 psi g (2.067 bar)
Temperature limits: 20-120 F (-6.67-48.9 C)

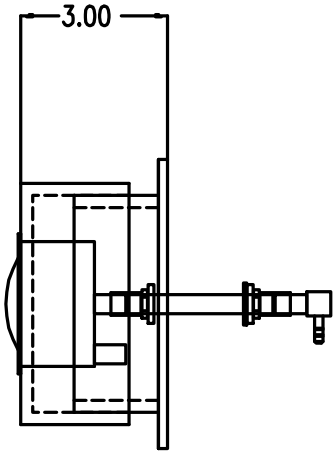


Figure M-7

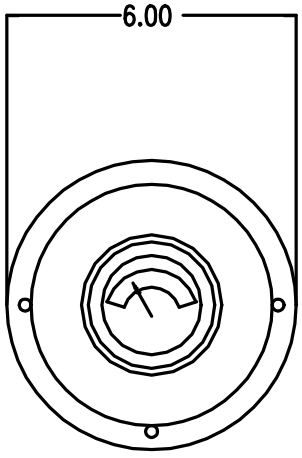


Figure M-8

Optional differential pressure gauge installation

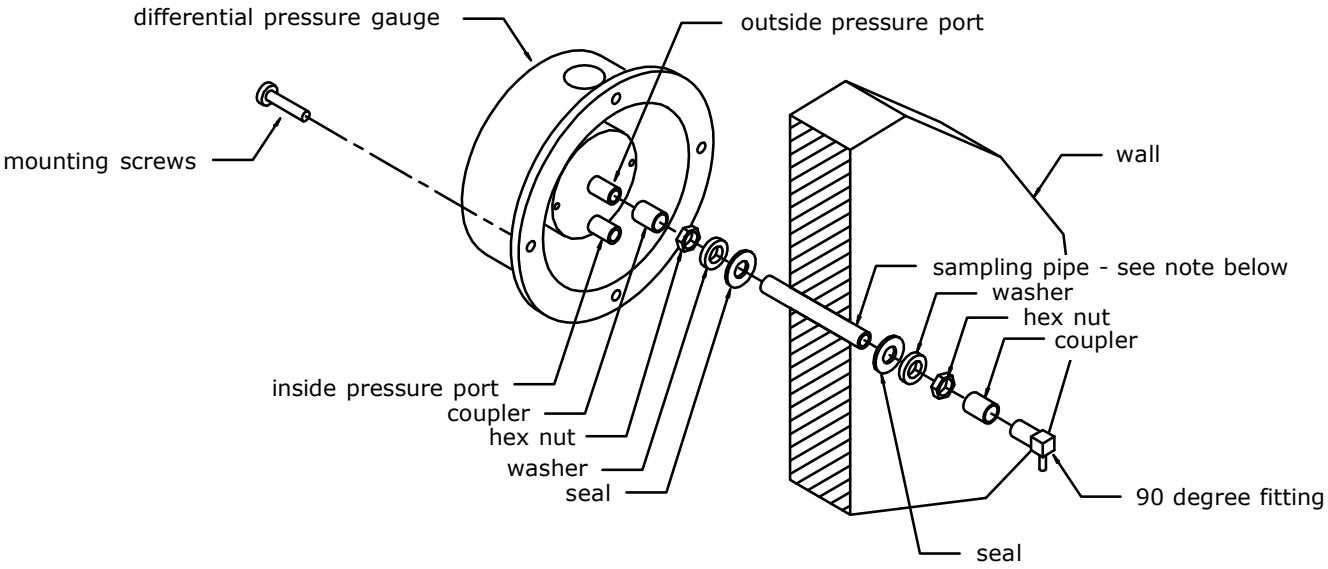


Figure M-9

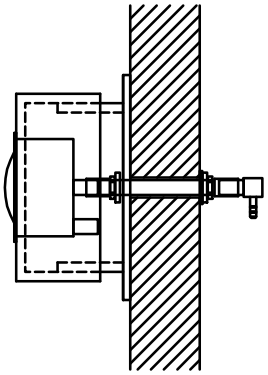


Figure M-10

Installation

1. Choose a mounting location on an outside wall with smooth flat surfaces to insure proper sealing of the bulkhead compression seals.

2. Drill a 13/32-inch diameter hole through the bulkhead wall.

3. Insert the hollow threaded rod through the hole and assemble the seals and threaded fasteners as shown in Figure M-6.

Note: two 6-inch sampling pipes are included with a coupler to connect them. Maximum wall thickness is 5-inches per sampling pipe. Please order additional sampling pipes for thicker walls.

Optional electrical connection kit overview

This optional kit brings 110 volt AC electrical service from the included ceiling penetration down to a breaker box and then out to two outlets on the bottom of that box. The basic load center kit is a 60 amp service installed in a NEMA 2, UL approved enclosure having two each 20 amp ground fault protected three prong outlets factory mounted at the bottom of the enclosure. The unit comes completely pre-wired except for the 4 wire connection to the grid or generator and accompanying UFER ground installed with the floor rebar kit. The kit is full expandable with eight additional breaker slots.

The kit also includes all connection hardware such as conduit, fittings, UFER ground rod and clamp and mounting hardware.

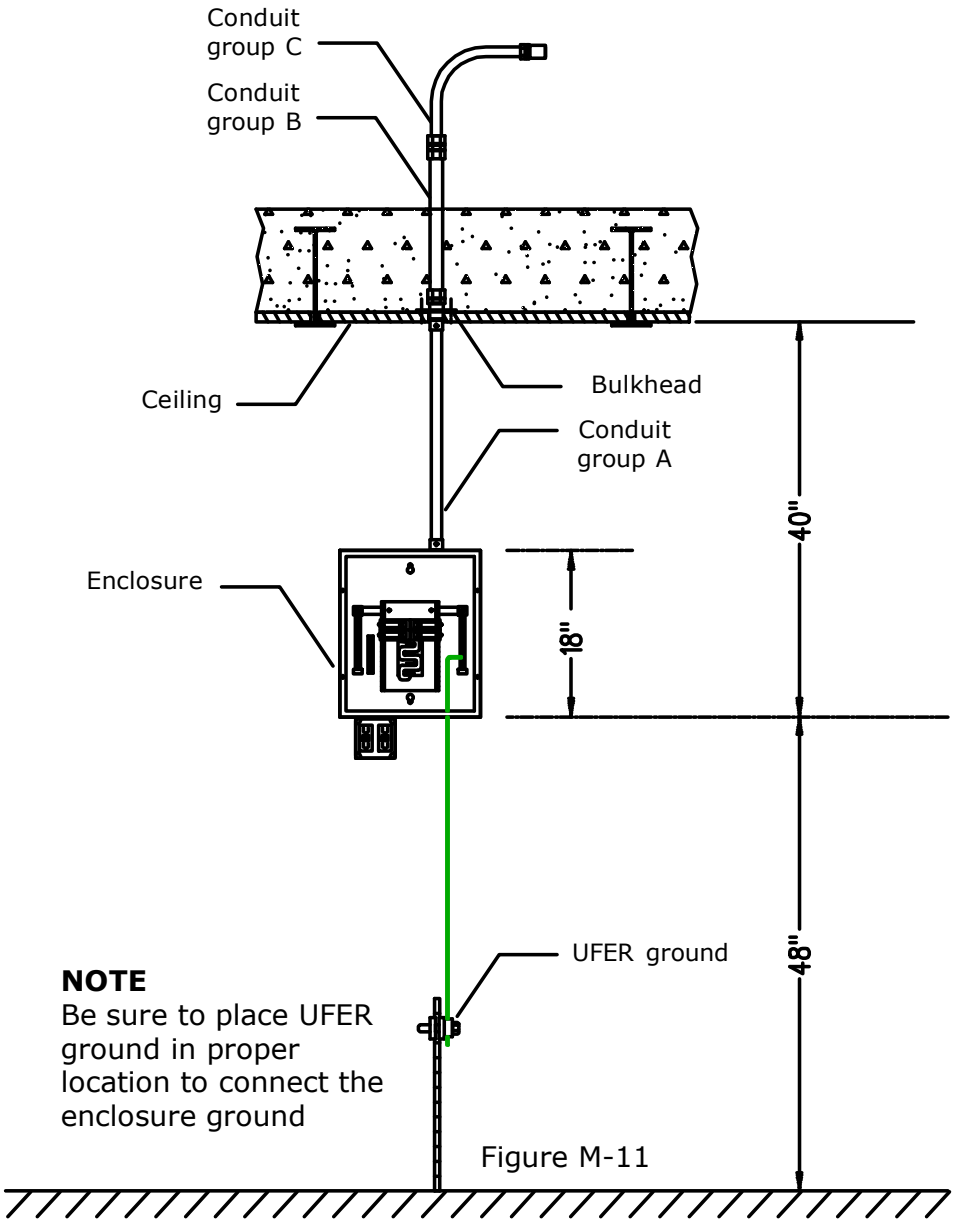


Figure M-11

Optional electrical connection kit installation

The components are listed in the order of installation

A. 1 each NEMA 2 enclosure and door
B. 2 each concrete anchors
C. 1 each bulkhead kit, w/ gasket and fasteners
D. 1 each conduit group A, w/ fittings
E. 1 each conduit group B, w/ fittings
F. 1 each conduit group C, w/ fittings
G. 1 each UFER ground kit

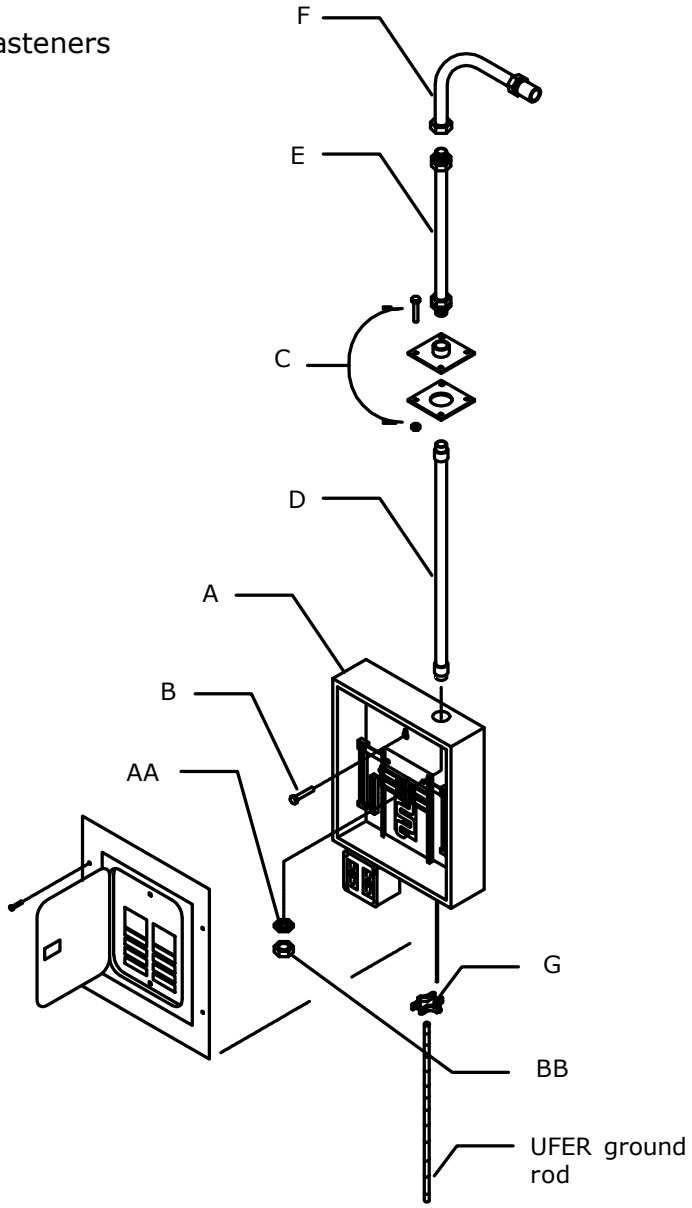


Figure M-12

Wiring instructions

All internal wiring of the load center from the main breaker on is done at the factory.

The minimum gage size of hook up wire shall be #6.

All conduits and fittings from conduit group C, to the source is to be provided by the installer.

All connection wire from the load center to the source is provided by the installer.

There are only four on site wire connections and a ground required by the installing electrician as per the figure M-13 below.

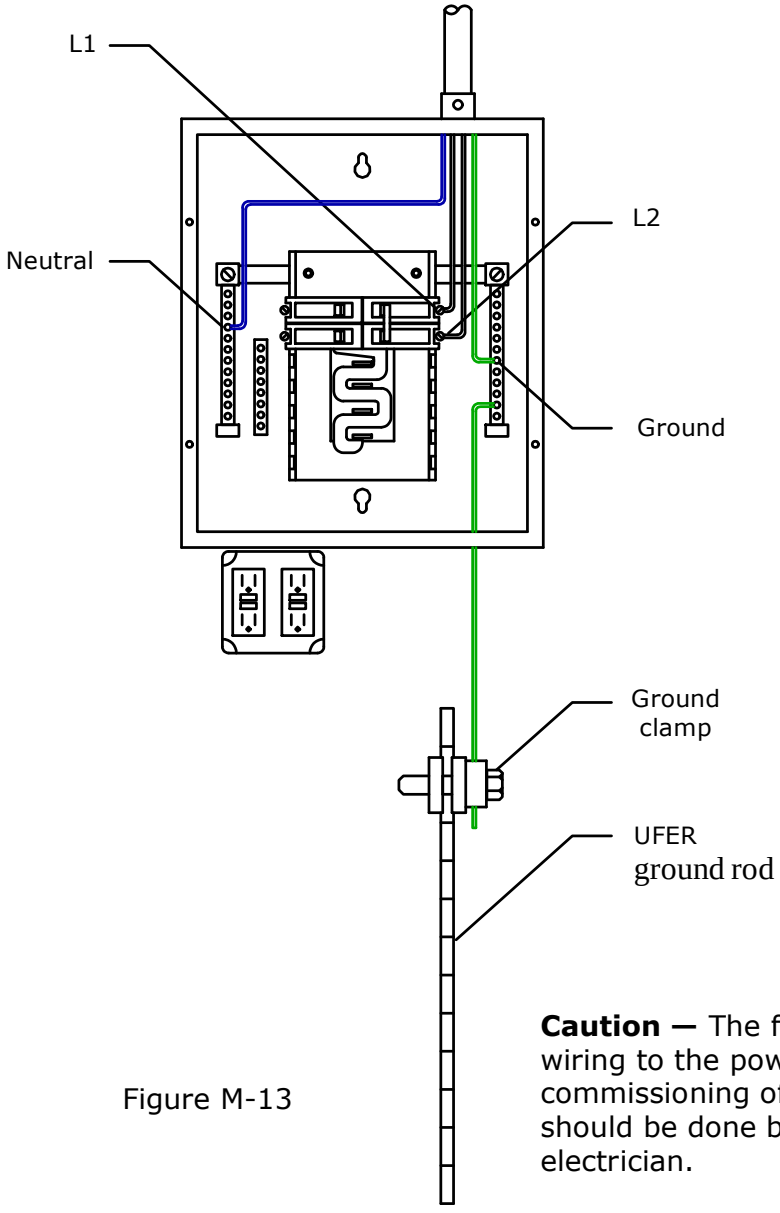


Figure M-13

Caution — The final hook up wiring to the power source and commissioning of the load center should be done by a licensed electrician.

Optional toilet installation kit overview

This kit will allow a Zoeller Qwik Jon to be installed in a shelter. It uses the air outflow vent pipe to vent the toilet by connecting between the overpressure valve and the blast valve. The overpressure valve is a one way check valve so septic odors will not be released into the shelter.

This kit contains parts R-6 through R-14 referenced below and shown on the next page.
Parts R-1 through R-5 (all items shown on the next page) are furnished with the ventilation kit hardware. Please specify that you want this optional item at time of ordering — there is an additional charge for this kit. Parts R-A through R-H are furnished by the end user.

> **Note —** the installation of the items in this section must be carried out **BEFORE** the ceiling/wall pour of concrete. Some of these parts are poured in place.

The Zoeller Qwik Jon, catalog sheet can be downloaded here:
http://www.zoeller.com/zcopump/zcopdfdocs/FM0692.pdf

The Zoeller Qwik Jon, installation instructions can be downloaded here:
http://www.zoeller.com/zcopump/zcopdfdocs/FM1469.pdf

The contact information for the factory is:

Zoller Pump Company
3649 Cane Run Road
Louisville, Kentucky. 40200-1961

Telephone: 800-928-7867
502-778-2731

Item index for the drawing on the next page:

R-1 ..... exhaust ventilation pipe
R-2 ..... blast valve
R-3 ..... fastener bolts, 8 each
R-4 ..... fastener nuts, 8 each
R-5 ..... overpressure valve
R-6 ..... Y-connection
R-7 ..... flanged trough the ceiling drain pipe
R-8 ..... fastener screws, 4 each
R-9 ..... fastener nuts, 4 each
R-10 ..... threaded 2-inch pipe coupling pipe to 2” PVC pipe
R-11 ..... flanged through the ceiling water pipe
R-12 ..... fastener screws
R-13 ..... threaded 3/4-inch pipe coupling pipe to 3/4-inch PVC pipe
R-14 ..... 3/4-inch mail to 1/2-inch female PVC nipple reducer

R-A ..... ½” shut off valve
R-B ..... ½” toilet connection pipe
R-C ..... toilet
R-D ..... Zoller, “Qwick Jon®” Model number 100 with sewage pump — part number WM264
R-E ..... vent pipe 3 inch PVC
R-F ..... 2-inch shut off valve
R-G ..... 2-inch PVC pipe
R-H ..... anti-backflow device

This system is recommended because of its cost effectiveness and this system allows for the addition of a sink and shower. See the Zoeller Qwik Jon installation manual pages 6 and 7 for plumbing of additional fixtures such as showers and sinks.

Optional toilet installation kit parts

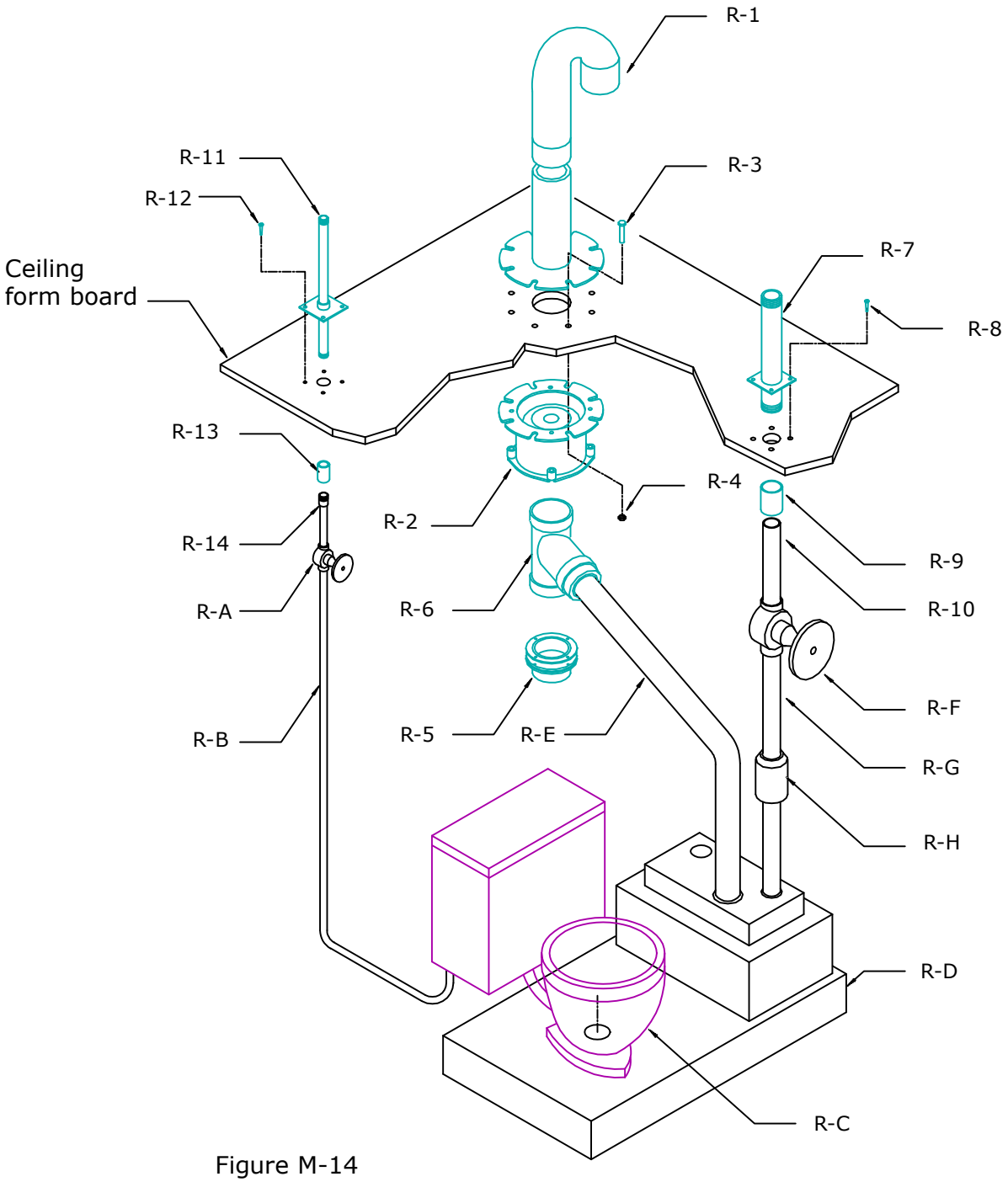
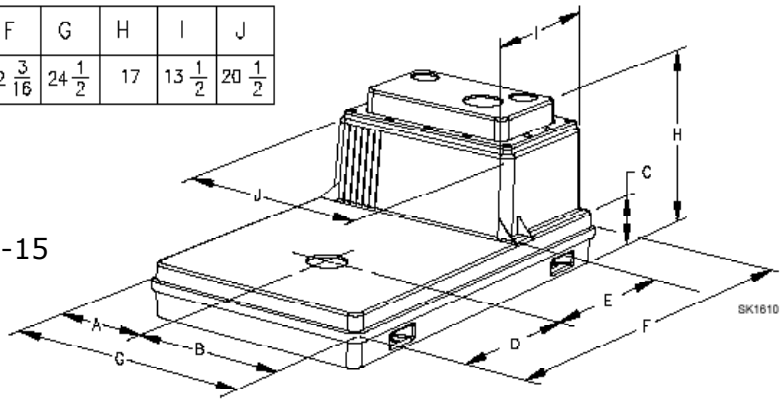


Figure M-14

Optional toilet installation kit dimensions

A	B	C	D	E	F	G	H	I	J
12 1/4	12 1/4	5 1/2	13 1/4	14 1/8	42 3/16	24 1/2	17	13 1/2	20 1/2

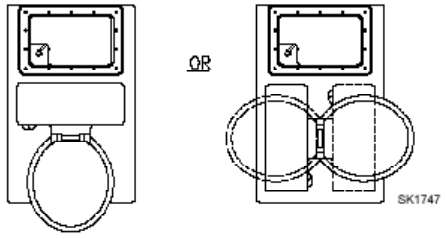
All dimensions are in inches.



DIMENSIONS A,B,D,F,& G ARE FROM THE WELD

Figure M-15

Determine the orientation of Toilet on Tank. This determines the location of the long bolts in STEP 3 of the installation. Refer to Figure 2.1 or Figure 2.2.



FORWARD INSTALLATION
Forward Installation
Figure 2.1

SIDE INSTALLATIONS
Side Installation
Figure 2.2

Figure M-16

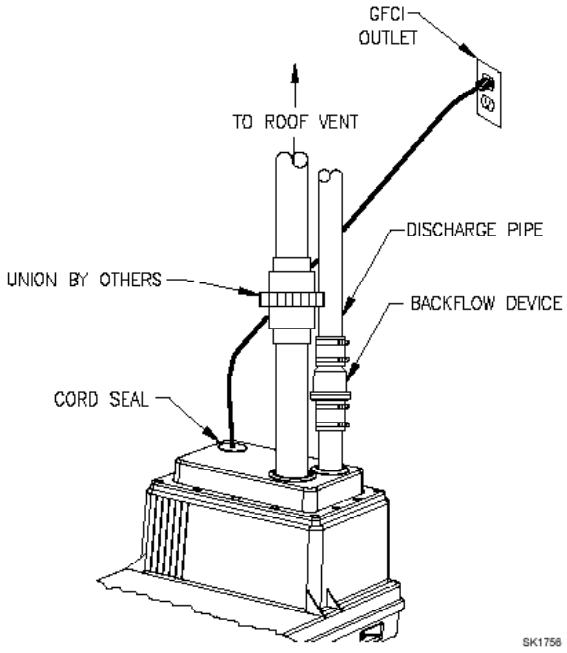


Figure M-17

Reference - rebar cut and forming chart

A

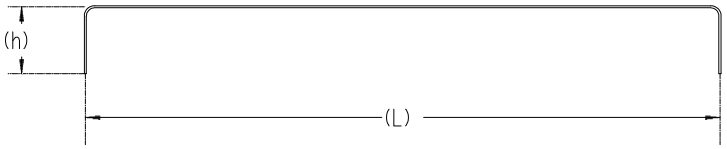


Figure N-1

B

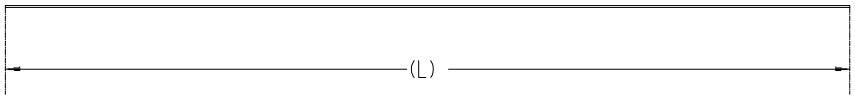
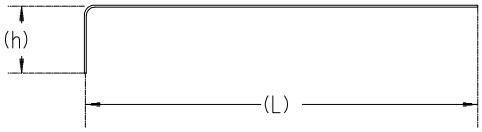


Figure N-2

C



D

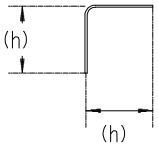


Figure N-3

Rebar naming convention

1st. character = destination, floor, walls, roof.
2ed. character = location at destination.
3rd. character = cut and forming detail.

(NOTE) bar size R2B

(NOTE) all rebar connections and intersections must be properly tied

Series 100

F1A = 34 pcs. #4 bar x 112″ lg.
F2A = 17 pcs. #4 bar x 248″ lg.
F1D = 01 pcs. #4 bar x 16″ lg
W1A = 10 pcs. #4 bar x 112″ lg.
W1B = 10 pcs. #4 bar x 248″ lg
W1C = 86 pcs. #4 bar x 92 ‟ lg.
R1B = 13 pcs. #4 bar x 248″ lg.
R2B = 30 pcs. #7 bar x 112″ lg.

Series 200

F1A = 34 pcs. #4 bar x 128″ lg.
F2A = 20 pcs. #4 bar X 248″ lg.
F1D = 01 pcs. #4 bar x 16″ lg.
W1A = 10 pcs. #4 bar x 128″ lg.
W1B = 10 pcs. #4 bar x 248″ lg.
W1C = 90 pcs. #4 bar x 92″ lg.
R1B = 14 pcs. #4 bar x 248″ lg.
R2B = 30 pcs. #7 bar x 128″ lg.

Series 300

F1A = 34 pcs. #4 bar X 152″ lg.
F2A = 24 pcs. #4 bar X 248″ lg.
F1D = 01 pcs. #4 bar x 16″ lg.
W1A = 10 pcs. #4 bar x 152″ lg.
W1B = 10 pcs. #4 bar x 248″ lg.
W1C = 94 pcs. #4 bar x 92″ lg.
R1B = 16 pcs. #4 bar x 248″ lg.
R2B = 30 pcs. #8 bar x 152″ lg.

Series 400

F1A = 34 pcs. #4 bar x 176″ lg.
F2A = 29 pcs. #4 bar x 248″ lg.
F1D = 01 pcs. #4 bar x 16″ lg.
W1A = 10 pcs. #4 bar x 176″ lg.
W1B = 10 pcs. #4 bar x 248″ lg.
W1C = 98 pcs. #4 bar x 92″ lg.
R1B = 18 pcs. #4 bar x 248″ lg.
R2B = 30 pcs. #9 bar x 176″ lg.

All series
H dimension = 16-in

Reference - certification of pressure rating

Maurice E Farr
Professional Engineer
395 Kirby Avenue
Roseburg, OR 97470

October 21, 2009

TO Whom it may concern:

This bunker roof is designed with reinforced Portland cement concrete to carry the imposed loads of soil overburden, a parked automobile or pickup truck as well as pressure from an apparent aerial explosion.

Structural wide flange steel beams spanning in the transverse direction which are used as false work support until the concrete attains design strength. Plywood 3/4" thick spanning between the lower flanges of the wide flange steel beams will carry the concrete as an integral part of the false work system.

Structural wide flange steel beams act not only as false work while the concrete gains strength but contribute additionally to the total carrying capacity of the roof. This estimated additional carrying capacity is computed to be plus or minus 7 psi.

Design loads for the reinforced Portland cement concrete roof are listed below:

Dead load of reinforced concrete	145 lbs/cuft
3 feet of soil overburden	100 lbs/cuft
Automobile or pickup truck	40 lbs/sqft
Apparent aerial explosion	2,500 lbs/sqft
	2,985 lbs/sqft or 20.7 psi

Maurice E Farr, P.E.

Maurice E Farr, PE