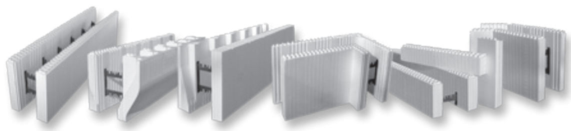
DESIGNING SAFE ROOMS AND SAFE HOMES WITH LOGIX.

LOGIX

INSULATED CONCRETE FORMS



Actual ICF-Built Home That Survived Katrina

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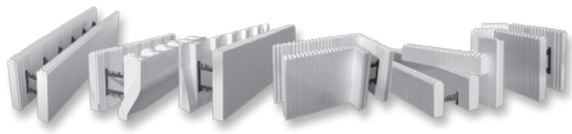


Hurricanes and tornadoes have progressively caused more damage to property, personal injury and loss of life than any other natural disaster in the United States.

In fact, 2011 is proving to be a record year for tornadoes costing billions in property damage, and hundreds of lives lost.

As we continue to rebuild in the paths of hurricanes and tornadoes, stronger and more durable building materials than traditional framed or masonry wall construction needs to be considered. Basically, these buildings need to be more resistant to extreme wind events than what is currently required by building codes.

Due to its many benefits, LOGIX has been gaining popularity in the building industry as an alternative to framed or masonry construction. Over the years, LOGIX has proven to be quick and easy to install while providing the built-in insulation and vapor barrier. The thick rigid foam insulation and concrete core also creates a high energy efficient wall system.

The added benefit of a solid reinforced concrete core protected by a layer of rigid foam makes LOGIX one of the strongest, most durable wall systems available, and ideal for buildings and safe rooms in high wind-prone regions.

This document discusses the use of LOGIX in the design and construction of buildings and safe rooms in high wind-prone regions. In addition, engineered wind load tables and FEMA compliant ready-to-use safe room construction plans are noted as a design aid specific for LOGIX.

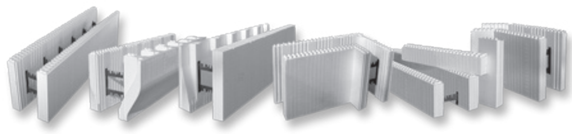
Buildings Constructed to Model Building Codes

Depending on the geographic location of the building, the model building codes require the design and construction of buildings in high wind regions to be based on basic wind speeds that may be up to 170 mph (200 mph in the Florida Building Code). Statistically, this covers approximately 90% of all wind speeds experienced in the US including those generated by hurricanes and weaker tornados.

Buildings in compliance to the model building codes are designed and constructed with adequate wall to roof, and wall to footing connections, so that a continuous load path is provided to transfer wind loads from the framing members to the foundation. *However, with the exception of window openings, model building codes have no requirements for the protection of exterior walls and roofs from wind-borne debris.* As a result, buildings hit from flying debris during high wind events can experience a breach in the building envelope through the exterior walls, even within wind speeds the building was designed for.

A breach in the building envelope during high wind events can greatly increase the pressure experienced by the building, which can lead to possible structural damage and potential harm to building occupants. *For the most part, minimum requirements of model building codes are meant to protect the loss of property rather than the loss of life.*

Generally, the costs associated to design and construct a debris resistant home, or larger building, with the intent to fully protect its building occupants, make it impractical to build. Which is likely the reason there are no wind-borne debris impact protection requirements for exterior walls and roofs in model building codes.



For the most part, minimum requirements of model building codes are meant to protect the loss of property rather than the loss of life.

However, with exterior walls being the main structural support for buildings, stronger, more durable walls offer more protection to building occupants against debris impacts, and can reduce the costs of maintenance and repairs compared to framed and masonry construction.

Without further enhancements, traditional framed buildings offer little resistance to debris impacts. In addition, air infiltrating through framed walls during extreme wind events can increase the stress on the building. Masonry construction requires full grouting and reinforcement. In comparison, LOGIX walls are naturally strong, durable and airtight structures that resist high wind loads, and debris impacts without the need to further strengthen the wall.

History has shown that reinforced concrete structures, like those built with LOGIX, are often the only buildings left standing in the aftermath of a hurricane or tornado.

Despite the lack of wind-borne debris protection in the model building codes for walls and roofs, using LOGIX can help ensure buildings stay intact and provide a higher level of safety, during extreme wind events.

Logix Wind Load Tables

Since reinforced concrete is the structural component of LOGIX, buildings constructed with LOGIX can be designed for higher wind loads than what is required by code.

To aide designers and builders, Table 3B in Section 6 of the LOGIX Design Manual offers a wind load table for above-grade walls where the design wind speed is greater than 150 mph. The table includes wind speeds of 200, 250, 275 and 300 mph for LOGIX walls of varying thicknesses and wall heights. Table 3B can be found at the end of this document.

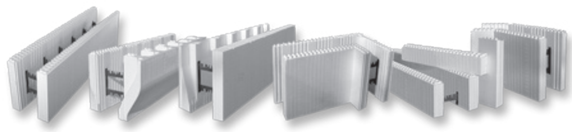
The use of Table 3B creates LOGIX walls capable of withstanding wind speeds greater than what is required by code, and will offer more safety than framed or masonry walls. However, it is important to note that special attention should be paid to the connection details for wind loads not covered in building codes. Connection details between the wall to footing, and wall to roof, will depend on a number of factors such as wind load, height and shape of building. A local licensed engineer should be consulted if the design of the building is outside the scope of the model building codes.

Safe Rooms

Typically buildings are not designed to fully withstand wind-borne debris impacts generated by hurricanes and tornados.

Wind driven debris presents the greatest hazard to building occupants and to building structures during a tornado or hurricane. In cases of extreme wind events, building occupants should evacuate to safe rooms designed to protect building occupants.

Every component of a safe room, from the roof to the foundation, is designed to withstand missile impacts and associated wind loads up to 250 mph. This represents more than 99% of all tornados known to have occurred in the United States, and higher than Category 5 hurricanes.



Research has shown that for strength and resistance to debris impacts, ICFs out perform other wall assemblies making them ideal for Safe Rooms. Traditional framed construction requires considerable improvements to match the strength and resistance of ICFs. CMUs require full grouting and reinforcing. Only traditional reinforced concrete and tilt-up panels were comparable to ICFs. However, ICFs were the only wall system that showed no signs of damage to the structural component of the wall assembly–no visible damage to the concrete core of the ICFs tested.

It is worth noting, that the tested ICF walls consisted of a 4 inch reinforced concrete core, and performed better than tested 6 inch thick traditional reinforced concrete walls. This is likely due to the layer of rigid foam insulation that blankets the concrete core absorbing energy from debris impacts. Hence, reducing the impact load to the concrete core (analogous to rigid foam used in helmets to absorb impacts).

LOGIX form panels have the thickest foam insulation in the ICF industry ranging from 2.75 to 8 inches, making LOGIX one of the most debris impact resistant ICFs available.

Building Safe Rooms with Logix

Based on numerous case studies and research, the Federal Emergency Management Agency (FEMA) has developed two best practice guides for the design and construction of safe rooms. FEMA 361 covers community safe rooms intended to accommodate more than 16 persons, and FEMA 320 covers residential and small business safe rooms intended to accommodate 16 persons or less.

Residential and Small Business Safe Rooms

FEMA 320, Taking Shelter from The Storm, offers a prescriptive guide to the design and construction of safe rooms specifically for residential and small businesses. These safe rooms are intended to hold no more than 16 persons, and include the use of ICFs for the construction of safe rooms.

As an aid to home owners, builders and designers, LOGIX has developed a set of construction plans for the construction of residential and small business safe rooms using LOGIX. The LOGIX construction plans are FEMA compliant and include plans for in-ground, basement, crawl space and detached safe rooms. For reference, the LOGIX Safe Room plans can be found at the end of this document.

Although the LOGIX safe room construction plans are complete, consulting a local engineer to review the plans can also help in indicating other local hazards that should be considered before construction.

Community Safe Rooms

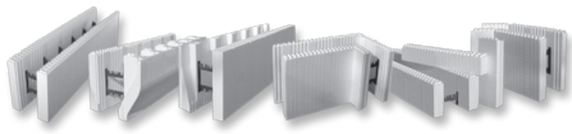
The construction of a safe room designed to hold a large number of people dictates a larger building than that required for residential or small business safe rooms. Hence, a structural engineer is required for the design of a community safe room.

FEMA 361, Design and Construction Guidance for Community Safe Rooms, offers design and construction guidelines for community safe rooms, and notes 4 inch ICFs as a wall system capable of providing sufficient protection against extreme wind events and debris impacts.

Depending on the size of the community safe room, designers can use the wind load table, Table 3B, in Section 6 of the LOGIX Design Manual to aide in design of the safe room.

Improving occupant safety means constructing stronger, more durable buildings capable of withstanding large wind loads, including debris impacts, than typical framed and masonry structures. Well recognized for their inherent resistance to large wind loads, and debris impacts, ICFs are the perfect choice for constructing buildings in high wind prone regions. And choosing LOGIX makes it easier for builders and designers to create a building, or safe room, by providing detailed engineered high wind load tables, and FEMA compliant ready-to-build safe room construction plans.

For more information contact LOGIX at info@logixicf.com



6.1 – U.S. ENGINEERING ANALYSIS REPORT

TABLE 3B - LOGIX ABOVE-GRADE WALL MINIMUM VERTICAL REINFORCEMENT (WIND SPEEDS GREATER THAN 150 MPH)

NOTE: LOGIX recommends builders, owners and/or designers using these tables confirm that on-site building conditions are w/in the scope of the tables being used.

LOGIX ABOVE-GRADE WALLS - VERTICAL REINFORCEMENT SPACING, in.

Ground Floor LOGIX Supporting Roof Only

Wall Height, ft	4" LOGIX Wall Thickness Wind Speed, mph					6.25" LOGIX Wall Thickness Wind Speed, mph					8" LOGIX Wall Thickness Wind Speed, mph					10" LOGIX Wall Thickness Wind Speed, mph					12" LOGIX Wall Thickness Wind Speed, mph				
	160	200	250	275	300	160	200	250	275	300	160	200	250	275	300	160	200	250	275	300	160	200	250	275	300
8	16	12	6	-	-	48	24	12	8	8	48	32	16	12	12	48	48	24	16	16	48	48	32	24	16
9	16	8	-	-	-	24	16	8	8	6	40	24	12	8	8	48	32	16	12	12	48	48	24	16	12
10	8	6	-	-	-	16	12	6	6	-	32	16	8	8	6	48	24	12	8	8	48	32	16	12	12
12	6	-	-	-	-	12	8	-	-	-	16	8	6	-	-	24	16	8	6	-	40	16	8	8	6
14	-	-	-	-	-	8	-	-	-	-	12	6	-	-	-	16	8	6	-	-	24	12	6	6	-
16	-	-	-	-	-	6	-	-	-	-	8	-	-	-	-	12	6	-	-	-	16	8	-	-	-
18	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	8	-	-	-	-	12	6	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	8	-	-	-	-

Ground Floor LOGIX Supporting 2nd Storey LOGIX (or 2nd Storey Wood Frame) & Roof Structure

Wall Height, ft	4" LOGIX Wall Thickness Wind Speed, mph					6.25" LOGIX Wall Thickness Wind Speed, mph					8" LOGIX Wall Thickness Wind Speed, mph					10" LOGIX Wall Thickness Wind Speed, mph					12" LOGIX Wall Thickness Wind Speed, mph				
	160	200	250	275	300	160	200	250	275	300	160	200	250	275	300	160	200	250	275	300	160	200	250	275	300
8	16	6	-	-	-	48	24	12	8	8	48	48	16	12	12	48	48	32	24	16	48	48	32	24	16
9	12	6	-	-	-	40	16	8	6	-	48	24	12	8	8	48	48	16	16	12	48	48	24	16	12
10	6	-	-	-	-	24	12	6	-	-	48	16	8	8	6	48	32	16	12	8	48	48	16	12	12
12	-	-	-	-	-	12	6	-	-	-	16	8	6	-	-	48	16	8	6	-	48	24	8	8	6
14	-	-	-	-	-	8	-	-	-	-	12	6	-	-	-	24	8	-	-	-	40	16	8	6	-
16	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	12	6	-	-	-	16	8	-	-	-
18	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	8	-	-	-	-	12	6	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	8	-	-	-	-

NOTES:

1. **Table 3B** must be used in conjunction with the notes listed under **"Notes For Above-Grade Wall Tables"**.
2. Vertical bar spacing is for #4 rebar. #5 rebar can be substituted provided the spacing is multiplied by 1.5. Spacing shall be no more than 48 inches on center.
3. Steel yield strength = 60 ksi, 28 day concrete compressive strength = 3 ksi.

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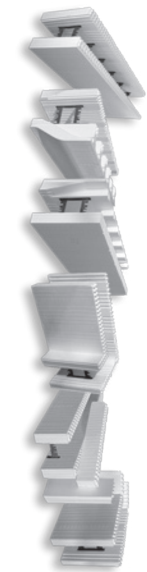


LOGIX ICF
IN-RESIDENCE & SMALL BUSINESS
SAFE ROOM DESIGNS

LIMIT OF LIABILITY

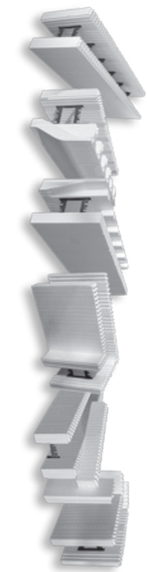
The designs in these drawing sheets are based on extensive research of the causes and effects of windstorm damage to buildings. Safe Rooms designed and built to these designs should provide a high degree of occupant protection during extreme windstorms (tornadoes and hurricanes). Any substitution of either materials or design concepts may decrease the level of occupant protection and/or increase the possibility of personal injury during an extreme wind event.

Because it is not possible to predict or test all conditions that may occur during extreme windstorms, or control the quality of construction, among other things, the designer does not guarantee the design.

The designer doesn't manufacture or sell Safe Rooms built from this design. The designers have not made and do not make any representation, warranty, or covenant, expressed or implied, with respect to the design, condition, quality, durability, operation, fitness for use, or suitability of the Safe Room in any respect whatsoever. Designers shall not be obligated or liable for actual, incidental, consequential, or other person or entity arising out of or in connection with the use, condition, and/or performance of Safe Rooms built from this design or from the maintenance thereof.

IN-RESIDENCE & SMALL BUSINESS SAFE ROOM DRAWING LIST

DRAWING NUMBER	TITLE
T-01	INDEX SHEET
G-01	GENERAL NOTES
IG-01	IN-GROUND SAFE ROOM - SECTIONS & DETAILS
B-01	BASEMENT SAFE ROOM - CORNER LOCATION
AG-01 to AG-03	AT-GRADE SAFE ROOM
MS-01	DOOR DETAILS & SIGNAGE
MS-02	MATERIALS LISTS



GENERAL NOTES

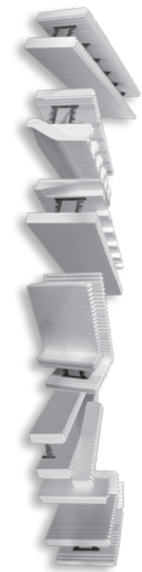
1. Concrete
   - 1.1. All concrete should have stone aggregate (normal weight) 28-day compressive strength (f'c) should be 3,000 psi minimum for cast-in-place concrete.
   - 1.2. Reinforcing bars should be mild steel with a minimum yield strength of 60 Ksi.
   - 1.3. Reinforcing bar protection:
     - 1.3.1. Concrete placed against earth = 3"
     - 1.3.2. Concrete placed in forms = 1.5"
   - 1.4. Reinforcing bar placement tolerance is 0.5" in any direction.
   - 1.5. Splicing of reinforcement is not permitted except as shown on the drawings. Bars should be lap spliced at all corners. Splice lengths as follows:
     - 1.5.1. #4 bars - 24"
     - 1.5.2. #5 bars - 30"
   - 1.6. Welded wire reinforcement: lap one and one-half mesh spaces at splices and wire in contact.
   - 1.7. Field welding of reinforcement should not be permitted.
   - 1.8. All reinforcing bar bends should be made mechanically. Heat-bending should not per permitted.
2. The construction drawings should not be scaled. Dimensions apply.
3. If there is a conflict among the General Notes, Specifications, and Plans, the order of precedence is Notes, then Specifications, then Plans.
4. The construction drawings represent the finished structure. The contractor is solely responsible for providing all measures necessary to ensure that the structure is protected during construction. These measures include (but not limited to) shoring and bracing for construction loads and worker safety purposes.
5. Follow manufacturer's recommendations for nailing requirements of uplift/shear resistance connectors.
6. Ventilation is to be provided in accordance with the local building code. Ventilation may be either natural or mechanical such that minimum ventilation is 0.5 air changes/hour.
7. The designs shown are compliant with the 1997 NEHRP recommended provisions.
8. To ensure the safe room provides the desired level of protection, a professional engineer or architect should be consulted for any design conditions found to be different from those represented by these plans.
9. See Drawings MS-01 and MS-02 for the materials list for Safe Rooms at-grade (referenced in Drawings AG-01 to AG-03.
10. To obtain an equivalent level of protection, Safe Room designs not meeting the specific requirements of the designs in these plans should be designed to meet the FEMA Safe Room Criteria set forth in FEMA 361, "Design and Construction Guidance for Community Safe Rooms."
11. The doors shown in these plans were laboratory-tested for debris impact for door widths from 2'-6" to 3'-0". DHS strongly encourages individuals to use a minimum door width of 2'-8" for wheel chair access.
12. For all construction, use only United States manufactured screws and hardware as there have been high recorded failure rates of screws and hardware imported from other countries.

DESIGN BASIS

1. Live loads used in design:
   - 1.1. Wind pressures developed from 250 mph 3-sec gust in accordance with the wind load calculation procedure in ASCE7-05, Section 6.5 Method 2-Analytical Method as modified by FEMA 361, Chapter 3 for Safe Room Design and Life-Safety Protection.
   - 1.2. Windborne debris (missile) impact loads created by a 15 lb 2x4 traveling horizontally at 100 mph, traveling vertically at 67 mph, and impacting normal to wall surface.
2. Soil bearing capacity of 2,000 psf min. has been assumed.

ABBREVIATIONS

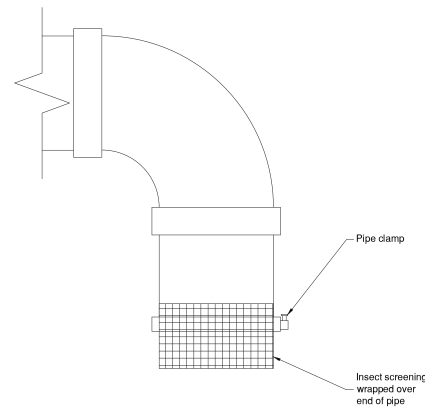
A.B. Anchor
O/C On Center
dia. Diameter
E/W Each Way
ICF Insulated Concrete Form
MH Manhole
Min. Minimum
Max. Maximum
Ksi One thousand pounds per square inch
psi Pounds per square inch
mph Miles per hour
P.T. Pressure Treated
EPS Expanded polystyrene
ga. Gauge



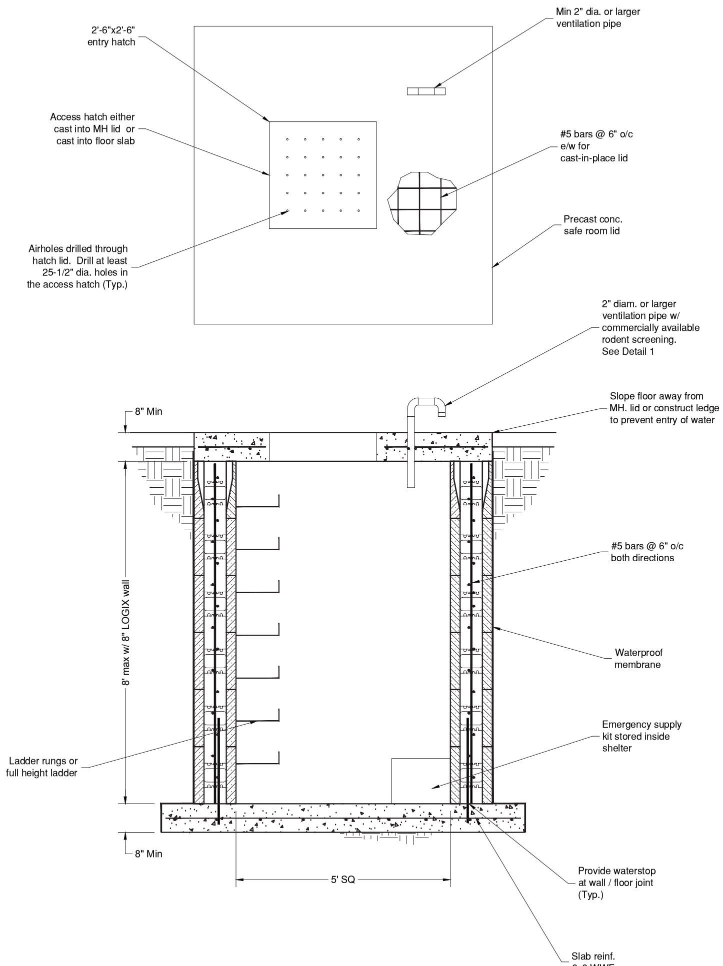
NOTES
1. Because not all contractors are familiar with the type of hatch cover shown in these drawings, the names of some companies that manufacture hatch covers have been included in this table. The list of companies is not, however, exhaustive. Additionally, this list is not intended to express a preference for those manufacturers.
2. Space required inside In-ground Safe Room is min. 5 S.F. / person.
3. Ladders installed should confrom to the requirements of ICC-500.

HATCH COVER REFERENCE	
Manufacturer	Model No.
ACUDOR	FA150
BILCO	J4AL
BABCOCK DAVIS	FB4700

CAUTION!
DO NOT INSTALL IN-GROUND SAFE ROOM IN AREAS OF EXPANSIVE CLAY OR HIGH WATER TABLE, OR IN AREAS THAT ARE FLOOD-PRONE.

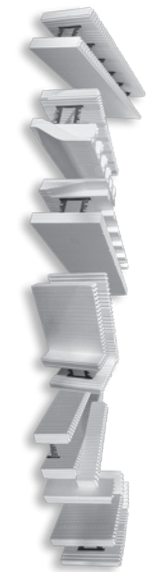


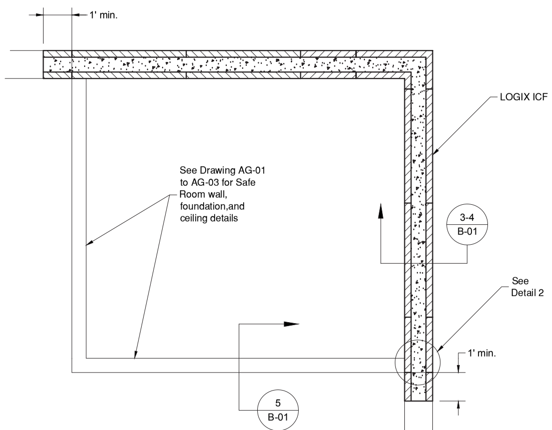
1 IG-01 **RODENT SCREENING**
SCALE: 6" = 1'-0"



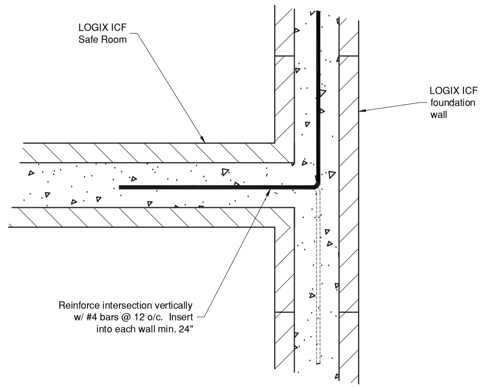
2 IG-01 **CONCRETE BOX**
SCALE: 3/8" = 1'-0"

LOGIX INSULATED CONCRETE FORMS

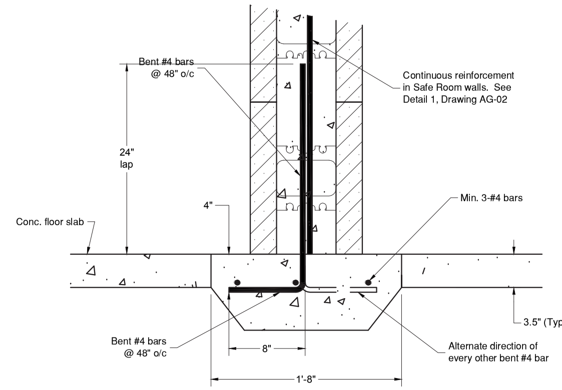




1 B-01 **CORNER SAFE ROOM PARTIAL PLAN**
SCALE: ¼" = 1'-0"



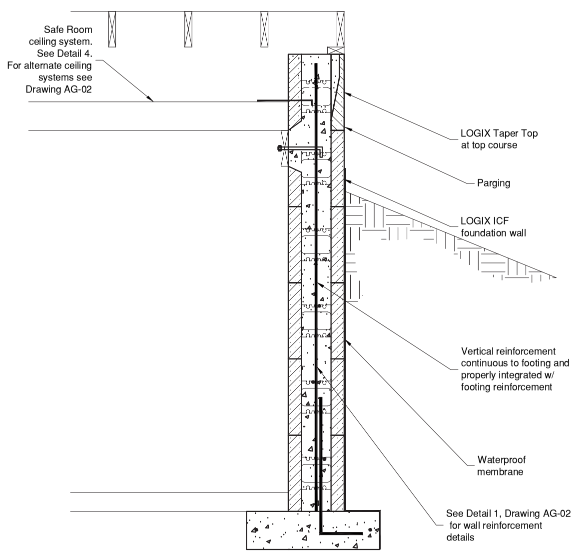
2 B-01 **SAFE ROOM WALL TO FOUNDATION WALL**
SCALE: ¾" = 1'-0"



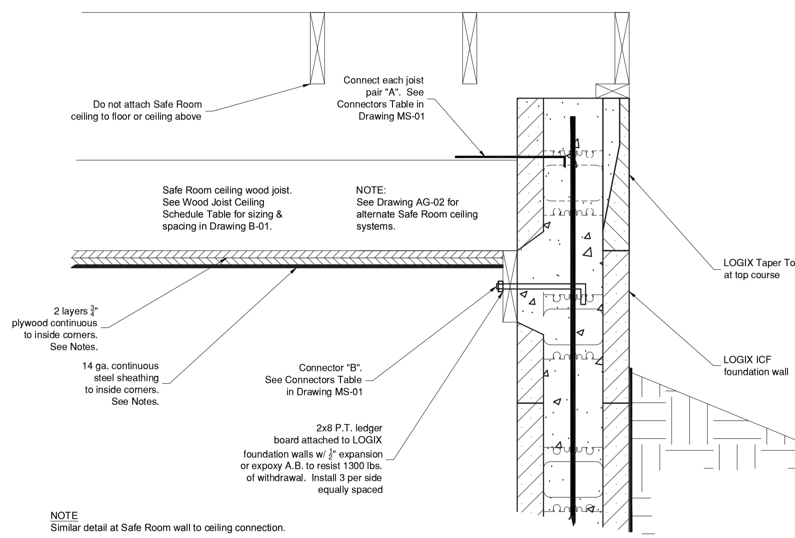
NOTES

1. When permitted by code, a retrofit Safe Room may be anchored to an existing slab if existing slab is found to have adequate thickness and reinforcing at each corner and each side of doorways min. and at a min. #4 bars must be dowelled and expoxy set into the slab such that they provide 1,000 lbs tensile and 800 lbs shear capacity.

5 B-01 **SAFE ROOM INTERIOR WALL FOOTING**
SCALE: 1" = 1'-0"



3 B-01 **FOUNDATION WALL ELEVATION**
SCALE: ½" = 1'-0"



NOTE
Similar detail at Safe Room wall to ceiling connection.

4 B-01 **FOUNDATION WALL ELEVATION**
SAFE ROOM CEILING CONNECTION
SCALE: 1" = 1'-0"

NOTES

1. Protection layer ceiling sheathing (14 ga. steel sheathing and 2 layers of ¾" plywood) orientation to vary 90 degrees by layer.
2. 4 ga. steel sheathing minimally secure with ¼" x 1" self-tapping screws. Or drill steel and secure with #6 x 1" wood deck screws or 8d nails to hold in place.
3. Middle layer ¾" plywood (next to steel sheathing layer) minimally secure with ¼"x1 ½" self-tapping screws to hold in place or drill and secure with #6x1 ½" wood deck screws or 10d nails.
4. Outer layer ¾" plywood attach with ¼"x3" self-tapping screws or drill and secure with #8x3" wood deck screws or 16d nails.
5. See Attachment Schedule Table below for Safe Room ceiling. See materials list for concrete ceiling alternative in Drawing MS-02 .
6. Safe Room w/ steel sheathing uncovered and available for contact by Safe Room occupants must be grounded at a single location with copper wire & ground rod to meet national electric code and local requirements.
7. Safe Room steel sheathing covered with gypsum board finish or otherwise separated from contact by Safe Room occupants need not be grounded,.

ATTACHMENT SCHEDULE

WALL LENGTH	16d NAILS	#8x3" WOOD DECK SCREWS	1/4"x3" SELF-TAPPING SCREWS
3'-6" to 5'	2" o/c @ edges 6" o/c in field	2" o/c @ edges 6" o/c in field	3" o/c @ edges 6" o/c in field
5'-1" to 7'	3" o/c @ edges 6" o/c in field	3" o/c @ edges 6" o/c in field	4" o/c @ edges 6" o/c in field
7'-1" to 12'	4" o/c @ edges 6" o/c in field	4" o/c @ edges 6" o/c in field	6" o/c @ edges 6" o/c in field

WOOD JOIST CEILING SCHEDULE

MAX. SPAN	MAX. JOIST SPACING
8'	2-2"x6" @ 19 ¼" o/c
12'	2-2"x10" @ 16" o/c

LOGIX
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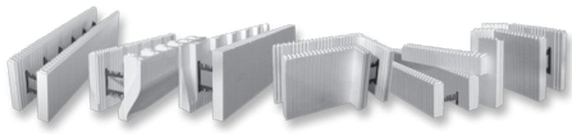
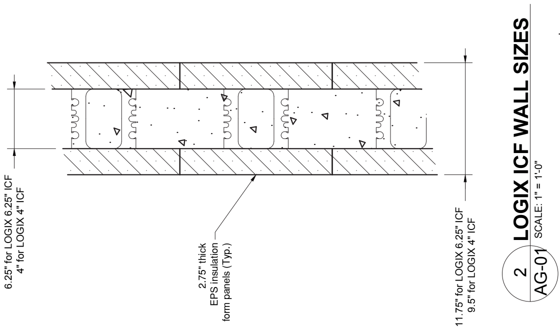
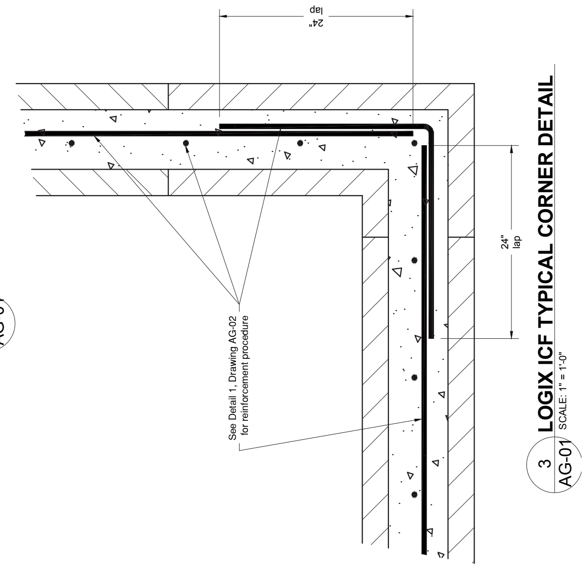
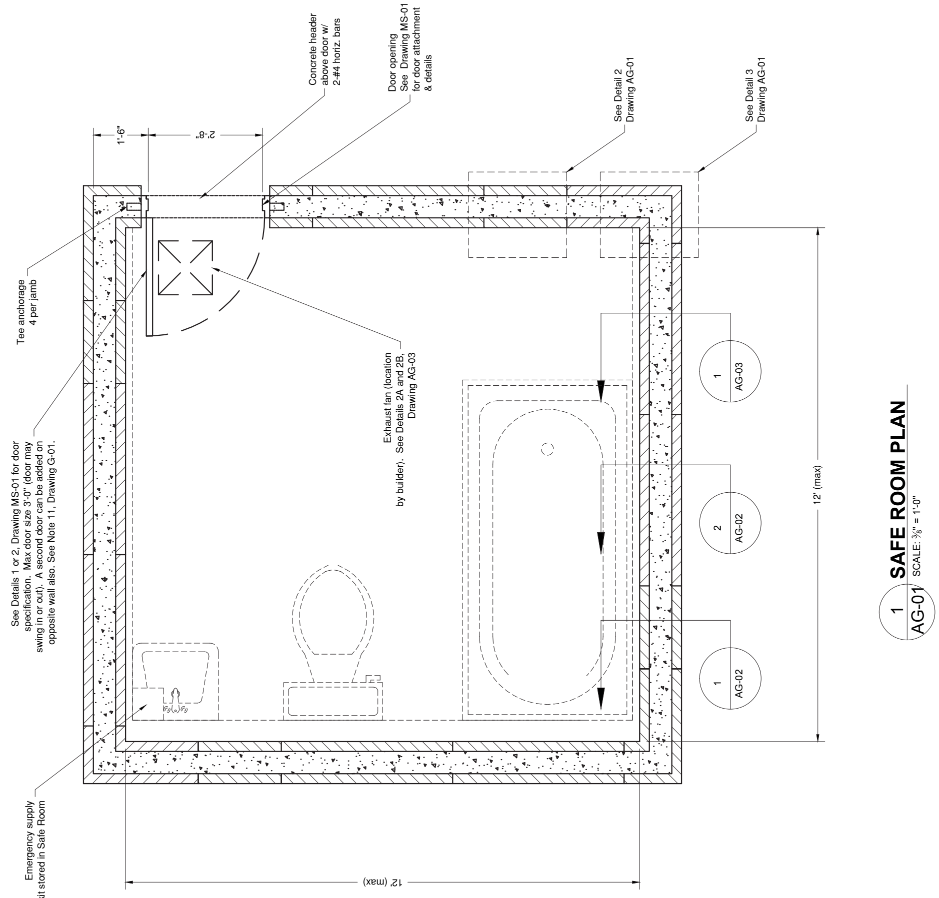
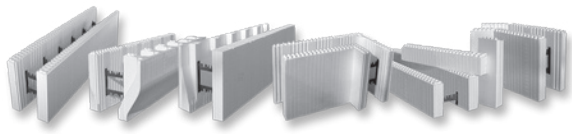
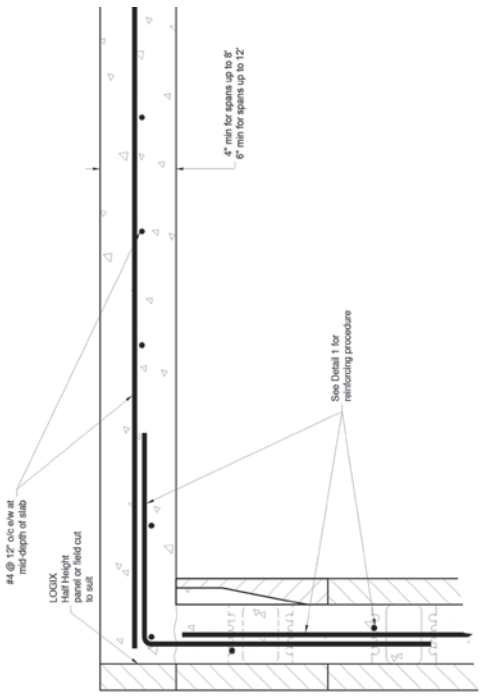




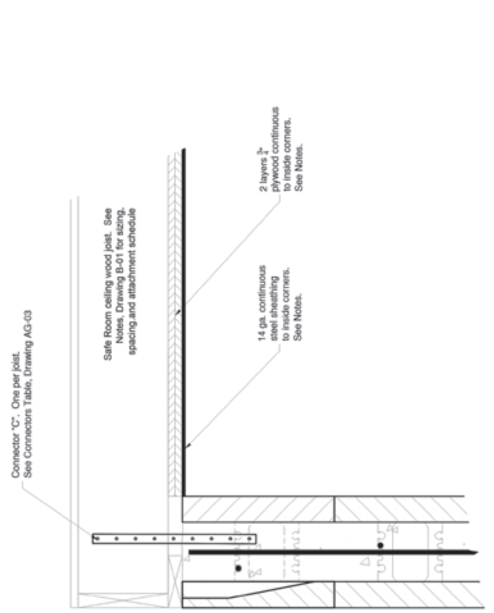




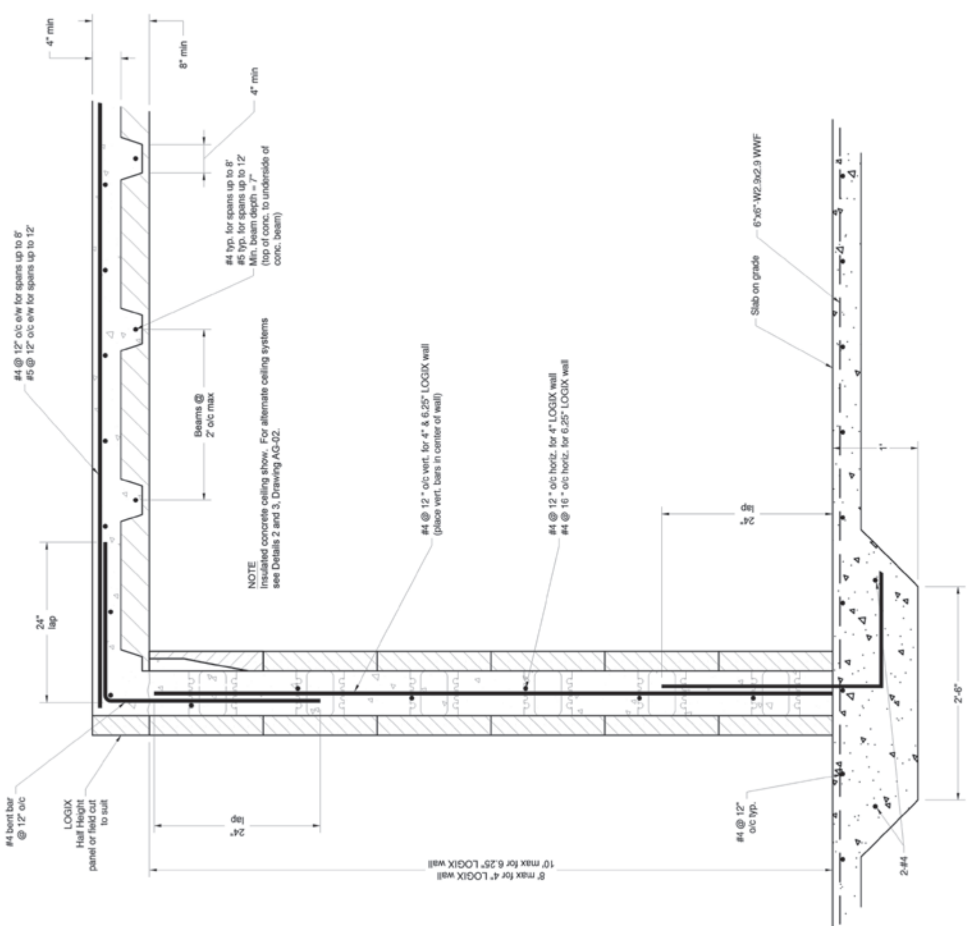




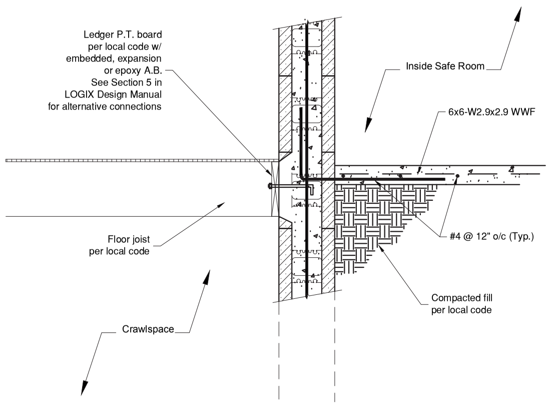
2 AG-02 ALTERNATE CEILING - FLAT CONCRETE CEILING
SCALE: 1" = 1'-0"



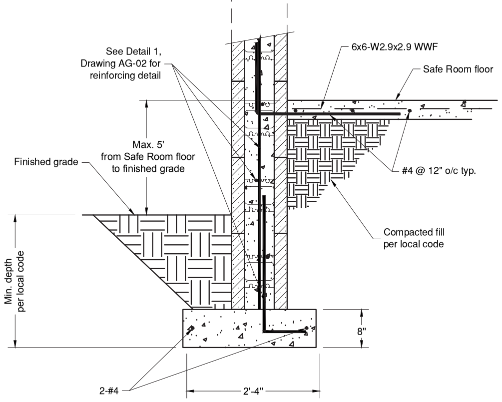
2 AG-02 ALTERNATE CEILING - WOOD JOIST CEILING
SCALE: 1" = 1'-0"



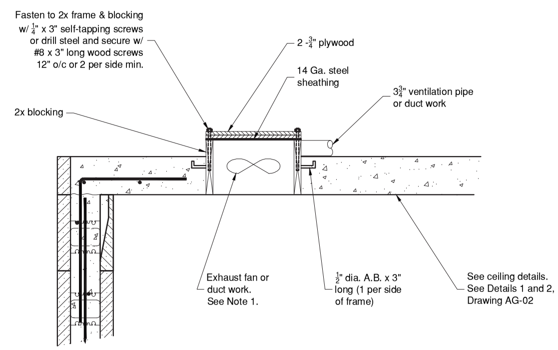
1 AG-02 SAFE ROOM INTERIOR WALL DETAIL
SCALE: 3/4" = 1'-0"



FLOOR CONNECTION DETAIL - CRAWL SPACE FOUNDATION
SCALE: ½" = 1'-0"

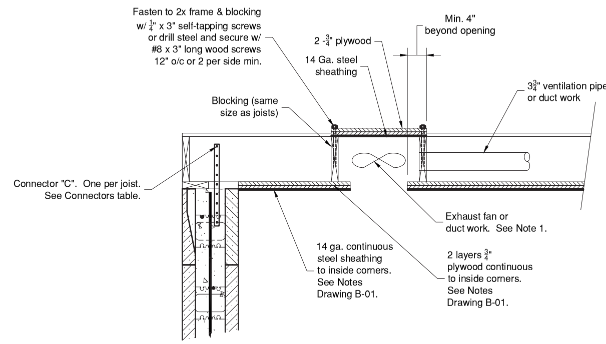


1 AG-03 **FOOTING DETAILS EXTERIOR WALLS**
SCALE: ½" = 1'-0"

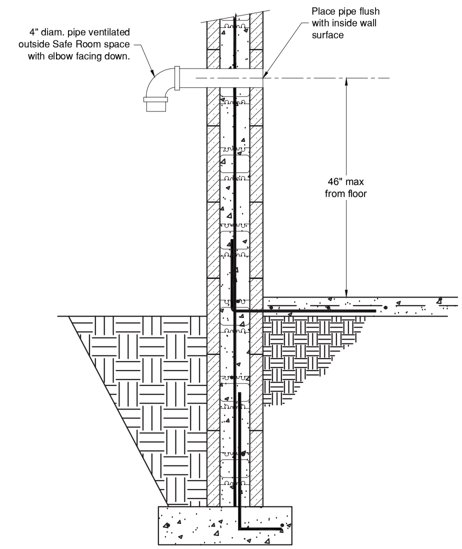


NOTE:
Locate fan opening between ceiling reinforcing bars.
Do not cut reinforcing bars.

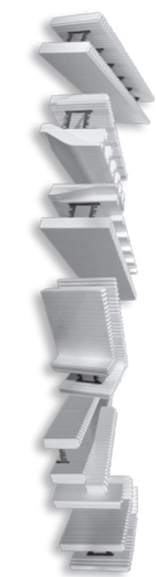
2A AG-03 **CEILING EXHAUST FAN / HVAC DETAIL**
SCALE: ½" = 1'-0"



2B AG-03 **CEILING EXHAUST FAN / HVAC DETAIL**
SCALE: ½" = 1'-0"



3 AG-03 **PASSIVE VENTILATION DETAIL**
EXTERIOR SAFE ROOM WALL TYPICAL
SCALE: ½" = 1'-0"

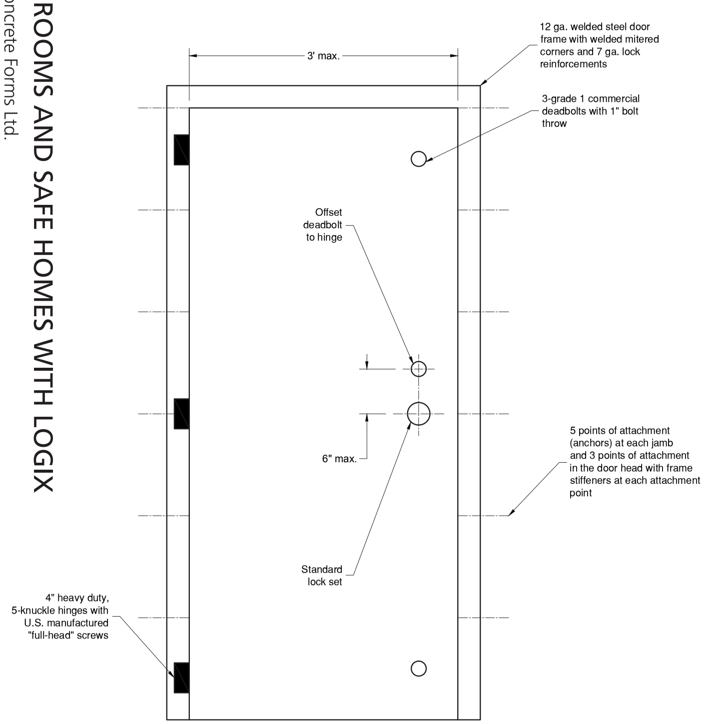


NOTES
1. Indicates normal exhaust ventilation of bathroom or HVAC ductwork to a room. The Safe Room design does not rely on this ventilation to ensure occupant safety.
2. Powered exhaust fans are only required for Safe Rooms as bathrooms.
3. If alternate ventilation apparatus are used on the Safe Room, the ducting of the ventilation must be hardened to prevent the passage of windborne debris into the Safe Room.

CONNECTORS

LOCATION	REQUIRED UPLIFT CAPACITY	SIMPSON STRONG-TIE	UNITED STEEL PRODUCTS
B	1,700 lbs	2-MTS12	2-MTW12
C	1,900 lbs	HHETA16	2-MTA12
A	1,700 lbs	HHETA16 or PAI23	2-HTA12

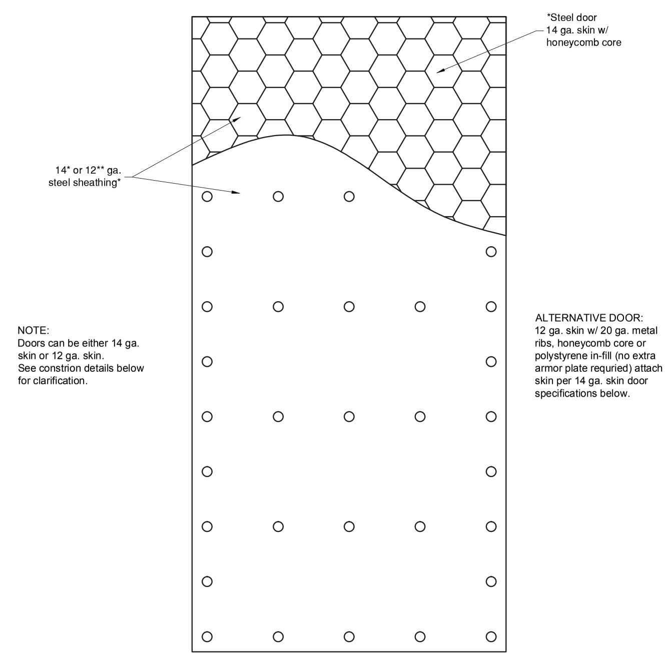
NOTES
Because not all contractors are familiar with the type of structural connectors shown in these drawings, the names of the two companies that manufacture connectors have been included in this table. The list of companies is not, however exhaustive. Additionally, this list is not intended to express a preference for those manufacturers and/or their products, and is not an endorsement of those manufacturers and/or products.



1 MS-01 **DOOR ATTACHMENT DETAILS**

SCALE: $\frac{3}{4}$" = 1'-0"

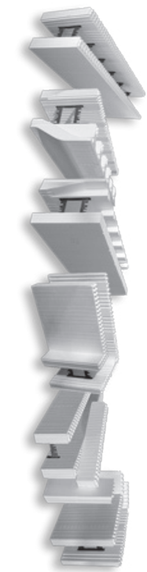
NOTE:
Doors can be either 14 ga. skin or 12 ga. skin.
See constrion details below for clarification.



ALTERNATIVE DOOR:
12 ga. skin w/ 20 ga. metal ribs, honeycomb core or polystyrene in-fill (no extra armor plate requried) attach skin per 14 ga. skin door specifications below.

2 MS-01 **DOOR - SHEET METAL ATTACHMENT PATTERN**

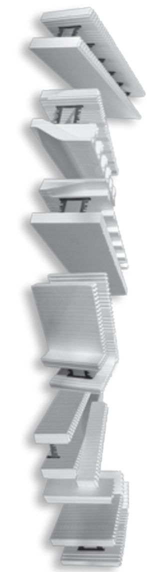
SCALE: $\frac{3}{4}$" = 1'-0"



* CONSTRUCTION OF 14 GA. SKIN DOOR AS FOLLOWS:
1. Vertical steel stiffeners
2. Closer reinforcement
3. 7 ga. hinge reinforcement
4. Reinforced lock boxes
5. Additional 14 ga. skin attached to door w/ $\frac{1}{4}$"x1$\frac{1}{4}$" self-tapping screws w/ hexagon washer heads spaced at 6" o/c along perimeter and 12" o/c in the filed.

** CONSTRUCTION OF 12 GA. SKIN DOOR AS FOLLOWS:
1. 12 ga. vertical steel stiffeners
2. 12 ga. full perimeter channel along the door edges (doubled at door head)
3. 7 ga. hinge reinforcement
4. 7 ga. closer reinforcement
5. 12 ga. reinforced lock boxes
6. Additional 12 ga. skin attached to door w/ $\frac{1}{4}$"x1$\frac{1}{4}$" self-tapping screws w/ hexagon washer heads spaced at 6" o/c along perimeter and 12" o/c in the filed.

RECOMMENDED SIGNAGE CRITERIA (SEE ALSO ICC-500)
1. Install a plaque, sign, or other marking to clearly identify:
   - 250 mph, 3-second gust Safe Room design wind speed
   - Missile impact resistance rating for:
     - 15 lb 2x4 traveling horizontally at 100 mph
     - 15 lb 2x4 traveling vertically at 67 mph
     - Name of shelter, manufacturer or builder
2. The sign shall be mounted on the inside wall of the Safe Room in a prominent location 60" above the floor.



NOTES:
Quantities for 4" and 6.25" LOGIX Safe Rooms based on At-grade Safe Room with the following max. dimensions (See Detail 1, Drawing AG-01 and Drawing AG-02):

- 4" LOGIX: 12' x 12' x 8' tall
- 6.25" LOGIX 12' x 12' x 10' tall

LOGIX ICF WALL

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
LOGIX Standards	4" / 6.25"	Each	20 / 50	
LOGIX Corners	4" / 6.25"	Each	38 / 24	
LOGIX Taper Top	4" / 6.25	Each	13 / 13	
LOGIX Half Height Standards	6.25"	Each	9	
LOGIX Half Height Corners	6.25"	Each	4	
Concrete	4" / 6.25"	yd^3	5 / 10	
Straight #4 bars	4" / 6.25"	feet	813 / 1045	
Bent bars, #4-2'x2'	4" / 6.25"	Each	32 / 32	Horiz. bent bars at corners

SLAB-ON-GRADE FOUNDATION

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
Concrete	4" thick	yd^3	2	
Wire mesh reinforcement	6"x6"-W2.9xW2.9	ft^2	144	

28"x8" THICK FOOTING

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
Concrete	4" thick	yd^3	3	
Straight #4 bars		ft	116	
#4 footing dowels	29" x 8"	Each	52	

INSULATED CONCRETE ROOF ALTERNATIVE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
Forms		ft^2	144	
Concrete		yd^3	2.5	Assuming 4" slab w/ 3" beam (7" beam from top conc. to bottom of beam)
#5 straight bars	4" LOGIX / 6.25" LOGIX	ft	410 / 429	
#4 bent bars	30"x24"	Each	52	Dowels at top of LOGIX wall/ceiling connection

FLAT CONCRETE ROOF ALTERNATIVE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
Concrete	6" thick slab	yd^3	3	
#5 Straight bars	4" LOGIX / 6.25" LOGIX	ft	410 / 429	
#4 bent bars	27"x24"	Each	52	Dowels at top of LOGIX wall/ceiling connection

HARDWARE

MATERIAL	SIZE	MEASURE	QUANTITY	REMARKS
Door frame		Each	1	See Detail 1 and 2, Drawing MS-01
Door		Each	1	See Detail 1 and 2, Drawing MS-01