Preface

Amvic ICFs are the highest quality, most innovative insulated concrete forms available on the market today. Competitive pricing, extensive product distribution and excellent technical support are combined to provide our clients with a simplified approach to a superior finished product at an installation cost less than any other comparable systems.

If any of your questions or concerns are not completely addressed in this manual, please attend one of Amvic's training seminars (check your local area for schedule) or feel free to contact us and our staff will be happy to answer your questions. At Amvic, we pride ourselves in offering our customers an exceptional level of customer service.

Technical Support

Please contact us for any inquiries pertaining to information included in this manual or if you require other technical assistance.

Technical Support 1-877-470-9991 (toll free)
1- 416-410-5674 ext. 129

Amvic Website

The Amvic website is updated regularly with the most current news including testing reports, technical bulletins and evaluation reports. This technical and installation manual is posted on the website.

Amvic website – www.amvicsystem.com

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Disclaimer

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This manual is intended to supplement rather than replace the basic construction knowledge of the construction professional. All structures built with the Amvic Building System must be designed and erected in accordance with all applicable building codes and/or guidance of a licensed professional engineer. In all cases, applicable building code regulations take precedence over this manual.

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Part 1 – Introduction

Amvic Insulated Concrete Forms (ICFs)

Amvic insulated concrete forms (ICFs) are hollow, lightweight forms manufactured using two 2 1/2 inch (63.5m), 1.5lbs/cu.ft density expanded polystyrene (EPS) panels which are connected by uniquely designed, high impact polypropylene webs. During construction, the forms are stacked then filled with concrete making stable, durable and sustainable walls.

Amvic ICFs combine the insulating effectiveness of EPS with the thermal mass and structural strength of a reinforced concrete wall. They also offer a "5 in 1" solution that provides structure, insulation, vapor barrier, sound barrier and attachments for drywall and exterior siding in one easy step.

Walls constructed with Amvic ICFs can provide a fire rating of 3+ hours (6, 8 and 10 inch walls), a sound transmission class (STC) of 50 (some wall assemblies exceed this value) and an insulation value of R-22+. By combining the performance R-value of EPS, the stabilizing effects of concrete thermal mass and the reduced air infiltration rates, Amvic ICF walls can perform up to an equivalent insulation value of R-50.

Figure 1.1 – Amvic ICF products

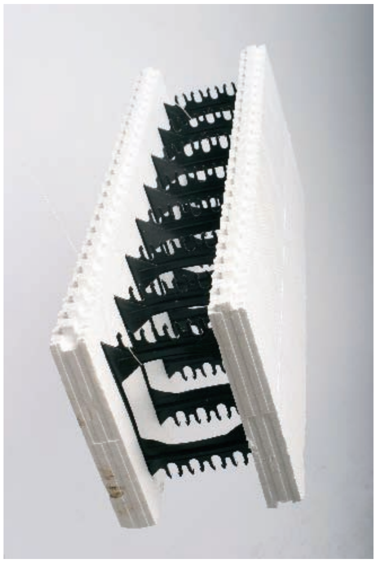


Figure 1.2 – Typical Amvic reversible ICF block

The webs used in Amvic ICF eliminate the need for tie downs and place reinforcing steel most effectively to ensure superior structural strength. The webs are manufactured using more raw material than competing products allowing for superior finishing capabilities and 198 lbs pull out strength for drywall screws. They are also spaced 6 inch (152mm) on center compared to 8 inch (200mm) on center resulting in greater rigidity, which keeps walls straight and plumb during stacking and the pouring of concrete.

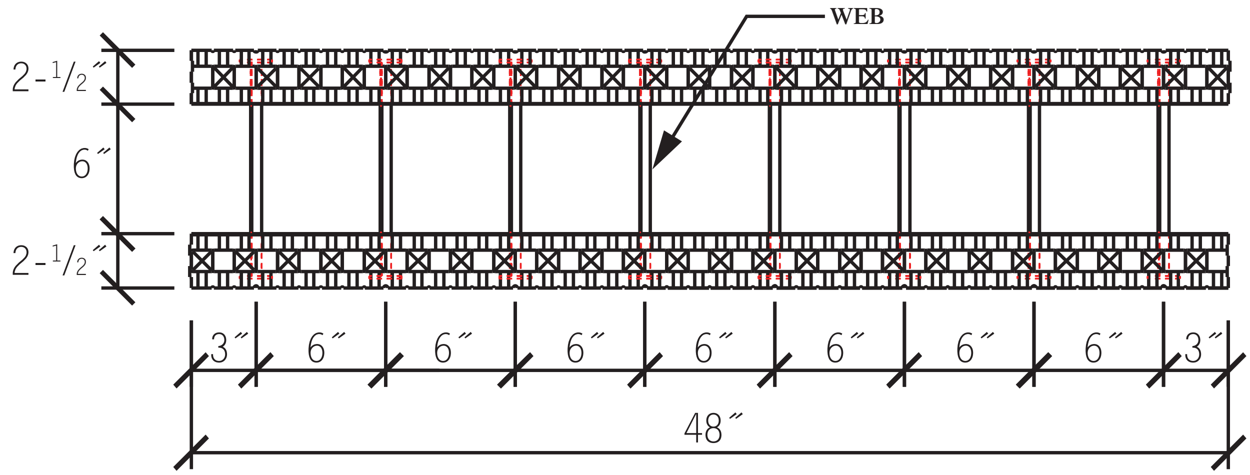


Figure 1.3 – Typical Amvic straight ICF block (6″ shown)

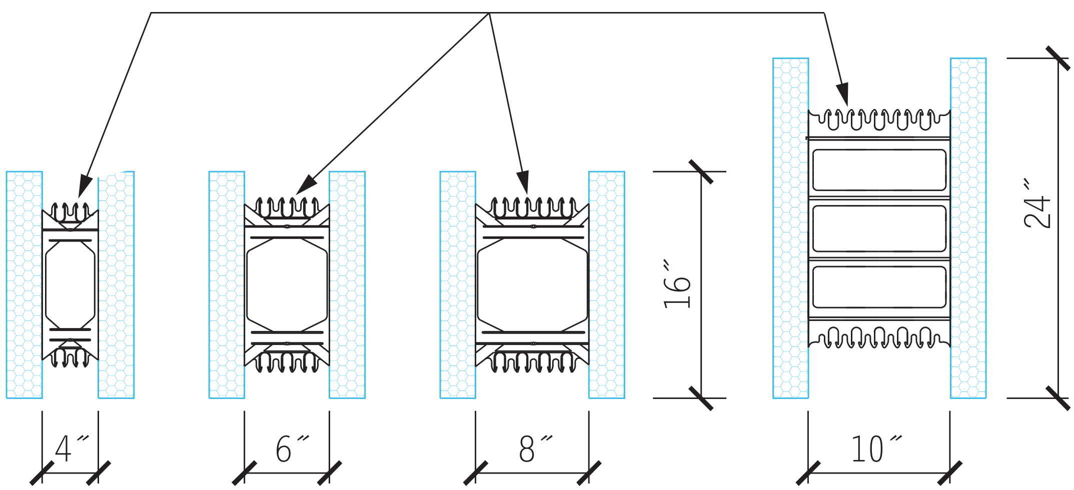


Figure 1.4 – Cross section of Amvic ICF blocks

Amvic webs connect the EPS panels and terminate with a 1 1/2 inch (38mm) flange which is embedded 5/8 inch (16mm) beneath the outside surface of the panels. The flange has a height of 15 inches (381mm) in all blocks except the 10 inch (254mm) block which has a flange height of 23 inches (584mm). When the Amvic blocks are stacked, the flanges form a continuous horizontal and vertical grid which is used to attach interior finishes like drywall and exterior finishes like stucco, wood siding and brick veneer. (Please refer to the interior and exterior applications sections of this manual for more details.)

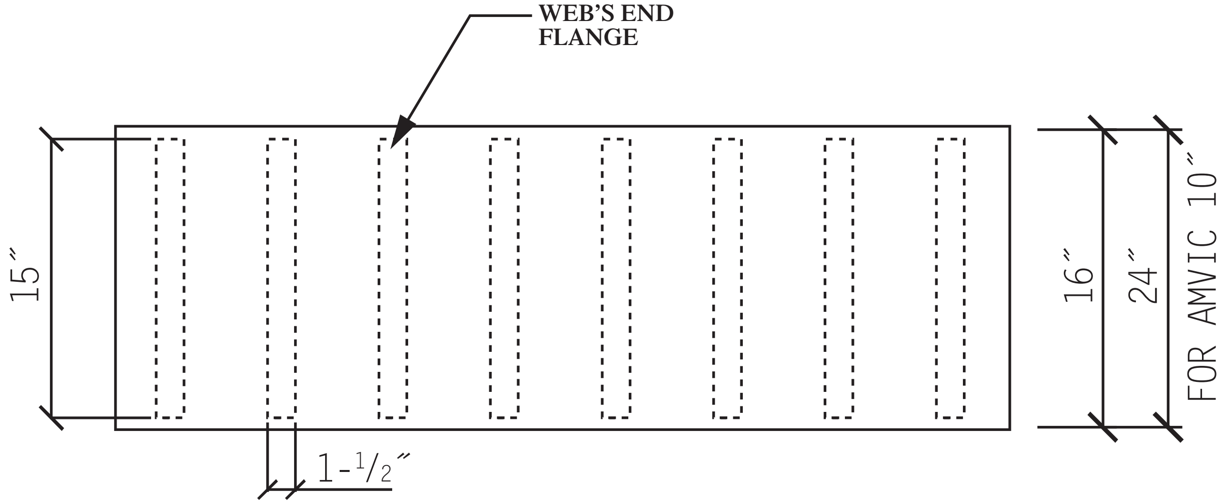


Figure 1.5 – Side view of Amvic ICF straight block showing web flanges

Amvic ICF blocks use the FormLock™ interlocking system developed by Amvic, which has considerably deeper grooves than competing products. The interlock exists on all edges allowing the blocks to be fully reversible. It also secures the courses together, preventing any movement or leakage during the concrete pour. This unique feature allows Amvic ICF to be stacked quickly, easily and without the need for glue or ties. Amvic's user friendly, easy to install system increases job site efficiency and worker productivity which saves time and money.

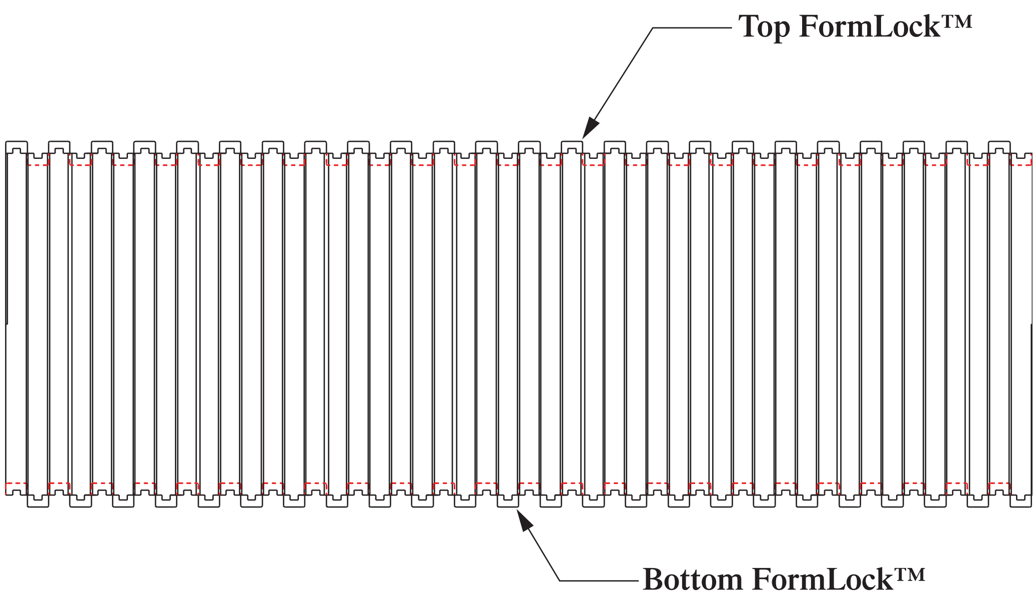


Figure 1.6 – Side view of Amvic straight block showing top and bottom interlocking system

Amvic ICFs are available in a variety of sizes allowing for concrete cores of 4, 6, 8 or 10 inches (100, 152, 200, 254mm). Straight, 90-degree corner, 45-degree corner and curved forms are available in most sizes.

Amvic 90-degree corner blocks have a pocket where a square polypropylene tube (corner rod) can be inserted. Its purpose is to provide a nailing point for mechanical attachments such as sheetrock, lathe or siding which would otherwise not exist in the EPS panel.

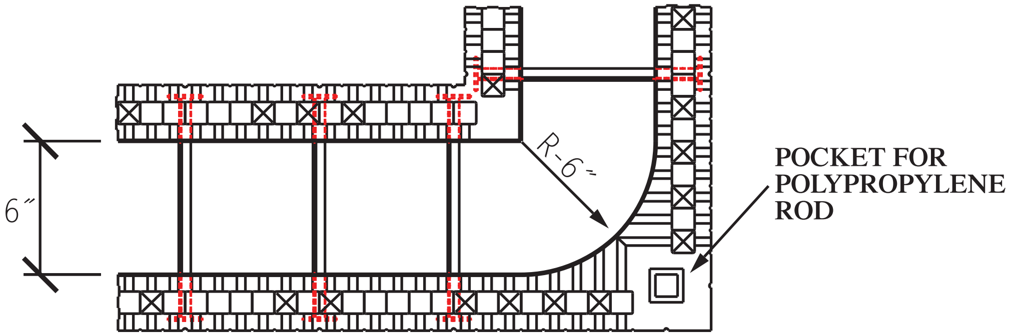


Figure 1.7 – Typical Amvic ICF corner block with pocket for polypropylene tube

Amvic is the best ICF system available on the market today. Competitive pricing, extensive product distribution and professional technical support are combined to provide customers with a superior product with an installation cost less than comparable systems.

Part 2 – Amvic Products

2.1 – Amvic ICF Products

Please refer to the chart below for Amvic ICF products and dimensions.

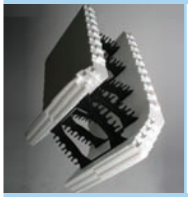
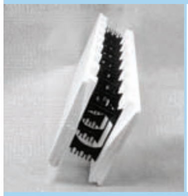
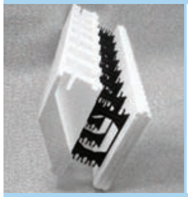
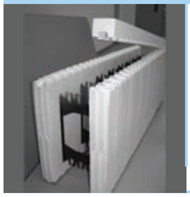
	Product	Concrete Core Width	Form Dimension Inches LxHxW (Metres)	Concrete Volume Per Form	Concrete Volume per sq.ft. of wall area	Surface Area Per Form
	**Amvic Straight Reversible Block**	4˝ (100mm)	48˝x16˝x9˝ (1.2 x0.4 x0.22)	0.066 cu-yd 0.05 m^3	0.012 cu-yd 0.009 m^3	5.33 ft^2 0.5 m^2
		6˝ (152mm)	48˝x16˝x11˝ (1.2 x 0.4 x 0.28)	0.099 cu-yd 0.076 m^3	0.019 cu-yd 0.014 m^3	5.33 ft^2 0.5m^2
		8˝ (203mm)	48˝x16˝x13˝ (1.2 x 0.4 x 0.33)	0.132 cu-yd 0.101 m^3	0.025 cu-yd 0.019 m^3	5.33 ft^2 0.5 m^2
		10˝ (254mm)	48˝x24˝x15˝ (1.2 x 0.61 x 0.38)	0.247 cu-yd 0.189 m^3	0.031 cu-yd 0.024 m^3	8 ft^2 0.74 m^2
	**Amvic 90° Corner Reversible Block***	4˝ (100mm)	[24.5˝ + 12.5˝] x 16˝ x 9˝ (0.62 + 0.32) x 0.4 x 0.22	0.037 cu-yd 0.028 m^3	0.009 cu-yd 0.007 m^3	4.11 ft^2 0.38 m^2
		6˝ (152mm)	[26.5˝ + 14.5˝] x 16˝ x 11˝ (0.67 + 0.37) x 0.4 x 0.28	0.059 cu-yd 0.045 m^3	0.013 cu-yd 0.01 m^3	4.56 ft^2 0.42 m^2
		8˝ (203mm)	[28.5˝ + 16.5˝] x 16 ˝x 13˝ (0.72 + 0.42) x 0.4 x 0.33	0.083 cu-yd 0.064 m^3	0.017 cu-yd 0.013 m^3	5.00 ft^2 0.46 m^2
		10˝ (254mm)	[42.5˝+ 18.5˝] x 24˝ x 15˝ (1.08 + 0.47) x 0.61 x 0.38	0.225 cu-yd 0.172 m^3	0.022 cu-yd 0.017 m^3	10.17 ft^2 0.94 m^2
	**Amvic 45° Corner Reversible Block***	4˝ (100mm)	[21˝+ 9˝] x 16˝ x 9˝ (0.53 + 0.23) x 0.4 x 0.22	0.036 cu-yd 0.028 m^3	0.009 cu-yd 0.008 m^3	3.33 ft^2 0.31 m^2
		6˝ (152mm)	[21.25˝+ 9.25˝] x 16˝ x 11˝ (0.54 + 0.23) x 0.4 x 0.28	0.05 cu-yd 0.038 m^3	0.015 cu-yd 0.011 m^3	3.38 ft^2 0.31 m^2
		8˝ (203mm)	[22˝+10˝] x 16˝ x 13˝ (0.56 + 0.25) x 0.4 x 0.33	0.068 cu-yd 0.052 m^3	0.019 cu-yd 0.015 m^3	3.56 ft^2 0.33m^2
	**Amvic Tapered Top Block**	6˝ (152mm)	48˝x16˝x11˝ - 9.5˝ concrete width at top (1.2 x 0.4 x 0.28 - 0.24 concrete width at top)	0.108 cu-yd 0.083 m^3	0.02 cu-yd 0.016 m^3	5.33 ft^2 0.5 m^2
		8˝ (203mm)	48˝x16˝x13˝ - 11.5˝ concrete width at top (1.2 x 0.4 x 0.33 - 0.29 concrete width at top)	0.141 cu-yd 0.108 m^3	0.026 cu-yd 0.02 m^3	5.33 ft^2 0.5 m^2
	**Amvic Brickledge Block**	6˝ (152mm)	48˝x16˝ & 5˝ Brick Ledge space	0.134 cu-yd 0.102 m^3	0.025 cu-yd 0.019 m^3	5.33 ft^2 0.5 m^2
		8˝ (203mm)	48˝x16˝ & 5˝ Brick Ledge space	0.167 cu-yd 0.128 m^3	0.031 cu-yd 0.024 m^3	5.33 ft^2 0.5 m^2
		8˝ to 6˝ transition	48˝x16˝ & 4.5 Brick Ledge space	0.157 cu-yd 0.12 m^3	0.029 cu-yd 0.023 m^3	5.33 ft^2 0.5 m^2
	**Amvic Height Adjuster**	2˝ (50mm)	48˝x2˝x2.5˝ (1.2 x 0.05 x 0.06)	N/A	N/A	N/A
		3˝ (76mm)	48˝ x 3˝ x 2.5˝ (1.2 x 0.076 x 0.06)	N/A	N/A	N/A
		4˝ (100mm)	48˝x4˝x2.5˝ (1.2 x 0.1 x 0.06)	N/A	N/A	N/A

Table 2.1 – Amvic ICF Products

* All dimensions taken are based on the outer perimeter of form.

2.2 – Product & Accessory Packaging

Amvic ICFs and accessories are packaged in bundles to achieve maximum space utilization during shipping. Please refer to table 2.2 below for packaging details.

Item Description	Individual Block Weight	Blocks / Bundle	Bundle Weight	Bundle Size	Approximate # of Bundles on 53 ft trailer*
4˝ Straight	2.975 Kg (6.56 lbs)	18	55.11 Kg (121.5 lbs)	54 3/4˝ X 48 1/2 ˝ X 49˝	48
4˝ 90 Degree	1.634 Kg (3.6 lbs)	24	(90 lbs)	50˝ X 50˝ X 48 1/2˝	48
4˝ 45 Degree	1.765 Kg (3.89 lbs)	24	(97 lbs)	50˝ X 50˝ X 48 1/2˝	48
6˝ Straight	3.005 Kg (6.62 lbs)	15	(103 lbs)	55˝ X 48 1/2˝ X 49˝	46
6˝ 90 Degree	1.706 Kg (3.76 lbs)	12	(48 lbs)	49 3/4˝ X 51 1/2˝ X 27˝	88
6˝ 45 Degree	1.800 Kg (3.97 lbs)	12	(50.5 lbs)	49 3/4˝ X 51 1/2˝ X 27˝	88
6˝ Taper Top	2.957 Kg (6.52 lbs)	15	(101.5 lbs)	55˝ X 48 1/2˝ X 49 ˝	46
6˝ to 6˝ Brickledge	3.700Kg (8.16 lbs)	9	(76.75 lbs)	48 1/2˝ X 48 1/2˝ X 49˝	48
8˝ Straight	3.160 Kg (6.97 lbs)	12	(87 lbs)	53˝ X 48 1/2˝ X 49˝	47
8˝ 90 Degree	1.943 Kg (4.28 lbs)	12	(54.5 lbs)	49 3/4˝ X 59 1/2˝ X 29 3/4˝	76
8˝ 45 Degree	1.900 Kg (4.19 lbs)	12	(53.5 lbs)	49 3/4˝ X 59 1/2˝ X 29 3/4˝	76
8˝ to 6˝ Brickledge	3.289 Kg (7.25 lbs)	9	(68.5 lbs)	49 1/2˝ X 50˝ X 48 1/2˝	48
8˝ Taper Top	3.010 kg (6.64 lbs)	12	(83 lbs)	53˝ X 48 1/2˝ X 49˝	47
8˝ to 8˝ Brickledge	3.700 Kg (8.16 lbs)	9	(76.75 lbs)	54 1/2˝ X 48 1/2˝ X 49˝	48
10˝ Straight	4.000 kg (8.82 lbs)	6	(56 lbs)	50˝ X 45˝ X 48 1/2˝	52
10˝ 90 Degree	4.400 Kg (9.7 lbs)	4	(43 lbs)	49˝ X 43˝ X 33 1/4˝	78

Table 2.2 Amvic ICF Packaging

* Size of 53ft trailer = L X W X H = 636˝ X 99˝ X 109˝

* Trucks usually have a mix of block type bundles .

Table 2.3 lists the most common Amvic ICF accessories available. Contact your local Amvic Distributor to discuss stock availability for accessories and construction tools and equipment.

Item Description	Units / Specs	Units
Accessories		
DuRock Prep-Coat B-2000	50 lb (22.7 kg) bag	ea
Fiber mesh, 475 S.F./roll	10 oz	roll
Ener Foam 12 cans per case	32 oz/can	ea
Foam to Foam 12 per case	24oz/can	ea
Cleaner for foam gun 12 per case	24oz/can	ea
Foam Gun W-FGSSX	piece	ea
Q-Zip Ties 8˝	100 per pk	ea
Q-Zip Ties 24˝	50 per pk	ea
Q-Zip Ties 36˝	50 per pk	ea
Tape 4˝ wide x 180 ft	roll	ea
Tape 1˝ Fiber x 180 ft	roll	ea
Simpson Strong Ties ICFLC	1	ea
Simpson Strong Ties ICFLC-W	1	ea
Simpson Strong Ties ICFLC-CW	1	ea
Simpson Strong Tie Screws ICFL-W & CW	120 per box	ea
Grappler 4´ x 8˝	90 per box	ea
Water Proofing/Damp Proofing Membrane		
System Platon	8´ x 65´ 6˝ (2.44m)	roll
System Platon	6´ 9˝ x 65´ 6˝ (2.07m)	roll
System Platon	6´ 6˝x 65´ 6˝ (1.98 m)	roll
System Platon	6´ x 65´ 6˝ (1.83 m)	roll
System Platon	5´ 5˝ x 65´ 6˝ (1.65m)	roll
System Platon Screws	500 per pack	box
System Platon Plugs	500 per pack	box
System Platon flat washers	100 per pack	box
System Platon Speed Clips	325 per pack	box
System Platon L Molding	10 per bundle	box
Soprema Peel and Stick Primer	coverage 10 rolls per	drum
Soprema Peel and Stick Summer 40 mil	75´ x 36˝	roll
Soprema Peel and Stick Winter 40 mil	75´ x 36˝	roll
Bracing & Alignment System		
Standard 10 Ft Plumwall Brace		piece
Standard 12 FTPlumwall Brace		piece
Econobrace w/ platform and diagonal Brace		piece
Knee Wall Brace (Frostwall Brace)		piece
Outer Corner Angle		piece
Inner Corner Angle		piece
Ground Screws		piece
Wall Brackets		piece
Wall Clips		piece
Wall Pins		piece
Ladder Section Highwall		piece
Outer Brace Assemble (Highwall)		piece
Platform (Highwall)		piece
Hardware Kit		piece
Complete Highwall System (ladder, platform, outer brace and hardware kit)		piece

*Table 2.3 - ICF Accessories**

* Please call Amvic Head Office or Local Distributor for complete or updated list of accessories and other construction tools and equipment.

Part 3 – Tools, Material and Accessory Requirements

3.1 -Tools for Block Installation

- Hand saw, folding pruning saw or conventional rip saw
- Portable power saw
- Keyhole saw
- Table saw (optional)
- Tape measure
- Cordless driver drill and appropriate bits
- Hammer drill
- Reinforcing steel tie tools
- Hammer
- Framing square
- 2 ft Spirit Level
- 6 ft Spirit Level
- Laser level, water level, or transit
- Plumb bob
- Mason's line (Enough to circle entire structure)
- Chalk line
- Foam gun
- Reinforcing steel bender and cutter
- Scaffold planks
- Wall alignment & bracing system
- Steel Stakes to anchor alignment braces (n/a if bracing off a slab)

3.2- Tools for Concrete Pour

- Concrete Vibrator, 1 inch to $1\frac{1}{4}$ inch (25 to 32mm) head – 10 to14 ft (3 to 4.2m) flexible shaft
- Rubber gloves
- Hard hats
- Concrete finishing tools
- Flat shovels for spill cleanup

Tip

Keep a spare concrete vibrator head and shaft on hand in case you need it.

3.3 - Tools for Utility Installation

- Hot Knife (for electric box cutout)
- Electric chain saw (for cutting Romex wiring and plumbing channels)
- Foam gun & Foam

3.4 - Materials list

- Reinforcing steel as required and accessories, e.g. ties, stirrups.
- Screws to attach alignment bracing to ICF blocks ($1\frac{5}{8}$ inch, $2\frac{1}{2}$ inch, #10 coarse thread)
- Concrete Screws $1\frac{1}{2}$ to $1\frac{3}{4}$ inch to attach foot of alignment braces to concrete slab (TAPCON brand or equivalent)
- Material for rough openings (i.e. 2x10, 2x6, etc.) lumber or plywood for fabricating wood bucks or vinyl bucks
- Tie wire in rolls and in pre-made reinforcing steel tie loops
- Anchor bolts, nuts, and washers or Simpson Strong-tie® ICFLC ledger connectors
- Sleeves for mechanical and/or electrical fixtures
- OSB or plywood for bridging cut joints, or removed webs, block outs for anchor bolts, etc.
- Foam 2 Foam® EPS controlled-expansion foam/adhesive
- Waterproofing / Damp Proofing system

Part 4 – Construction Overview

10 Step Construction Guide

Step 1 - Plan the outline of the block and the location of door and window openings on a conventional footing or a slab that is level, straight and square. Reinforcing steel dowels should extend upward from the footing into the cavity of the block or as per engineering and/or local code requirements.

Figure 4.1 – Outlining walls

Step 2 - Place the first corner blocks on each corner, then lay the straight blocks toward the center of each wall segment. On the first course, use zip-ties or wire ties on the webs to connect the blocks and pull them snugly together. Following this, install horizontal steel reinforcement by placing it in the clips at the top of the internal webs within the block cavity. The clips hold the reinforcing steel securely and eliminate the need for wire tying. (Repeat this process for each course of block).

Figure 4.2 – Placing corner blocks first

Figure 4.3 – Installing horizontal reinforcing steel and lap splicing

Step 3 - Install the second course of ICF by reversing the corner blocks, so that the second course of block is offset from the first, in a running bond pattern. At this point check for level across all of the blocks. If the courses are not level, use shims or trim the block as required.

Figure 4.4 – Installing second course of ICF

Step 4 - Install window & door frames ("bucks") at each location where an opening is required; cut and fit the Amvic blocks around them. Bucks are used to hold back the concrete and stay in place permanently providing a nailing surface for the installation of windows and doors. Pressure-treated lumber or vinyl bucks may be used.

Figure 4.5 – Installing window and door bucks

Step 5 - Install additional courses of block by continuing to overlap the courses so that all joints are locked both above and below by overlapping blocks.

Figure 4.6 – Continuing installing block courses

Step 6 - Install alignment bracing around the entire wall of the structure to ensure that the walls are straight and plumb and to enable alignment adjustment before and during the pour. The bracing also serves the dual purpose of providing a secure and safe framework to support scaffolding planks once five courses have been stacked.

Figure 4.7 – Installing alignment and bracing system around the perimeter of the wall

Step 7 - Stack the block to the full wall height for single storey construction, or to just above floor height for multi storey construction. Cut the vertical reinforcing steel to length and begin installing it from the opening at the top of the wall, through the spaces between the horizontal reinforcing steel.

Figure 4.8 – Install vertical reinforcing steel after top course of blocks

Step 8 - Pour the concrete into the stacked walls using a boom pump. Do this in lifts approximately 3-4 ft (0.9-1.2m) at a time, circling the structure until the top of the wall is reached. Next, use a mechanical pencil vibrator (stinger) to vibrate the concrete and remove all air pockets within the wall. Up to one story can be poured each day using this method.

Figure 4.9 – Pouring concrete in lifts of 3-4 ft (0.9-1.2m)

Step 9 - Screed off the concrete until it is even with the block top and then "wet set" anchor bolts into the concrete top. These bolts will be used later to install the top plate (mud sill) for the installation of rafters or trusses.

Figure 4.10 – Wet set anchor bolts in top course of upper floor

Step 10 - Remove bracing after the concrete has cured, then proceed with further stages of construction.

Part 5 – Window & Door Openings

5.1 Window & Door Bucks

Window and door bucks are an integral part of the ICF construction process. This section explains the main principles and most common methods of buck construction and installation.

The two most common materials used for bucks are wood and vinyl. Some contractors build their own bucks using 2x lumber, while others prefer using a vinyl buck.

Please Note

Experienced ICF installers use a variety of methods for forming and installing bucks. This section only provides a guideline for new ICF installers.

Figure 5.1 – Constructing window/door bucks

Tip

In many cases the specified window rough opening is the size of the buck, and the window itself is smaller. In the case of a few window manufacturers, their specified rough opening is the size of the window frame itself and a larger rough opening is required.

VERIFY THIS BEFORE BEGINNING!

5.2 - Wood Bucks

5.2.1 – Choosing the Lumber

Historically, full dimension pressure treated 2x lumber was used to construct bucks. More recently builders who still use wood bucks are using untreated wood with a waterproof barrier between the buck and the concrete surface. Untreated wood is available in higher quality, is easier to work with and the waterproof barrier keeps the buck straighter. In both circumstances, wood bucks will distort and twist to some degree which can cause window, trim and sheetrock installation problems.

Figure 5.2 – Typical buck made of pressure treated lumber

Figure 5.3 – Untreated lumber with waterproof barrier

5.2.2 - Constructing Wood Bucks

When constructing a wood buck for Amvic 6 inch (152mm) block, trim 2x12 stock lumber for the top and sides of the buck since the total thickness of the block is 11 inches. This may be done using a table saw. The bottom of the buck should be constructed using two pressure treated 2x4s. This leaves an opening at the bottom of the window through which concrete will be poured and consolidated using a vibrator. (Fig 5.4 & 5.5 below).

Figure 5.4 – Typical window buck bottom construction

Figure 5.5 – Opening at bottom of window buck for pouring concrete

5.2.3 - Connecting Wood Bucks to Concrete

The simplest way to connect wood bucks to the concrete wall is to drive galvanized 16d nails through the bucks, so the nails will be embedded into the concrete when it is poured. Alternatively, galvanized deck screws can be used.

Install the nails or screws every 12 inches (300 mm) at opposing angles (i.e. 20-30 degrees from perpendicular), to prevent movement of the buck once the concrete has set.

Figure 5.6 – Installing nails into the bucks for attachment to concrete

5.3 - Vinyl Bucks

Increasingly builders are using bucks made from extruded vinyl. These bucks come in sections and are commonly cut on site with either a portable power saw, or more conveniently a compound miter saw. Connectors are used at the corners to tie the cut sides together.

Figure 5.7 – Typical vinyl window buck

5.3.1 - Advantages

- Labour is 50% less for vinyl than wood bucks
- Vinyl does not rot or decay
- Vinyl bucks do not allow moisture to seep into the structure should a leak develop around a window
- Vinyl is substantially lighter than wood
- Curves and rounds are much easier to construct and install (please refer to Figure 5.8). Vinyl bucks can be bent into the desired shape on site, or can be ordered pre-formed (recommended).

Figure 5.8 – Round openings can be formed easily using vinyl bucks

- Flanges on the vinyl buck capture the edges of the block at the openings and eliminate the need for gluing and additional cleats and bracing.
- Material waste is minimal. With couplers, the waste pieces can be rejoined and made fully usable.

5.3.2 - Disadvantages

- Vinyl bucks are not as stiff as wood bucks and require more bracing to prevent flexing and to maintain square and plumb position during the concrete pour.
- Vinyl bucks are typically more expensive than lumber.

5.3.3 – Steps for Vinyl Buck Construction

Vinyl bucks come in standard 16 ft (4.8m) lengths with full accessory packages. They can be ordered pre-built to required size, which is recommended since it reduces on site labor. Packages contain corner connectors, straight connectors and metal squaring pans. Bracing pans must be used with vinyl bucks.

Figure 5.9 – Vinyl bucks come with accessories including bracing pans and connectors

1. Cut vinyl into required lengths for buck construction.

5.10 – Cutting vinyl bucks to required size

Link

V-Buck is one of the most common types of vinyl bucks currently used with Amvic ICF. Please visit their website address below for more information about their product and accessories.

www.vbuck.com

2. Cut a hole in the bottom buck (sill) to allow for concrete pouring and vibration.

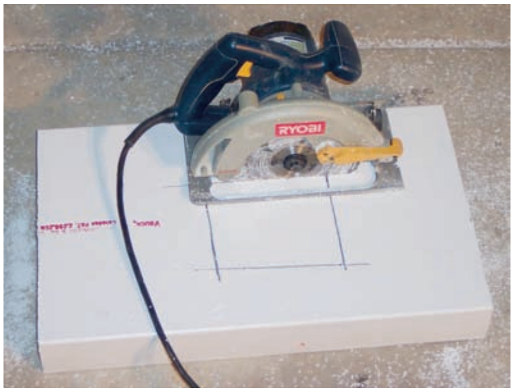


Figure 5.11 – Cutting a hole in bottom buck

Figure 5.12 – Bottom buck is ready for pouring concrete

3. Insert corner connectors on both ends of the sill

Figure 5.13 – Inserting Connectors. Image courtesy of V-Buck

4. Attach the two side bucks to the sill.
5. Insert the final corner connectors to the two side bucks and install the window or door header piece in place.

Figure 5.14 – Attaching side pieces to the sill.
(Hole for pouring concrete not shown.)
Image courtesy of V-Buck

Figure 5.15 – Installing the header.
(Hole for pouring concrete not shown.)
Image courtesy of V-Buck

6. Insert the corner metal bracings and screw to the sides of the buck.
7. The completed buck is now ready to be installed in the proper location during construction.

Figure 5.16 – Bracing the bucks with metal corner pans. Image courtesy of V-Buck

Figure 5.17 – Placing the complete buck in appropriate place. Image courtesy of V-Buck

Part 6 – Steel Reinforcement for Walls

6.1 – Overview

Building any structure using Amvic ICFs requires the installer to have a good knowledge of the fundamentals of steel reinforcement. This part of the manual will discuss the basics of reinforcing steel requirements for Amvic ICF walls.

6.2 – Plan Requirements

The designer (Architect/Engineer) of any project should clearly indicate the following information on his plans:

1. Separate cross sections of all walls using Amvic ICF. Each cross section should clearly show the size of Amvic ICF block used (i.e. 4, 6, 8, or 10 inch) for the building inspector and installer.
2. Each cross section should show the wall heights involved for every storey.
3. Vertical and horizontal reinforcing steel bar sizes, spacing and grade of steel should be clearly marked for every storey in each wall cross section or in a separate note on other sheets.
4. The placement of reinforcing steel, especially the vertical ones should be clearly marked (i.e. off center or towards interior/exterior or centered in the wall).
5. The designer should specify the lap splice type and lengths for every section of the wall where splicing is anticipated. (Please refer to Reinforcing Steel Splicing in **section 6.6** of this chapter.)

6.3 – The Purpose of Reinforcing Bars

Reinforced concrete structures are composed of two different materials;

a. Concrete

b. Steel

Plain concrete is a strong material in compression. Compressing a plain concrete cube or cylinder requires a relatively large amount of compressive force before reaching compression failure. However plain concrete is relatively weak in tension (typically can only carry one tenth ($1/10$) of its compression strength in tension).

Reinforcing steel has excellent strength in both compression and tension loads but is more expensive than concrete.

Therefore reinforced concrete structures are typically designed by engineers such that concrete is mainly utilized for most of the compressive forces and reinforcing steel is utilized for all of the tensile forces and in some cases some of the compressive forces.

The design of reinforced concrete structures have been streamlined particularly over the last century for safety as well as economic feasibility. Reinforced concrete structures have had a tremendous track record in some of the most complicated structures including dams, bridges and high rise buildings across the globe.

6.4 – Horizontal Reinforcement

Amvic polypropylene webs are specifically designed to accommodate and secure the horizontal reinforcing steel in place without the need to tie them.

Typically the first course of horizontal reinforcement is placed in the notches closer to the EPS panel.

The second course of horizontal reinforcement is staggered so that it is placed in the notch towards the center of the concrete wall.

The third course is placed in the same position as the first course. The fourth course is placed in the same position as the second.

This staggered pattern of horizontal reinforcement is necessary to allow for the vertical reinforcement to be placed from the top and weave in between the horizontal steel bars.

Figures 6.1 and 6.2 below show typical vertical and horizontal reinforcing patterns for below grade and above grade applications using 8” Amvic ICF block respectively.

6.5 – Vertical Reinforcement

Vertical reinforcement is placed after the Amvic ICF wall has been stacked and completely erected. In case of a multi-storey wall then the vertical reinforcement is placed after the erection of each individual storey. Vertical reinforcement bars are slid into place from the top and weaved into the horizontal reinforcement and secured into the proper place according to the project plans and specs.

Refer to figures 6.1 and 6.2 below.

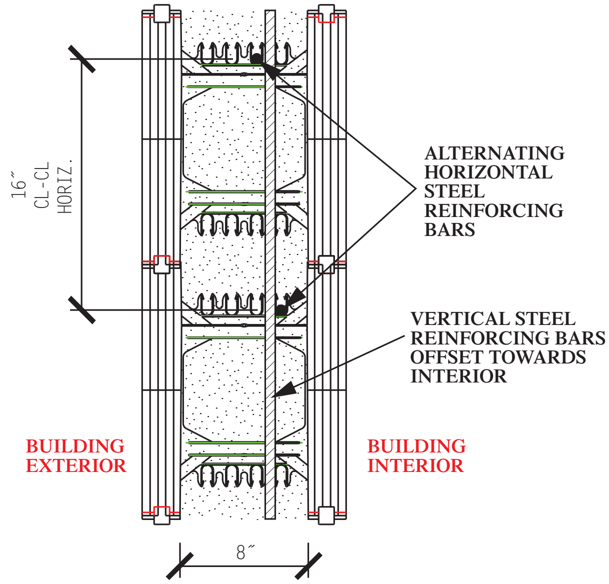


Figure 6.1 – Typical below grade reinforcing steel placement

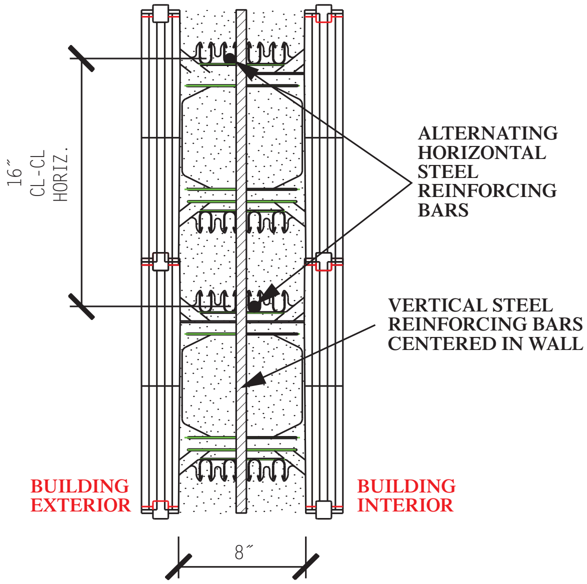


Figure 6.2 – Typical above grade reinforcing steel placement

6.6 - Reinforcement for Wall Openings

Most walls will have window or door openings or both. Creating a wall opening in a reinforced concrete wall creates extra stress around that opening especially at the corners. Window and door headers also known as lintels can be subjected to significant bending moment and shear forces depending on several factors.

Please refer to Appendix A for more details on how to handle reinforcement in wall openings.

6.7 – Reinforcement Splicing

Steel reinforcement typically comes in 20 foot (6 meter) lengths. In such cases where steel reinforcement is required to exceed this length, then a splice is required. The main purpose of the splice is to transform the stresses whether tensile or compression from one steel reinforcing bar or a group of bundled bars to another in a manner to satisfy the governing local building/engineering codes and/or requirements of engineering plans and specs.

6.7.1 – Types of Lap Splice

For the purpose and scope of this manual we will only discuss one type of splicing known as **lap splicing.**

Lap splicing is typically overlapping reinforcing steel over a certain length. The length of the splice should be calculated according to the local building codes or by a local engineer and specified on the project plans.

There are two main types of lap splices:

1. **Contact Lap Splice** – The lapped reinforcing bars MUST be in contact with each other and secured together.

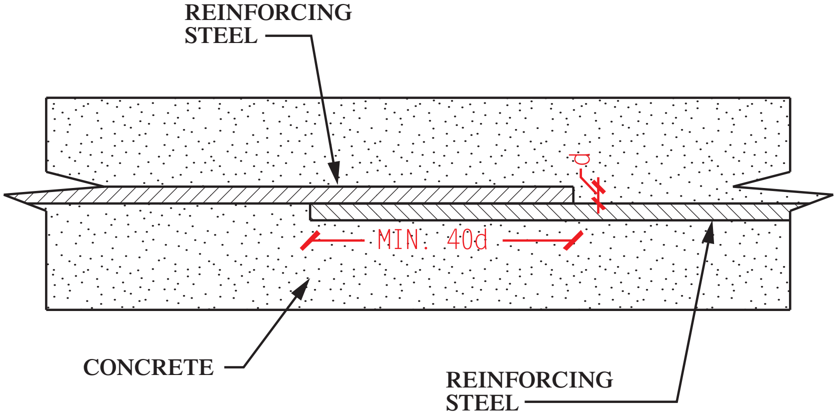


Figure 6.3 – Contact lap splice

2. **Non Contact Lap Splice** – The reinforcing bars are allowed to be spaced at a distance of one fifth ($^{1}/_{5}$) of the lapped length to a maximum of 150 mm or 6 inches.

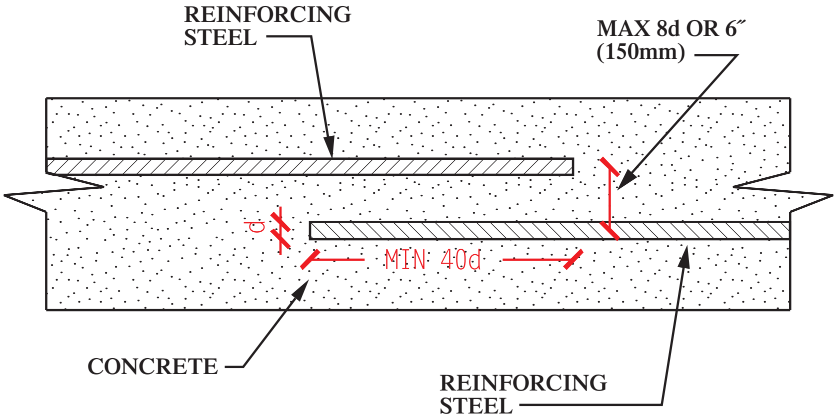


Figure 6.4 – Non-contact lap splice

6.7.2 – Minimum Requirement for Lap Splice Length

Both types of lap splices have a minimum splice length requirement as follows:

Tip

Minimum Lap Splice Length = 40 x Reinforcing Steel bar diameter (40d)

Example

Canadian Reinforcing Steel System

When splicing a 10M reinforcing steel bar which has a diameter of 11.3mm, the minimum lapped splice length is:

40 x 11.3mm = 452mm

Example

US Reinforcing Steel System

When splicing a #5 reinforcing steel bar which has a diameter of 0.625 inches, the minimum lapped splice length is:

40 x 0.625 inches = 25 inches

6.8 – Lapped Splices for Multiple Concrete Pours

When a project has more than one storey of Amvic ICF walls, it is necessary for the installer to understand how to perform vertical reinforcement lap splices between the different pours.

There are two options, both of which are satisfactory from an engineering/structural standpoint.

Option 1

Extend the vertical reinforcement steel bars beyond the top level of the lower storey. The length of the extension should be equal to the required splice length specified by the design engineer or a minimum length of 40d (where d = diameter of smaller steel bar being spliced). Please refer to figure 6.5 below for typical details.

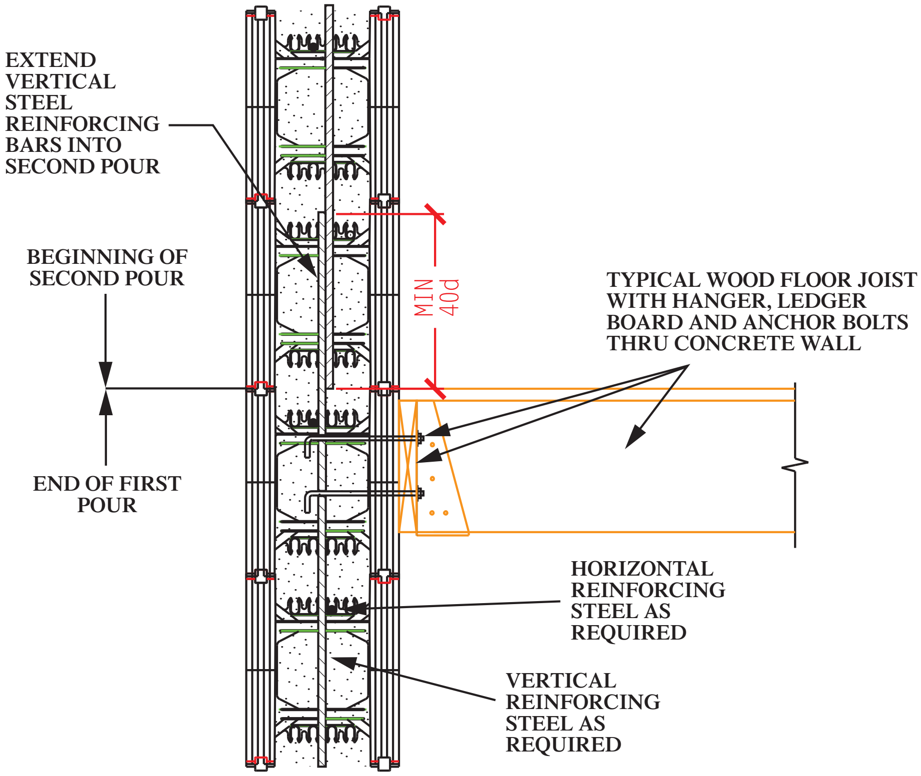


Figure 6.5 – Vertical lap splice

Option 2

Cut the vertical reinforcement steel bars for the lower storey so that they are flush with the top of that wall. Shortly after pouring the concrete, wet set additional vertical reinforcing bars also known as dowels into the concrete. These should extend into the freshly poured wall a length equal to the splice length specified by the design engineer or a minimum length of 40d (where d = diameter of smaller steel bar being spliced). The wet-set vertical splice reinforcing steel bars should ALSO protrude into the upper wall by the same splice length specified by the design engineer or 40d as a minimum. Please refer to figure 6.6 below for details.

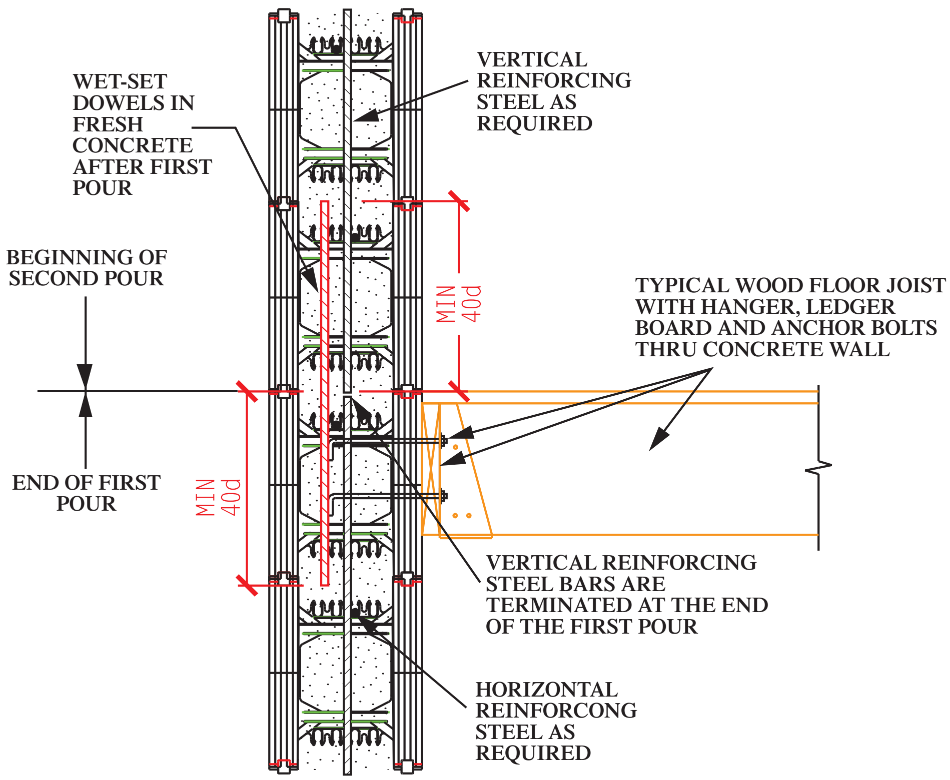


Figure 6.6 – Vertical lap splice using a dowel

6.9 – Designing Reinforcing Steel for Walls

Determining the reinforcing steel schedule whether vertical or horizontal is a structural engineering task which depends on many factors. This is beyond the scope of this technical manual, however, some tools are available for the residential construction market to assist in reinforcing steel design. The tools are explained below.

6.9.1 – Canada

CCMC report no.13043-R contains reinforcing steel tables for below grade and up to 2 storeys of above grade applications in residential projects. The report also contains some lintel tables for wall openings both in metric and imperial units.

There are applicability limits mentioned in the report which must be adhered to.

Code Requirements

A – Design of reinforced concrete shall be in accordance with CSA A23.3.

B – Reinforcing steel placement shall conform to CSA A23.1, CSA A23.4 and/or the local building code having jurisdiction.

C – Reinforcing steel bars shall conform to clause 7 of CSA A23.1 AND CSA G30.18.

D – Minimum Steel Yield Strength shall not be less than 300 MPA (40 ksi).

If the particular project at hand falls outside of these limits then a local licensed/registered engineer should be retained.

6.9.2 – United States

NAHB (National Association of Home Builders) in association with PCA (Portland Cement Association) have prepared the **“Prescriptive Method for Insulating Concrete Forms in Residential Construction”** specifically for the ICF industry [REF. 1].

This document contains reinforcing steel schedules for below grade and up to 2 storeys above grade applications. It also contains several lintel tables for wall openings in different applications. As expected, there are limitations which must be adhered to.

Code Requirements

A – Design of reinforced concrete and placement of reinforcing steel bars shall be in accordance to ACI 318 or ACI 332 and/or the local building code having jurisdiction.

B – Reinforcing steel bars shall conform to one of the following specifications;
1 – ASTM A615 – Specifications for Deformed and Plain Billet-Steel Bars

B – 2 – ASTM A706 – Specifications for Low-Alloy Steel Deformed and Plain Bars

B – 3 – ASTM A996 – Specifications for Rail-Steel and Axle Steel Deformed Bars

C – Minimum yield strength of reinforcing steel shall be Grade 40 (300 MPa) except for seismic design categories D1 & D2 the minimum yield strength of reinforcing steel shall be Grade 60 (400 MPa).

For applications that fall outside the scope of the **"Prescriptive Method"** a local licensed/registered engineer should be retained.

PCA (Portland Cement Association) has prepared another tool for engineers to assist in the design of ICF walls – "Structural Design of Insulating Concrete Form Walls in Residential Construction" [REF. 2]. This publication explains in more detail the engineering principles involved in design load bearing and non-load bearing ICF walls even for walls outside the scope of "The Prescriptive Method".

6.10 – Steel Reinforcing Bars and Jobsite Safety

Unguarded protruding steel reinforcing bars are hazardous and can result in injury or death.

The following measures greatly reduce the hazards of exposed reinforcing steel:

- Guard all protruding ends of reinforcing steel bars with caps or wooden troughs, or
- Bend reinforcing steel so exposed ends are no longer upright.
- When employees are working at any height above exposed rebar, fall protection/ prevention is the first line of defense against impalement.

Figure 6.7 – Plastic mushroom caps on protruding steel bars

Code Compliance

According to OSHA (Occupational Safey & Health Administration – USA) article 1926.701 (b), the following clause shall apply to the jobsite:

"All protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement."

A similar compliance clause present in OSHA (Occupational Health and Safety Act – Canada).

Part 7 – Preparing Footings & Slab on Grade (SOG)

7.0 – Introduction

An Amvic ICF wall can be started from either a footing or a slab depending on the design and engineering/architectural requirements. There are benefits and drawbacks to both methods, with no clear advantage one way or the other.

First Course of Block Set on Slab

The benefit to starting an Amvic wall on a slab is that there is a hard, level surface to work on and to anchor bracing on. A sturdy working surface can increase job site efficiency.

First Course of Block Set on a Footing

The primary advantage to starting from a footing is that the ICF provides slab edge insulation. The edge of a slab, where the floor is located is where the greatest amount of heat loss occurs in the winter. By insulating this area, heat loss is minimized and homeowners experience cost savings. This method is also preferable when a radiant floor heating system will be used, or if the final floor finish will be stained and sealed concrete. (Fig 7.1 Below)

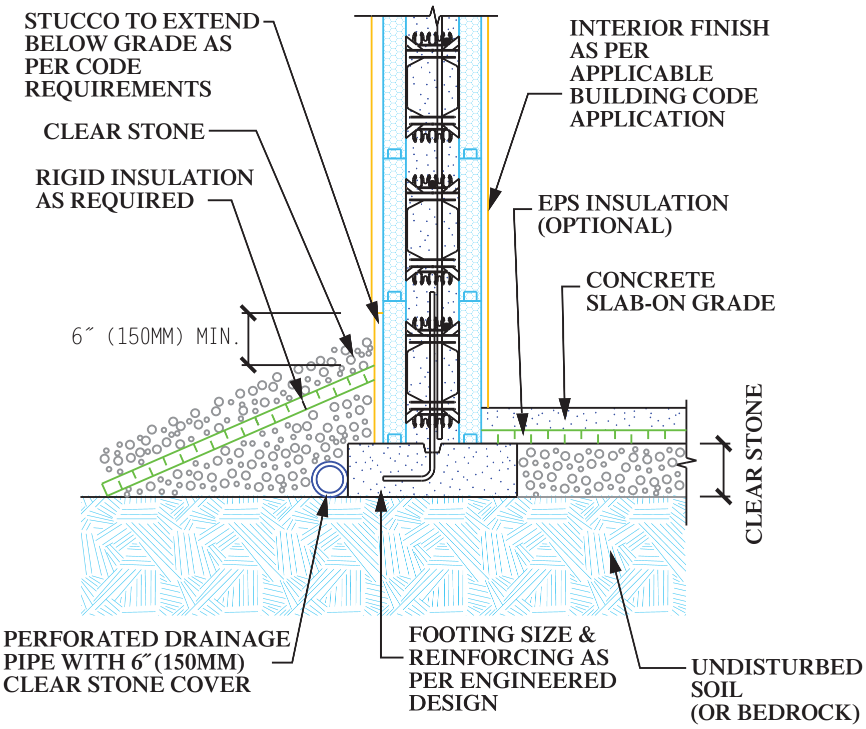


Figure 7.1 – Typical wall section on footing

Footings and Walls for a Raised Floor

If the first floor will be a raised floor, then the wall must be started off of a footing. In some cases, builders will elect to pour 2-3 courses of block initially, and then install their floor system. Once the floor has been installed, continue stacking block.

7.1 - Dowel Placement in Footings/SOG (Slab On Grade)

Loads from the Amvic ICF walls need to be transferred to the footing/SOG. For that purpose reinforcing steel dowels, a keyway or a combination of both need to be present in the foundations. Check with your local design engineer or the local building code requirements for the method that is most suitable for the application at hand.

When pouring footings or slab on grade, place reinforcing dowels as per engineer and/or local building code requirements. On 90 degree corners, start the first dowel 8 1/2 inches in from the outside edge of the Amvic form, then space subsequent dowels in increments of 6 inches to avoid hitting webs (Figure 7.2 below).

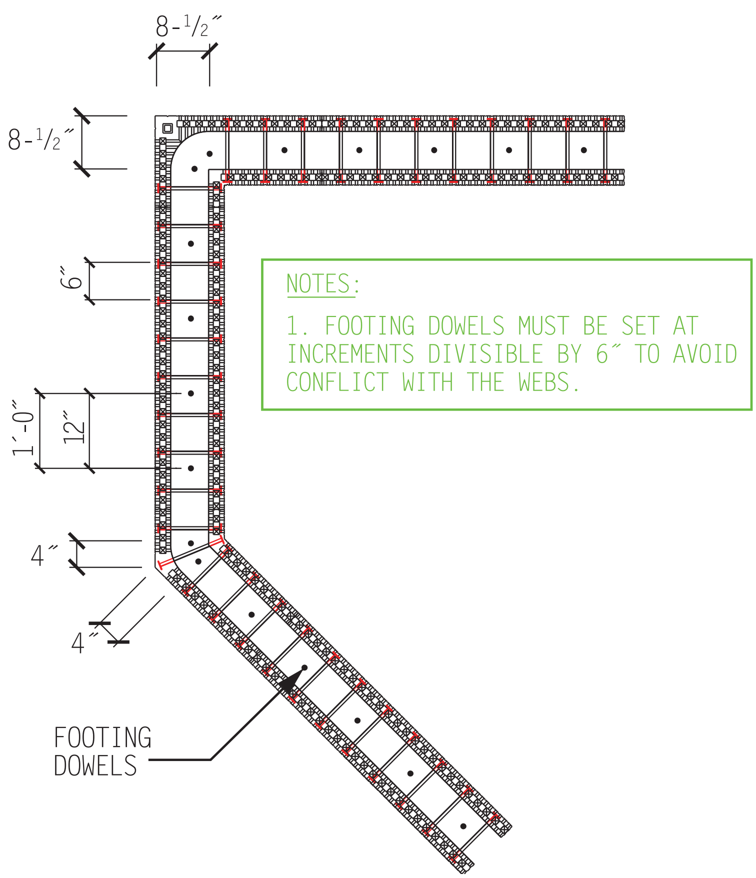


Figure 7.2 – Plan of typical dowels placement

Tip

On most walls, you will end up going off layout, the block will have to be cut and you will have one location in the wall where the webs are not 6 inches apart because of the cut joint. In this case, start dowel placement in the corners and work towards the cut joint. (It is not a major issue if you have the rebar coming up directly on a web location. If this occurs, you can bend the bar in a slight S-curve and that will clear the web.)

7.2 – Level Foundations

After pouring the footings and or slab on grade, make sure the top finished surface is level to within 1/4 inch (5mm). (Commonly this is the local building code requirement). A proper level footing will make installing the first two courses of block significantly easier.

Level can be checked using a laser, transit or water level. If you find you are within 1/4 inch (5mm) all the way around, proceed with stacking. If not, mark the variance of each corner on the footing or slab and adjust the ICF in later stages of installation.

Figure 7.3 – Level Top Surface of your Footing and SOG

7.3 – Outlining Your Project

There are several steps in outlining your project which are necessary and should be marked on your foundations before you begin installing Amvic ICF. This increases jobsite efficiency and reduces complications.

7.3.1- Outlining Wall Layout

Using Chalk Line

Before you begin outlining the wall layout, check your building/project plans carefully to determine the proper foundation wall layout and dimensions. Use a chalk line or string and mark the wall layout on your footings/SOG. You can either mark the outside or the inside face of your walls. Most installers tend to mark the outside face simply because the building/project plans will readily indicate this information. Make sure that all 90 degree corners are properly squared. This can be done by measuring diagonals or 3-4-5 right angle triangle. A surveyor may be hired to establish the correct angles on the jobsite including variable angles and special radius walls.

Figure 7.4 – Snap a chalk line to mark your wall Layout

Using Metal Angle/ C-Channel Section

An alternative to using a chalk line is to use a light gauge metal angle or c-channel section to mark your wall layout. The angle should be fastened to your footings/SOG with proper concrete screws or foam adhesive. When installing the first course, the angle/C-channel will serve as a guide against which you can place the blocks as per figures 7.5, 7.6 below.

However, should you need to make minor modifications to the wall placement after a few courses of block are placed, it becomes difficult to remove the metal angle after it has been screwed or adhered to the concrete footings/SOG.

Figure 7.5 – Using a C-Channel to mark your wall layout

Figure 7.6 – C-Channel section acting as a guide for the first course placement

7.3.2 - Outlining Windows / Doors

From your plans measure and mark the center of each door and window location on the footing/slab. It is also useful to mark the rough size of the opening.

7.3.3 - Outline Rough Size Openings

From your plans, carefully calculate the height intended for the bottom of each rough opening. From this rough opening height, subtract the amount that is the thickness of the buck ($1^1/_2$ inches if using 2x stock lumber or V-Buck). This line is the “cut line” for the block. Write this on the slab/SOG beside the rough opening size of the window. This is the height at which you will cut the block and install the buck.

Tip

If Amvic ICF installation will take more than one day to complete, protect the chalk line to avoid it being erased or washed away.

Tip

Consider snapping the chalk line at a 1/2 inch offset from the actual wall outline. Later on if you need to adjust the wall placement for any reason, then you can still see your marked outline.

Part 8 – The Installation Process

8.1 - Overview

This part of the manual will explain the detailed steps in constructing a typical Amvic ICF project. By the end of this chapter, your Amvic ICF wall(s) should be set up and ready for the concrete pour.

8.2 – Mobilization: Material & Tools Positioning

Once wall, window and door layouts are complete, materials and tools should be organized to maximize efficiency during construction. A typical Amvic ICF project is much easier to construct from inside of the footprint rather than the outside.

The following are recommended practices:

1. Before any installation begins it is preferable to move as much block as possible within the perimeter of the wall layout. Stack it if necessary. This will minimize workers movement during the construction process.

Figure 8.1 – Placing Amvic ICF within the perimeter of the wall layout

2. Place reinforcing steel, tools and equipment within the perimeter of the wall layout including bracing, bender/cutter, table saws, scaffolds and planks as well as any other equipment you may need.

3. For each storey, build door and window bucks before starting to lay block and position them within the wall layout perimeter close to where they will be installed. (Please refer to part 5.)

Tips

Prior to construction, order pre-cut and bent rebar from your steel supplier. For 90 degree corners, have them cut and bent to the proper lap splice lengths so they will be ready for placement when they arrive to the site. Similarly Z-shaped reinforcing steel (Figure 8.2) required for wall bump-outs can be ordered from your steel supplier.

Figure 8.2 – Pre-cut & bent reinforcing steel will increase efficiency

Tip

Try to place all materials and tools at least six feet away from the inside wall to provide space for bracing and alignment equipment.

Tip

If Amvic ICF blocks will be stored for a prolonged time on the jobsite, protect them from dust, sunlight and extreme weather by storing them in a contained environment.

Amvic ICF comes in bundles of different quantities depending on the type and size of block ordered. The most convenient way to move a small number of bundles is to slide 2x lumber through the forms then carry them to the desired location (Figure 8.3 below). A greater number of bundles may require using a forklift (Figure 8.4 below). An average person can easily carry a few separate blocks during construction.

Figure 8.3 – Moving ICF bundles by hand

Figure 8.4 – Using forklift to move bundles

8.3 – Course Planning: Determining wall heights & no. of courses per Storey

Prior to laying block, determine the exact wall height required for the project.

Amvic ICF is 16 inches (406.4 mm) high except for the 10 inch block which is 24 inches high (609.6 mm). If your storey height is not divisible by 16 inches or 24 inches, you have two options:

1. Rip-cut the first or last course of block horizontally. Cutting the first course is recommended since the cut edge will be glued to the footing/SOG and will not affect the interlocking of subsequent courses. If you decide to use this method, make sure you preserve the polypropylene webs which connect the two EPS panels. (Figure 8.5 below.)

Tip

A circular saw is recommended for rip cuts since cutting the webs by hand can be tedious and time consuming. (Figure 8.5 below.)

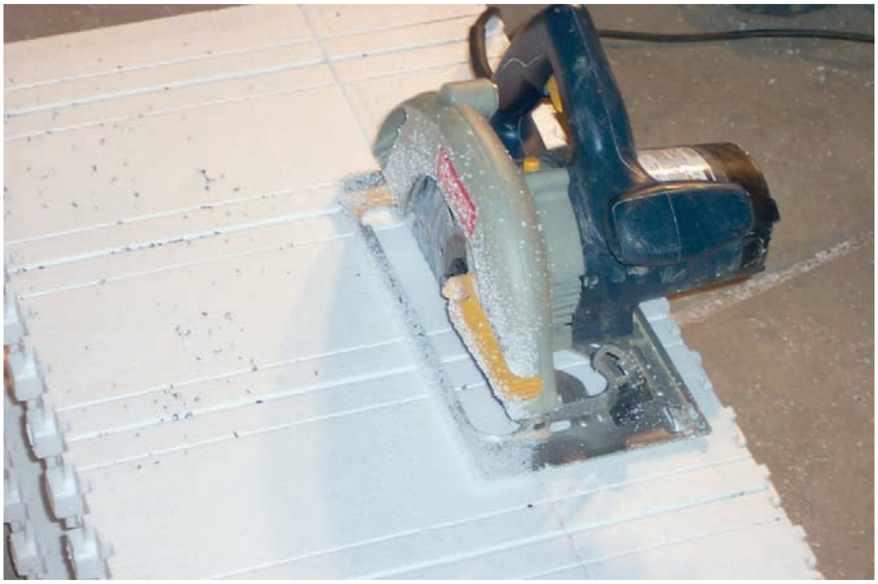


Figure 8.5 – Using a circular saw to horizontally rip cut ICF

Tip

When using a circular saw for rip cuts, use one with an 8 1/4″ blade.

2. Use an Amvic ICF height adjuster. These are available in 2, 3 & 4 inch heights (50.8, 76.2 & 101.6 mm) and can be placed below the first course or above the last course. Placing the height adjuster above the top course is recommended. (Figure 8.6 below)

Figure 8.6 – Amvic height adjuster

8.3.1 – Single Storey vs. Multi-Storey Construction

For single storey structures the walls are poured in one day from the footing/SOG to the top plate. For multi-storey structures forms are typically stacked and concrete poured one storey at a time. Once a storey is complete, the floor joists and floor will be installed before the next storey is stacked and poured.

8.4 – Placing First Course of Block

Once the pre-planning stages are complete, begin placing the first course of block by following the steps outlined below.

1. Place door bucks in their proper location on the footing/SOG. Install a temporary kicker, stacked outside to hold each safely in place.

Figure 8.7 – Placing Door Bucks

Note

Some installers will not place door bucks until at least two courses of block have been stacked. This provides the benefit of establishing an interlocking pattern between the courses before buck installation. When using this method, bucks are installed by cutting through the blocks to the rough opening sizes then securing the bucks in place. This method is acceptable but may increase block wastage.

2. If you are not rip-cutting the first course horizontally. (Refer to section 8.2 above). The nubs on bottom interlock may be shaved off to provide a flat contact surface with the footing. Some installers may opt to leave them, which is also acceptable.

3. Start stacking by first placing the corner forms. It does not matter how the corner blocks are laid as long as the direction is reversed on the subsequent course.

Tip

Test different placements of the corner blocks to minimize block wastage.

Figure 8.8 – Placing corners first

4. Install straight forms starting from the corners and working toward the center of the wall or door buck. If a dowel from the footing/SOG is in contact with a web, bend it to make an offset curve around the web. This will help to prevent pressure on the blocks which may result in misaligned walls.

Figure 8.9 – Placing straight blocks

5. Cut the final block in each wall section to size. Ideally the cut will be made at a 2 inch increment line (center between two interlocks). This will allow for proper alignment of the interlocking system. Where possible, slightly adjust wall dimensions to accommodate this. If it is not possible to adjust wall dimensions, an offset/stack joint will be created. (Refer to Section 8.10.) Keep this offset/stack joint at the same location when stacking the subsequent courses of block.

Note

Offset/stack joints require additional bracing to withstand hydrostatic pressure during the concrete pour. Please refer to section 8.10 for more information.

Figure 8.10 – Cutting the final block for a wall section

Figure 8.11 – Fitting the cut block in place

Optional:

Connect blocks in the first course together using zip ties (plastic ties or wire ties). One zip tie per end joint is generally sufficient. Place zip or wire ties towards either edge (next to the EPS inside face). Tightening at the center will flex the webs and may lead to foam fracturing at that location creating a source of failure during the concrete pour.

Figure 8.12 – Using zip ties to tie the first course blocks together

6. Install the horizontal reinforcing steel as per engineering or local building code requirements. (Refer to part 6 of manual.)

Figure 8.13 – Installing horizontal rebar

8.5 – Placing the Second Course of Block

Figure 8.14 – Second course placement

1. Start by stacking the corner blocks first. Every corner block has a short leg and a long leg. Make sure that you reverse the corners on the second course by flipping them upside down so that the long leg interlocks with the short leg of the first course. This will create a 12 inch (304 mm) running bond pattern between the two courses.

Figure 8.15 – Reversing 45 degree corner blocks for bay window

2. Stack the straight forms, working towards the center of the wall.

3. Place the cut block on this course at the same location as the first course. This will ensure your offset/stack joint remains roughly in the same place.

Figure 8.16 – Placing the offset joint in approximately same place as first course

4. Press down firmly on the blocks to ensure a secure connection with the course below.
5. Install horizontal reinforcing steel as per engineering or local building code requirements.

Note

It is very important to keep the offset/stack joint at roughly the same location for each wall section as you stack the courses. This will ensure that there is a straight "stud" for interior and exterior attachments.

8.6 – Checking for Level

Once the second course has been laid, place a square of plywood or OSB over each corner block and check for level. If you are more than 1/4 inch out then you will need to either shim low spots or trim high spots. Once the walls have been leveled to within 1/4 inch you are ready to secure the first course of block to the footings/SOG.

Figure 8.17 – Checking for level after second course placement

Use foam cuttings as shims to level the wall at the vertical joints.

Figure 8.18 – Shimming the first course with foam cuttings

If you need to trim the first course of block, slide a hand saw underneath the blocks and shave off the desired amount.

Figure 8.19 – Trimming the first course of block with a hand saw

Once the walls have been leveled to the desired tolerance, you are ready to secure the first course of block to the footings/SOG.

Tip

When shimming/brimming keep in mind that this may be needed on both sides of the form.

8.7 - Securing First Course to Foundation/SOG

Ensure that all walls are on their layout lines then use low expansion foam adhesive to glue the base of the first course to the footing/SOG. Insert the nose of the foam gun into one of the notches every 6–12 inches (150-300 mm) along the footing and squirt a small amount of foam adhesive under the block along the entire wall. Allow the adhesive to set for up for 30-60 minutes.

Tip

Securing the first course of block to the foundation is an ideal task to do just before a break.

Figure 8.20 – Using foam adhesive to secure the first course of block to the foundation/SOG

When foaming under a large, low spot, ensure that the entire area is done.

Figure 8.21 – Foaming under a large, low spot area

8.8 – Placing 3rd & Subsequent Courses of Block

The installation of subsequent courses of block is the same as for the second course of block.

Remember:

1. Start in the corners, alternating the direction of the corner forms.
2. After setting corners, work towards the centre of the wall
3. Keep offset/stack joints (where you lose layout) in the same place as the wall goes up. The remainder of all wall sections should maintain their web alignment (indicated by the deep grooves on the outside face of the EPS panels).
4. Place horizontal steel reinforcement as required by engineering or local building code requirements.

Note

Webs will not line up where your offset/stack joints occur.

8.8.1 - Cutting Block around Door Bucks

If you have chosen to delay door buck installation until after you have placed the first two courses of block, it must be done at this point. Cut the blocks and secure the door bucks in place, remember to leave 1/4 inch gap between the forms and the buck to allow for adjustment before pouring the concrete. (Refer to section 8.10.)

Figure 8.22 – Stacking courses around door bucks

8.8.1.1 - Elevated Doorways

For doors on second storeys or doors with elevated floors, the height of the door sill must be carefully calculated before the floor is in place. It is a good idea to install a pressure treated 2x4 or 2x6 sill into the block that will be poured in place to provide an attachment point for the door threshold.

Figure 8.23 – Installing door bucks on the second floor

8.8.2- Cutting Forms around Window Bucks

The window and/or door bucks should already be assembled and ready for installation. (Refer to part 5 of manual.) The bottoms of window bucks are usually placed in the 3rd or 4th course of blocks and must be perfectly level. If they are not, then trim or shim as required. When cutting the block, leave a 1/4 inch gap between the block and the buck to allow for adjustment after all the courses have been stacked and before concrete is poured. (Refer to section 8.10.)

Figure 8.24 – Building courses around window bucks

8.8.3 – Reinforcing Steel around Wall Openings

Install reinforcing steel around the window/doors as you stack the blocks. Wall openings are required to have minimum shrinkage and crack control steel bars on both sides and sill (area below window opening). For wall openings greater than 2 feet (610 mm) in length, diagonal reinforcing steel may also be required at the corners. The headers (area above door/window opening), commonly known as lintels require specially engineered and detailed reinforcing steel bars. (Please refer to **Appendix A** for more details on steel requirements for wall openings.)

Figure 8.25 – Installing reinforcing steel bars for wall opening header or lintel

8.8.4 - Placing the Top Course of Block

The top course of block in each pour needs special attention since it is not locked at the top. During the concrete pour the upper sides of the top course tends to flex outward, and if not secured properly may go out of plumb. This will also cause the interlock to be misaligned if there is another ICF wall storey above.

The following steps are recommended for each top course of a storey;

1. Tie each block to the next using zip or wire ties on the webs ensuring they are pulled snugly together.
2. Use a horizontal wailer around the top at the corners of the structure. A 1x4 or 1x6 lumber is ideal. Install a drywall screw into every other web on each block to minimize stretching.
3. If there are long narrow lintels, install a wailer on both sides of the block wall and to each other. This should prevent the course from flexing outwards.
4. If another course of block will be installed above this temporary top course, protect the tops of the block. An ideal protective device is 2 1/2 inch metal stud starter track. It is exactly the right dimension to slip over the EPS foam panel on each side. Alternatively, 4 inch wide plastic tape can be used.

Figure 8.26 – Protecting the Interlock on a top course

8.8.5 - Installing Vertical Rebar

The vertical reinforcing steel bars are installed after the top course of block for each storey has been placed.

At the uppermost wall storey, cut the reinforcing steel short to ensure there is 2 inches (50 mm) of concrete cover.

Tip

Review site safety plans and OSHA compliance regulations for protruding steel bars on the jobsite to protect workers from this hazard.

The steel bars are inserted from the top of the wall and weaved in between the horizontal steel bars that are already installed in place.

If there will be another ICF wall storey above, then refer to **Part 6 section 6.6** of this manual for splicing details and placement.

Figure 8.27 – Installing vertical reinforcing steel

8.9 – Installing Wall Alignment & Bracing

Alignment and bracing systems are required during construction with Amvic ICF and perform the three main functions listed below:

1. Ensure blocks are straight, plumb and properly aligned along each wall length.
2. Support stacked walls against wind and other lateral loads until the concrete is poured and gains enough strength.
3. Act as a scaffold for construction workers to stack the block courses.

Code Requirements

- *In the United States scaffolds must meet the safety requirements of OSHA (Occupational Safety and Health Administration)*
- *In Canada scaffolds must meet the fall protection and scaffolding regulations of OHSA (Occupational Health and Safety Act)*

Figure 8.28 – Plumwall bracing & alignment system

8.9.1- General Application

The following rules of thumb generally apply to bracing and alignment systems used with Amvic ICF regardless of which type or proprietary brand being used:

- Before using a new bracing system, check with your local Amvic distributor to ensure that it is appropriate for your use.
- Bracing is typically installed after the 3rd or 4th course of block is laid.

- In most cases, bracing is installed only on the inside of the wall structure, since this is where all the labor work occurs.
- Bracing will push very well, but is very limited in pulling the wall. While generally you brace only one side, if you have a wall section that you cannot plumb any other way, you may need to install braces on both sides to properly align the wall.

Figure 8.29 – Bracing the inside of the wall

Most bracing and alignment systems are specifically designed to allow for placing scaffolding planks and installing handrails. The planks and handrails are usually provided or acquired separately.

Figure 8.30 –Platform and scaffold planks

Bracing is usually attached either with a "hat bracket" that wraps around the strong-back or a screw through a slot in the brace. Amvic recommends using wrapping hat brackets as they screw into two webs. A single center slot screw system is more likely to get damaged and/or get pulled out. If a single slot screw bracing system is used, install the screw near the *top of the slot.* Over tightening the screw may result in the block not settling or compressing which can misalign a wall, however, this is unlikely with Amvic ICF which compresses very little.

If you have glued down the first course of block and it is firmly attached to the footing/slab start installing the brackets on the second course. Continue attaching the brackets on every other course e.g. 2nd, 4th, 6th etc.

Figure 8.31 – A hat bracket wrapped around a vertical strong-back and screwed to webs on both sides

8.9.2 – Spacing for the Alignment & Bracing System

Depending on the system used and the governing local codes, there are minimum spacing requirements for the bracing which support scaffolding. Following the recommendations below will ensure you are well within the limits of these requirements.

Recommended Practices:

• Install two braces within 2 feet (610 mm) of a corner, one on each side.

Figure 8.32 – Bracing corners on the inside

• Install a brace at the edge of every door and window opening.

Figure 8.33 – Bracing both sides of wall openings

• Install braces along all the wall segments at a maximum of 6 feet (1.8 meters) apart.

Figure 8.34 – Bracing every 6 feet

• On walls that end without an adjoining corner (stub walls), install braces on all three sides.

• On T-walls, install at least two kicker braces on the outside of the T (the top). This is because walls tend to bulge at T-joints due to the pressure from the concrete in the leg of the T.

8.10 –Preparing Bucks for the Concrete Pour

At this stage you need to re-check the window and door bucks for the final adjustments in preparation of the concrete pour. The following steps are recommended:

1. **Ensure that bucks are square and plumb.** At each door or window buck, check again for square and plumb. Adjust as required.
2. **Glue & fill the buck-block joint.** Once bucks are square and flush, fill the gaps between them and the forms with adhesive foam. Allow this to set for at least 30 minutes.

Figure 8.35 – Filling gaps between bucks and forms with foam adhesive

3. **Cleat the corners.** At each buck, at all the four corners on each side, install a cleat that screws to the buck. Overlap the foam to hold the buck flush with the form on both the inside and outside. The cleat can be anything, e.g. a concrete stake, piece of OSB or plywood, etc.

Figure 8.36 – Installing cleats around wall openings

4. **Install cross braces for all bucks.** These are required to keep the bucks from bowing due to the pressure of the concrete. Install both horizontal and vertical braces in all doors and windows. Generally there should be a cross brace at least every 2 feet (610 mm). Lintels over 8 feet (2.4 meters) may require additional shoring.

Tip

When in doubt, add another brace.

Figure 8.37 – Bracing wall opening vertically and horizontally

8.11 Additional Bracing

Additional bracing may be needed to connect or bridge at least two intact webs or a web and a buck. You can make this added bracing/cleat with strips of OSB, square patches, dimension lumber, concrete stakes, etc.

Additional cleats or bracing are required for any but are not limited to the following situations:

- Where an internal web has been cut out (to fit around rebar or other obstructions). This illustrates the importance of marking block on the inner face at the time you cut a web so that it later is apparent that the web was cut.
- Where a stack joint exists. A stack joint is when there is no "running bond" pattern between the Amvic ICF block courses. Here the joint between the blocks in a single course are repeated exactly in the same place for the courses to follow. Try to avoid this kind of joint as much as possible.

Figure 8.38 – Bracing a stack joint on both sides of wall.

- Where an offset joint exists. An offset joint is where the interlocking system between the block courses does not line up. This most likely happens when you have cut the last block in a wall section so that it fits the required wall dimension. You may also note that the "running bond" pattern on an offset joint is less than 12 inches which is the recommended overlap of the interlock.

Figure 8.39 – Additional bracing for an offset joint

- Where the edge of the block joins a window or door buck if using wooden bucks (not applicable when using V-Buck).

Figure 8.40 – Cleat installation around a door opening using OSB

IMPORTANT NOTE

This added reinforcement is <u>extremely important</u>. Failure to install this bracing will frequently produce a blowout. The block itself resists blowout as long as the webs are intact and the joint in any course is locked together both above and below by the interlock.

8.12 - Penetrations

Utility Penetrations

Penetrations for utilities must be installed after a storey has been stacked and before the concrete has been poured. Generally all wiring and plumbing is run inside the walls by cutting channels in the EPS foam and installing the wiring and plumbing. Wiring for external fixtures is normally run through the wall only at the point where the external fixture will be placed. (For details on electrical wiring etc. please refer to Appendix E of this manual.)

Penetrations are required for the following:

The following list contains the most common types of penetrations encountered:

- Exterior electrical fixtures
- Exterior electrical outlets and/or fixtures such as pump controls, watering systems, etc.
- Entrances or exits for high voltage electrical wiring
- Low voltage wiring (phone, cable TV, satellite dishes, conventional antennas, alarm systems, gate controls, etc.)
- Dryer vents
- Wall venting chimneys
- Condensate lines or other lines for furnaces and air conditioning
- Water lines
- Water faucets
- Crawl space vents and/or crawl space access doors
- HVAC ducts (for example when the furnace is in the garage and ducts run beneath a raised floor)

> **Tip**
>
> *Consider installing extra penetrations for potential future needs.*

In most cases a piece of ABS or PVC pipe inserted through the wall can be used for a block-out. Cut a hole the same size as the pipe and insert it all the way through the block. Use adhesive foam around the pipe to seal it.

Figure 8.41 – Using PVC pipe for penetration block-outs

8.13 – Suspended Floor Installations

Floor systems are most commonly suspended from rim joists or ledgers that are mechanically attached to the concrete with anchor bolts or with a proprietary tie. The Simpson Strong-Tie™ ICFLC ledger is highly recommended, as it simplifies installation and can be used with both wood and steel floor joists.

8.13.1 – Ledgers Installed with Anchor Bolts

Anchor bolt sizing, spacing and pattern of installation, must be specified by the structural engineer as it is an essential element of the structural design. The "Prescriptive Method" contains engineering tables for using anchor bolts to connect wood floor joist to ICF walls. (Please check Appendix B of this manual for more information on this subject.)

Installation:

1. Cut 8 inch x 8 inch (200 x 200 mm) pieces of OSB or plywood and drill a hole in the center for the anchor bolt.
2. Install the anchor bolt through the hole using double nuts on either side. Make sure the anchor bolts used have enough thread to allow double nuts on both sides. With 1/2 inch (13 mm) OSB, you need approximately 3 1/4 inch (83 mm) of thread.

Figure 8.42 – Cutting square OSB boards for anchor bolt installation

3. Cut out a 4 inch (100 mm) wide opening between webs, up to the full height of the ledger. Make the top and bottom cuts with a flare to the inside at 20-30 degrees allowing the concrete to readily fill the cavity.

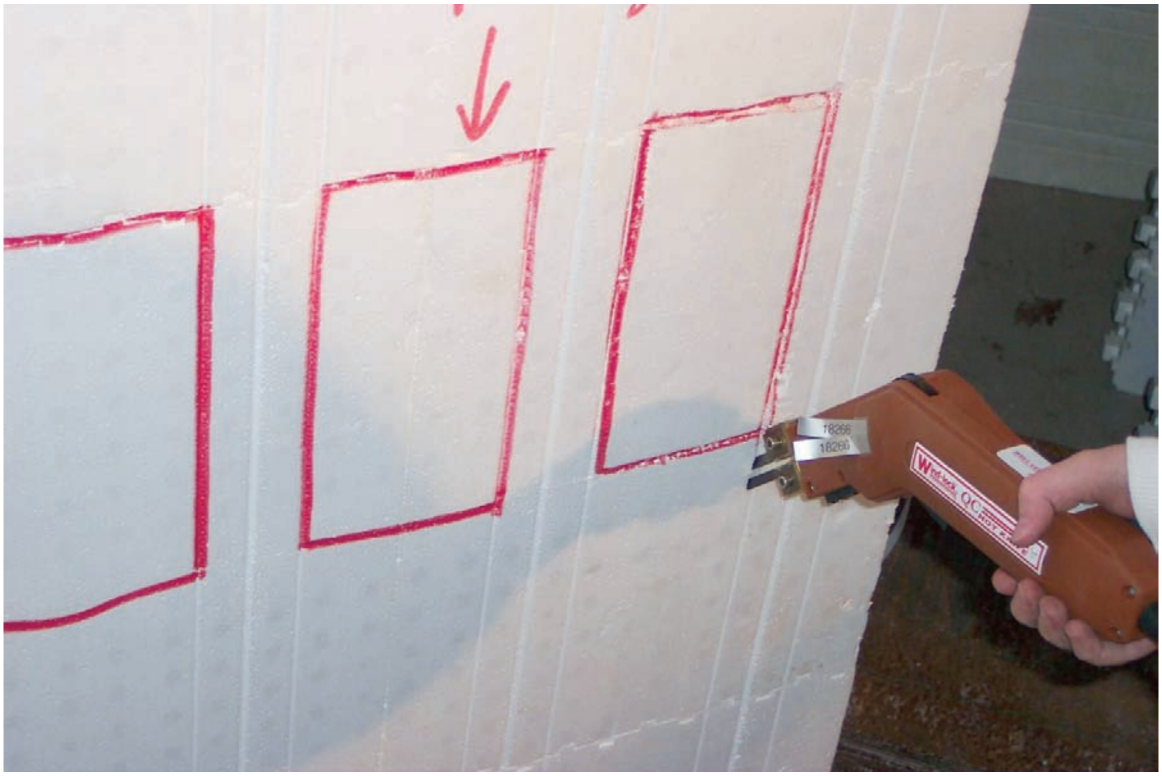


Figure 8.43 – Cutting openings in EPS between webs

Figure 8.44 – Making the end cuttings flare out

4. Place the OSB & anchor bolts into the holes and attach with four screws, one in each corner. Sheetrock screws work well.

Figure 8.45 – Installing the OSB with anchor bolts onto the EPS openings and securing with sheet rock screws

5. Allow the concrete to gain adequate strength after the pour and before tensioning the anchor bolts.

Figure 8.46 – Allowing the concrete to cure for at least 3 days before removing the OSB square pieces

6. Install the ledger, by leveling it precisely below the anchor bolts. Using a reference block, do a drop down takeoff and drill holes slightly larger than the anchor bolts. Place the ledger. Install the required anchor bolt washers and nuts.
7. Use standard joist hangers to attach floor joists.

Figure 8.47 – Installing ledger board with proper nuts and washers

8.13.2 - Installing Ledgers with the Simpson Strong-Tie™ ICFLC Ledger Connector

The Simpson Strong-Tie ™ ICFLC connector is the preferred method for attaching a ledger, primarily because it lowers the cost of construction of the floor. The labor time to install an ICFLC hung ledger is up to 30% less than for an anchor bolt hung ledger.

Simpson's ledger connector system is easy, quick and versatile to use. The perforations in the embedded leg of the ICFLC permit the concrete to flow around it anchoring the ICFLC securely with the block. The exposed flange provides a structural surface for mounting either a wood or a steel ledger. In addition, the new ICFLC & ICFLC-W/CW ledger connector system is engineered to solve the challenges of mounting steel or wood ledgers on insulated concrete form (ICF) walls.

The system comes in three parts:

a. Base plate designated as **ICFLC.** This can be either 16 gauge (0.054 inch thickness) or 14 gauge (0.068 inch thickness) galvanized steel.

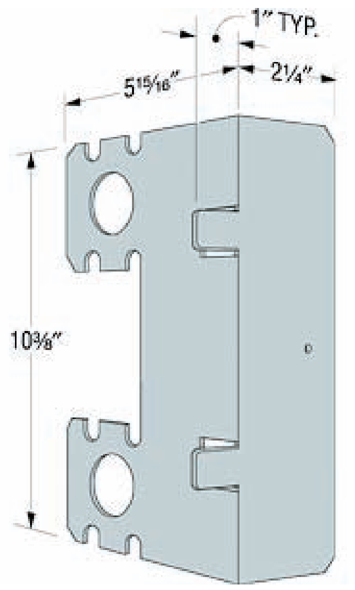


Figure 8.48 – ICFLC

b. Ledger hanger designated as **ICFLC-W** or **ICFLC-CW** made of 16 gauge (0.054 inch thickness) galvanized steel.

c. Self tapping screws.

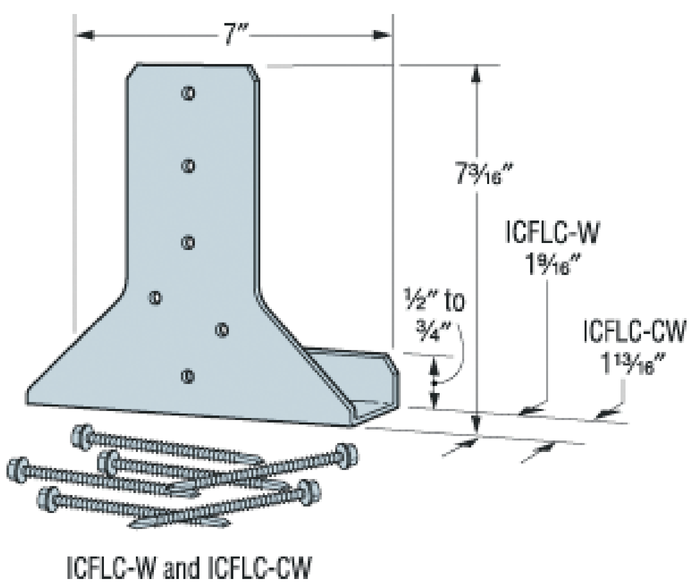


Figure 8.49 – ICFLC-W/CW and Screws

Installation:

1. Make a saw cut in the block and insert the long blade of the **ICFLC** piece into the block.

Figure 8.50 – Inserting the ICFLC long blade through the EPS and into the concrete

2. Fix it in place with a foam adhesive or a single screw through the small hole in the **ICFLC,** into an adjoining web.
3. After the concrete has been poured and has cured for 3-4 days place the ledger in the proper place, level it and temporarily brace it.

Figure 8.51 – Securing the ledger board in place temporarily

4. Install the **ICFLC-W/CW** piece around the ledger.
5. Using a driver drill, install the self-tapping machine screws through the holes in the **ICFLC-W/CW,** through the ledger and into the flange of the **ICFLC.**

Figure 8.52 – Installing the ICFLC-W around the ledger board and drilling self tapping screws in the designated holes through to the ICFLC piece

6. Attach the floor joists to the ledger board using standard Simpson Strong-Tie™ or equivalent.

Figure 8.53 – Attaching floor joists to the ledger board with the Simpson Strong-Tie™

Link

Please visit http://www.strongtie.com/products/connectors/ICF.html for technical and engineering information for ICFLC system

8.14 – Beam Pocket – Floor Joist Directly Bearing on ICF Wall

Steel beams and solid wood floor joists may be required to bear on the ICF walls according to the plans. A beam pocket made inside the wall will have to be created as per the following steps:

1. Establish the beam dimensions and the elevation at which it will be installed. Use a laser level to mark the elevations on the inside of the EPS panel.
2. On one side of the wall where one end of the beam will bear, cut out an opening from the inside and outside EPS panels. Make sure that the cut out pieces are aligned and are larger than the actual beam size by about $^1/_2$ inch (13 mm) all around. This will facilitate placing the beam in place.

Figure 8.54 – Cut out opening from the inside and outside EPS panels on one side

3. On the opposite wall where the other end of the beam will be bearing, cut out a piece from the inside EPS panel only. The opening should be aligned with the one on the opposite wall and larger than the actual beam size by $^1/_2$ inch (13 mm) all around.

4. Block the void between the two openings in one wall completely from inside out using waste EPS or wood. The opening in the other wall should also be blocked deep enough into the wall cavity to provide the required bearing length as depicted on the plans.

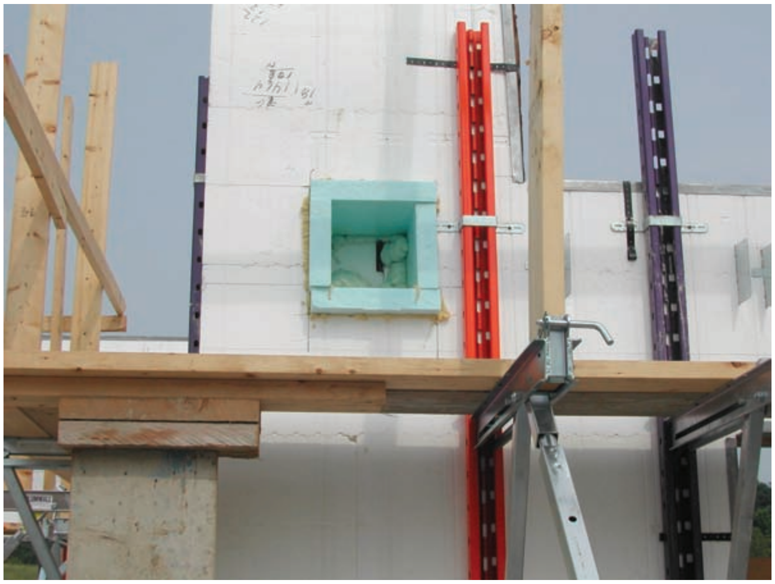


Figure 8.55 – Blocking void with EPS before pouring concrete

5. After the concrete is poured and has gained enough strength, break off the blocking EPS or wood to reveal the beam pocket or voids created in the wall.
6. Maneuver the beam in place and secure. Seal the area between the beam and void pocket as required.

Figure 8.56 – Maneuvering wood beam in place to bear on beam pocket

8.15 - Final Adjustments Prior Pouring Concrete

Check corners for plumb. Reconfirm that corners are plumb. If they are not, use additional bracing as required to plumb corners.

Straighten the walls. Set a screw at each corner and install a taut string line around the perimeter of the wall. Use an offset block (2x4 lumber piece) set at the corners, on the top course of forms behind the string line using another block of equal size as a guide to set the wall to the string line.

Tip

Many builders prefer to lean the center of each wall inward (toward the bracing) by 1/4 inch or so at the center of the wall segment. Then immediately after the pour, the braces are adjusted to push the wall segment perfectly in line.

Part 9 – Special ICF Installation

9.1 – Overview

This chapter of the manual explains some advanced installation techniques and special flooring systems used with Amvic ICFs. The most common special installations are included below, however, if you have a site specific situation that is not mentioned here, please contact us for assistance.

9.2 - Short Corner Construction

Short corners (notches, bump-outs) are commonly found in residential construction. Depending on the plan dimensions, Amvic 90° forms can be used or a special corner detail can be constructed from straight blocks.

9.2.1 – Short corners using 90° corner blocks with a stack Joint

A short corner can be constructed using at least two 90° corner blocks. Refer to **Appendix C** for minimum corner dimensions using this method. Recommended steps are given below:

Important Note

Failure to brace a stack joint adequately may lead to a blowout during the concrete pour. Make sure to use additional bracing if necessary.

1. Install the first course so that the short legs on both blocks are adjoining as illustrated in figure 9.1 below.
2. Install second and consecutive courses of corner blocks in the same manner without alternating forms. This will create a stack joint.
3. Ensure that the stack joint is adequately braced on both sides of forms and at every course.

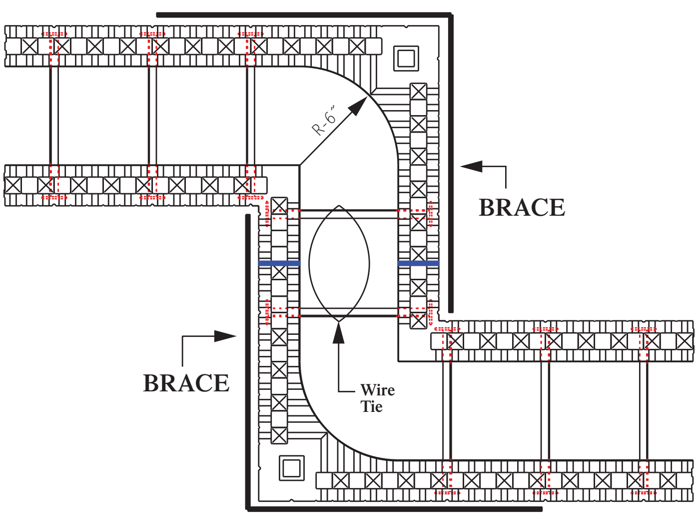


Figure 9.1 – Short corner made of 90 degree forms with a stack joint

9.2.2 – Short corners using 90° corner blocks with running bond pattern

This method also involves at least two 90° degree corner blocks. Refer to **Appendix C** for minimum corner dimensions using this method. The recommended steps are given below:

1. Install the first course so that the long leg of one corner block and the short leg from the other block are adjoining as illustrated in figure 9.2 below.
2. Install the second and consecutive courses by alternating the forms to create a running bond pattern. (Refer to figure 9.3 below.)

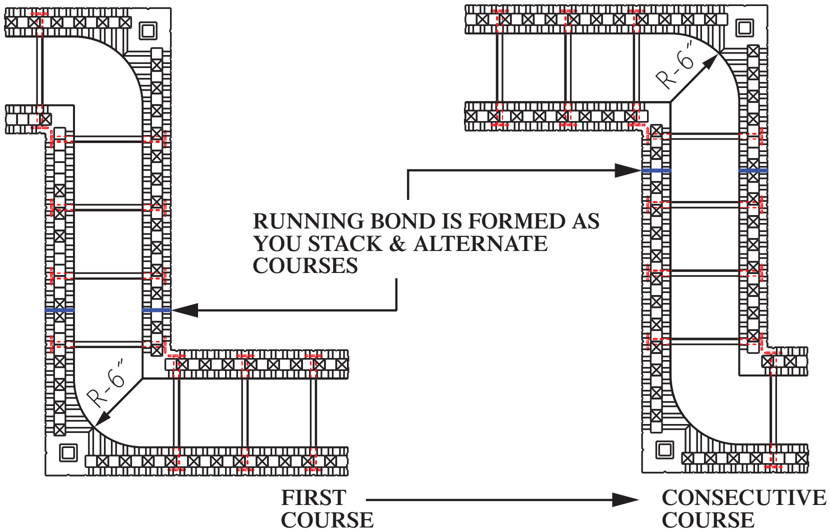


Figure 9.2 – Plan view of two short corners made using 90° forms to create a running bond pattern

Figure 9.3 – A short corner made of 90° forms with a running bond pattern

9.2.3 – Short corners made of straight Amvic ICF

Corners shorter than the minimum allowed by our 90° blocks can be achieved by using straight Amvic ICFs.

Steps in Creating a Custom Short Corner:

1. To begin, you will need a minimum of two straight Amvic forms.
2. Cut off 4, 6, 8 or 10 inches (100, 152, 203 or 254 mm) depending on which block you are using from one foam panel on each straight block at the edge of the form.

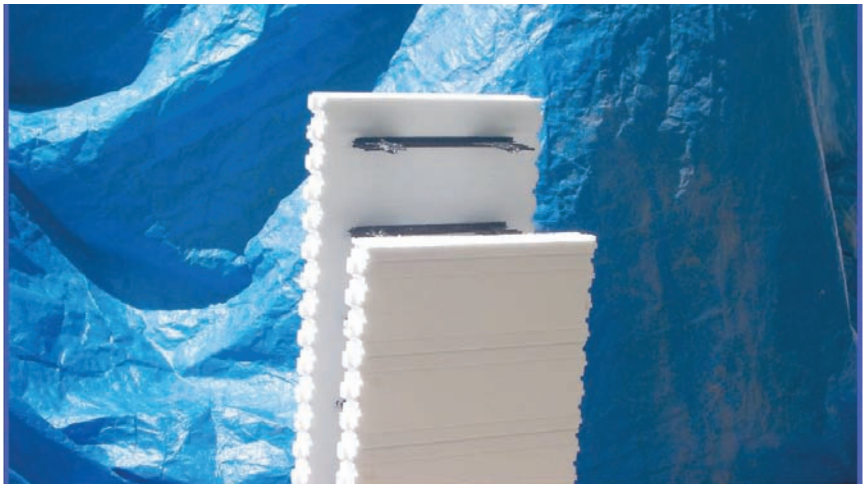


Figure 9.4 – Cutting foam from the end of the straight block on one EPS panel

3. Set the forms in place and glue the cut off pieces to fill the ends of the forms to create a 90° corner.

Figure 9.5 – Setting the two cut forms into position

Figure 9.6 – Using cut off pieces to close the open ends and create a corner

4. Construct two 90° wood forms made of 2x10 and place them on each of the formed EPS corners.

Figure 9.7 – Using 2 x 10 wood forms to support the formed corner

5. Drill a $^1/_2$ inch (13 mm) hole through the wood forms and the EPS panels starting about 12 inches (304 mm) from footing or SOG. Insert a $^3/_8$ inch (9.5 mm) threaded rod through holes in the wood forms. Use plate washers and nuts on both sides to hold the rod securely.

Figure 9.8 – Inserting the threaded rod through the drilled holes

Figure 9.9 – Threaded rod inserted through both wood forms.

6. Continue to cut and stack the blocks to the desired wall height. Place the threaded bolts approximately 16 inches (400 mm) on center vertically. When the concrete has been poured and has set for a few hours, remove the wooden forms and cut the threaded rod so that it is flush with the concrete surface. Use foam adhesive to fill the holes in the EPS panels.

9.3 – Radius Wall Construction

Amvic manufacturing facilities provide pre-cut radius forms which ensure that courses fit together easily and installation goes smoothly with minimal labor costs. Pre-cut radius forms are tongue and groove cut on the inside EPS panel and slit cut on the outside EPS panel. See Figure 9.10.

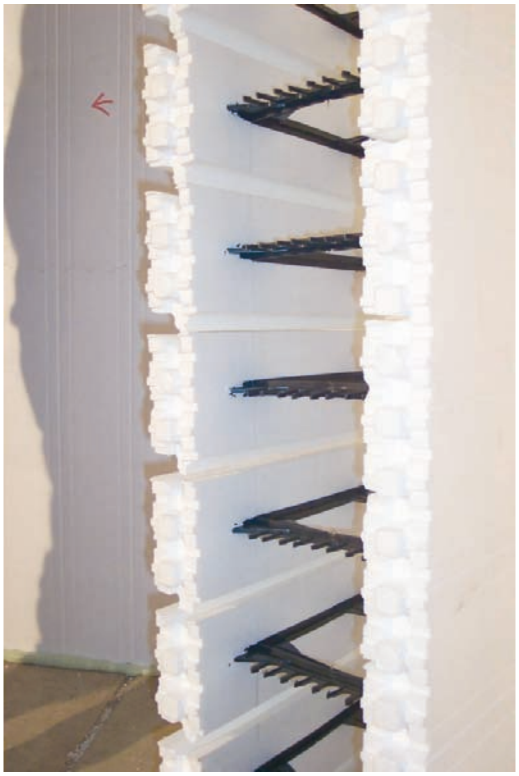


Figure 9.10 – Pre-cut Amvic radius blocks. Tongue and groove cut on the inside and slit cut on the outside

Radius forms can also be constructed by the contractor on site using straight Amvic ICF.

Installing Radius Forms:

1. On the footings/SOG, set a template or guide board to match the desired radius.
2. Apply a bead of spray foam to the bottom of the form along the tongue and groove cut (for pre-cut forms), bend the form into shape and install it.

Figure 9.11 – Bending and securing the radius form into place

3. After laying the first course, install the horizontal rebar as per engineering requirements and/or local building codes.

Figure 9.12 – Several courses of Amvic pre-cut radius blocks installed

4. Support the outside of the form using bracing or plumbers pipe strapping.
5. Brace the wall adequately before pouring concrete.

For contractors who opt to cut the ICF on site, please refer to figures 9.13 and 9.14 as well as tables 9.1 and 9.2 for information on radius dimensions and cutting blocks.

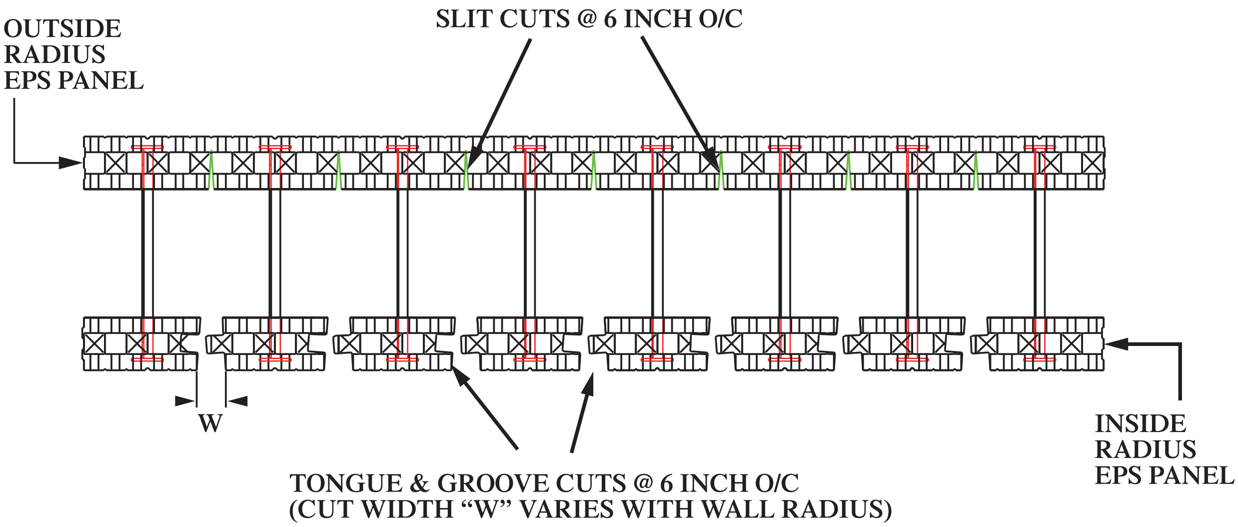


Figure 9.13 – Radius wall tongue & groove and slit cut details

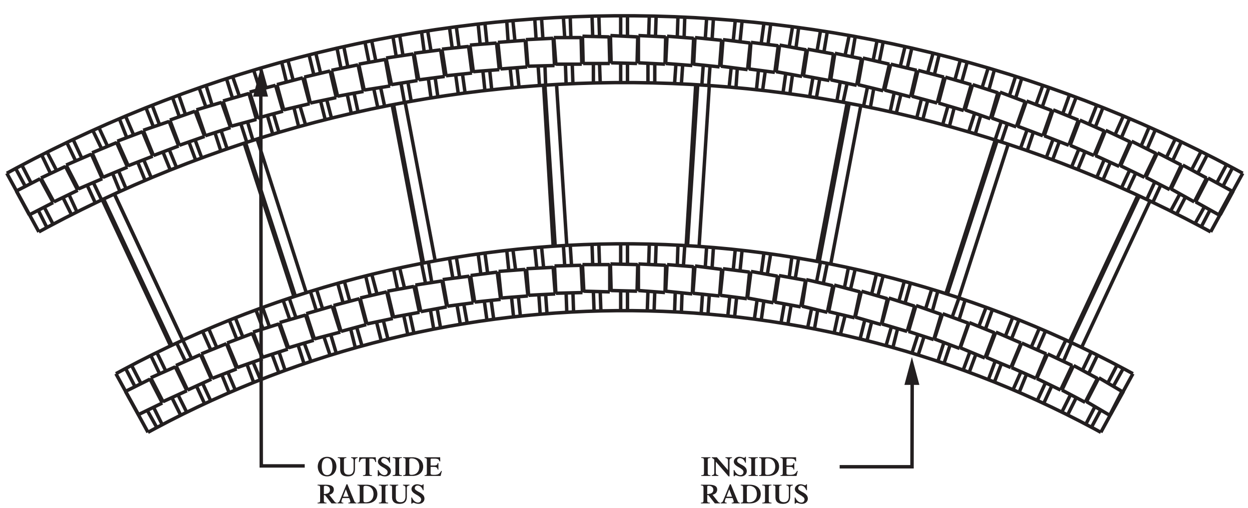


Figure 9.14 – Radius wall bent to shape

Wall Outside Radius (Imperial)	Tongue & Groove Cut Width "W" Spaced @ 6 inch O/C Decimal Inches			
	4˝ ICF	6˝ ICF	8˝ ICF	10˝ ICF
3´-0˝ ft (36 inch)	1.714˝	2.095˝	N/A	N/A
3´-6˝ ft (42 inch)	1.469˝	1.796˝	2.122˝	N/A
4´-0˝ ft (48 inch)	1.286˝	1.571˝	1.857˝	2.143˝
4´-6˝ ft (54 inch)	1.143˝	1.397˝	1.651˝	1.905˝
5´-0˝ ft (60 inch)	1.029˝	1.257˝	1.486˝	1.714˝
6´-0˝ ft (72 inch)	0.857˝	1.048˝	1.238˝	1.429˝
7´-0˝ ft (84 inch)	0.735˝	0.898˝	1.061˝	1.224˝
8´-0˝ ft (96 inch)	0.643˝	0.786˝	0.929˝	1.071˝
9´-0˝ ft (108 inch)	0.571˝	0.698˝	0.825˝	0.952˝
10´-0˝ ft (120 inch)	0.514˝	0.629˝	0.743˝	0.857˝
12´-0˝ ft (144 inch)	0.429˝	0.524˝	0.619˝	0.714˝
14´-0˝ ft (168 inch)	0.367˝	0.449˝	0.531˝	0.612˝
16´-0˝ ft (192 inch)	0.321˝	0.393˝	0.464˝	0.536˝
18´-0˝ ft (216 inch)	0.286˝	0.349˝	0.413˝	0.476˝
20´-0˝ ft (240 inch)	0.257˝	0.314˝	0.371˝	0.429˝
25´-0˝ ft (300 inch)	0.206˝	0.251˝	0.297˝	0.343˝
30´-0˝ ft (360 inch)	0.171˝	0.210˝	0.248˝	0.286˝
35´-0˝ ft (420 inch)	0.147˝	0.18 ˝	0.212˝	0.245˝
40´-0˝ ft (480 inch)	0.129˝	0.157˝	0.186˝	0.214˝
45´-0˝ ft (540 inch)	0.114˝	0.14 ˝	0.165˝	0.19 ˝
50´-0˝ ft (600 inch)	0.103˝	0.126˝	0.149˝	0.171˝

Table 9.1 – Cut out opening width "W" for varying radii (Imperial)

Wall Outside Radius (Metric)	Tongue & Groove Cut Width "W" Spaced @ 152 mm O/C Millimetres			
	100 mm ICF	152 mm ICF	200 mm ICF	254 mm ICF
0.90 m	44.2 mm	54.1 mm	N/A	N/A
1.00 m	39.8 mm	48.7 mm	57.5 mm	N/A
1.10 m	36.2 mm	44.2 mm	52.3 mm	60.3 mm
1.20 m	33.2 mm	40.6 mm	47.9 mm	55.3 mm
1.30 m	30.6 mm	37.4 mm	44.2 mm	51.0 mm
1.40 m	28.4 mm	34.8 mm	41.1 mm	47.4 mm
1.50 m	26.5 mm	32.4 mm	38.3 mm	44.2 mm
1.75 m	22.8 mm	27.8 mm	32.9 mm	37.9 mm
2.00 m	19.9 mm	24.3 mm	28.8 mm	33.2 mm
2.25 m	17.7 mm	21.6 mm	25.6 mm	29.5 mm
2.50 m	15.9 mm	19.5 mm	23.0 mm	26.5 mm
3.00 m	13.3 mm	16.2 mm	19.2 mm	22.1 mm
3.50 m	11.4 mm	13.9 mm	16.4 mm	19.0 mm
4.00 m	10.0 mm	12.2 mm	14.4 mm	16.6 mm
5.00 m	8.0 mm	9.7 mm	11.5 mm	13.3 mm
6.00 m	6.6 mm	8.1 mm	9.6 mm	11.1 mm
8.00 m	5.0 mm	6.1 mm	7.2 mm	8.3 mm
10.00 m	4.0 mm	4.9 mm	5.8 mm	6.6 mm
12.00 m	3.3 mm	4.1 mm	4.8 mm	5.5 mm
14.00 m	2.8 mm	3.5 mm	4.1 mm	4.7 mm
16.00 m	2.5 mm	3.0 mm	3.6 mm	4.1 mm

Table 9.2 – Cut out opening width "W" for varying radii (Metric)

9.4 – T-wall Construction

T-walls require special attention before the concrete pour. Proper bracing and alignment are essential.

Constructing T-Walls:

1. Locate the T-wall intersection as you lay the first course.
2. Cut the Amvic blocks appropriately and butt them together to form the T-intersection. Use zip ties (or equivalent) to secure the blocks together.

Figure 9.15 – Placing the cut forms together and tying intersecting blocks to form a T-wall. Use metal or plastic wire ties supplied by Amvic

3. Install horizontal reinforcing steel bars including bent 90° corner bars with proper lap splice length as per engineering requirements and/or local building code.

Figure 9.16 – Install horizontal reinforcing steel bars as each course is laid

4. Continue stacking subsequent courses of block until the full wall height is achieved.
5. Check walls for level. If the walls are level, run a bead of spray foam down along each side of the forms on the T-wall.
6. For below grade and main floor level walls, additional bracing **MUST** be installed on the exterior side of the intersection. Failure to brace properly may cause a blow out during the concrete pour.

Figure 9.17 – Bracing installed on the exterior side of the T-wall

7. For above grade levels where there is no ground surface to anchor the exterior bracing, insert wire ties (or equivalent) through the forms around to each side of the intersecting T-Walls. Do not tighten the zip ties yet. (Figure 9.17 below)
8. Once the wall is formed to the desired height, slide a 2x6 down the backside of the wall that runs straight through in between the forms and the tie wire. Tighten the wire tie to hold the lumber in place. Make sure the wire ties are installed at every course. (Figure 9.17 below)

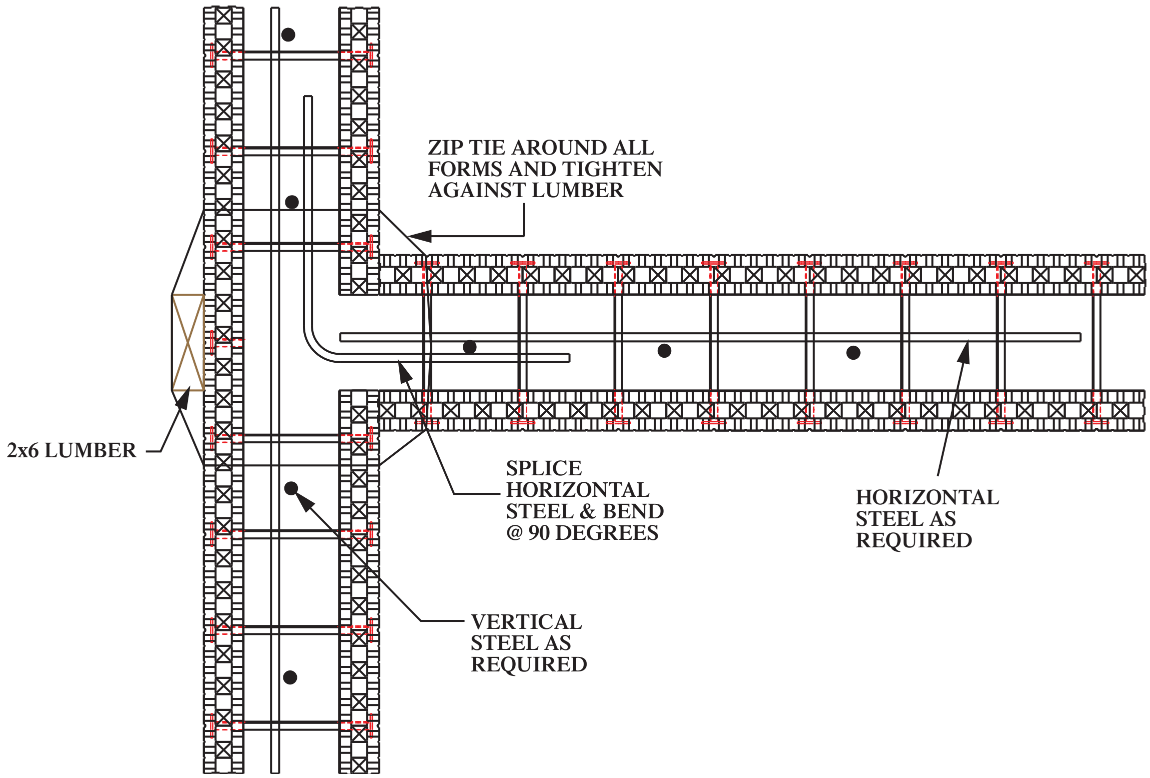


Figure 9.18 – Securing T-wall forms together with 2x6 lumber and zip tie

Tip

Always use caution when pouring concrete into T-wall sections.

9.5 – Brick Ledge Applications

A brick ledge is usually required to support the gravity loads of exterior masonry applications such as brick, natural stone veneer or any other exterior which cannot be supported by screwing into the Amvic block webs.

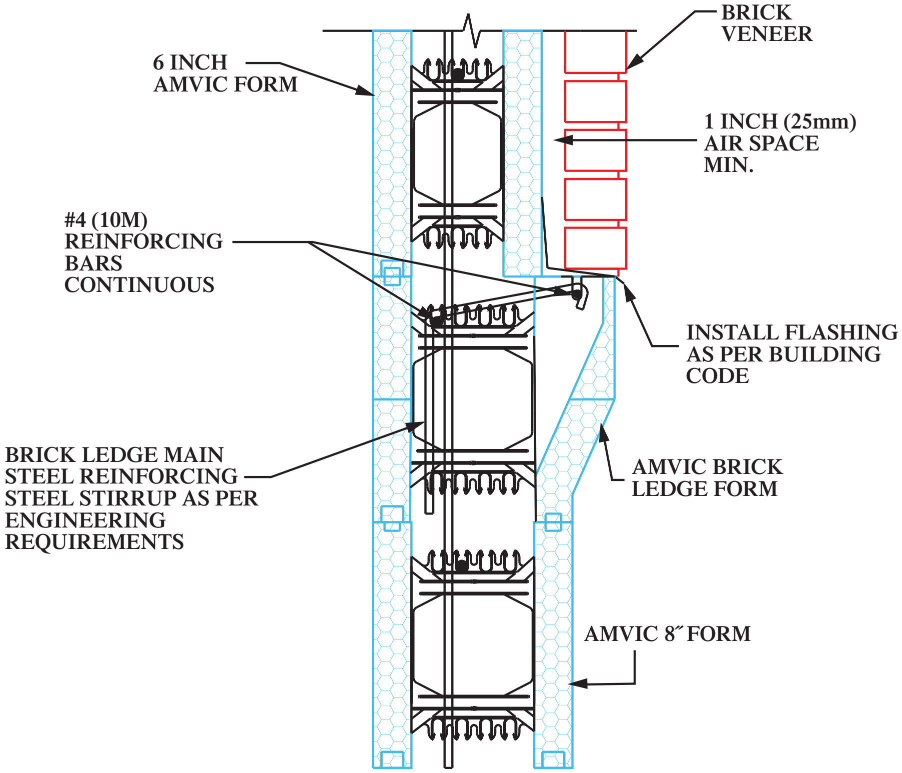


Figure 9.19 – Brick ledge form used for supporting exterior masonry veneer

Amvic has three brick ledge forms available. These are installed in exactly the same manner as straight blocks and provide the space and structural support needed for your exterior brick veneer application.

Alternatively the brick ledge forms can be used with the ledge support on the interior side of the building to provide support for flooring systems such as wood joists, steel joists, etc.

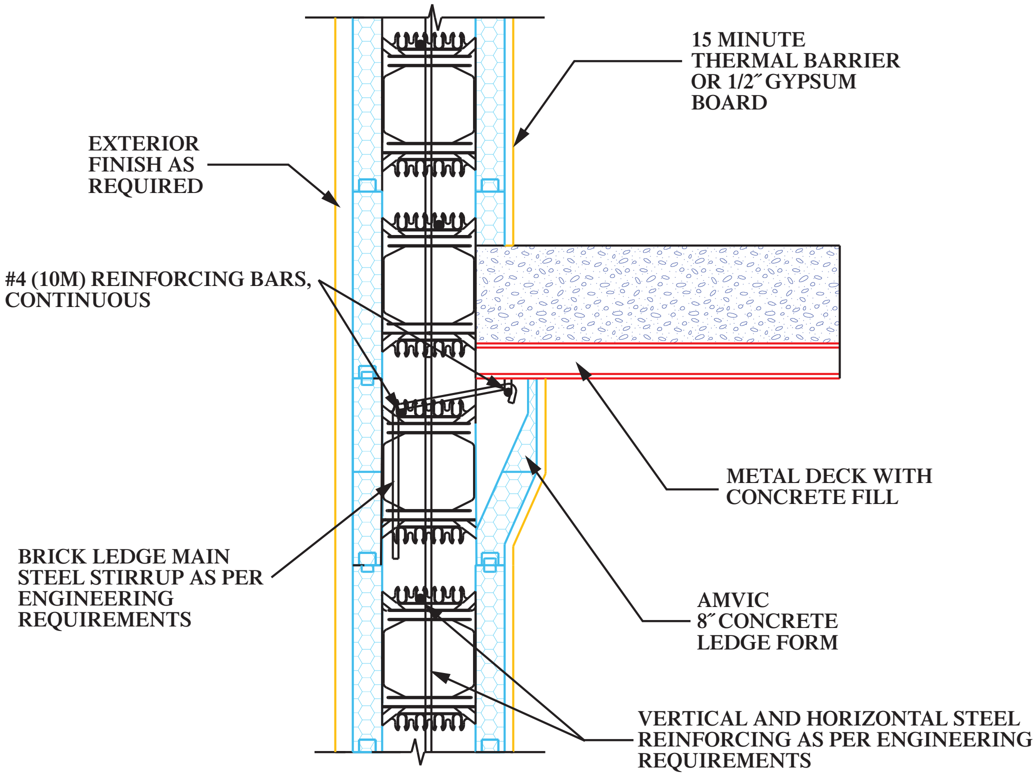


Figure 9.20 –Brick ledge form used for supporting interior floor system

Note

The main reinforcing steel stirrups for Amvic brick ledge forms should be designed to requirements outlined by a local licensed engineer and/or governing building code. Proper stirrup size and spacing is essential for the structural performance of the brick ledge.

9.5.1 – Installing Amvic Brick Ledge Blocks

Amvic brick ledge forms are specially designed so they can be installed as a complete course at the required level just like straight forms. They feature a notch to place the horizontal stirrup hanger on which the main steel stirrups are attached and anchored.

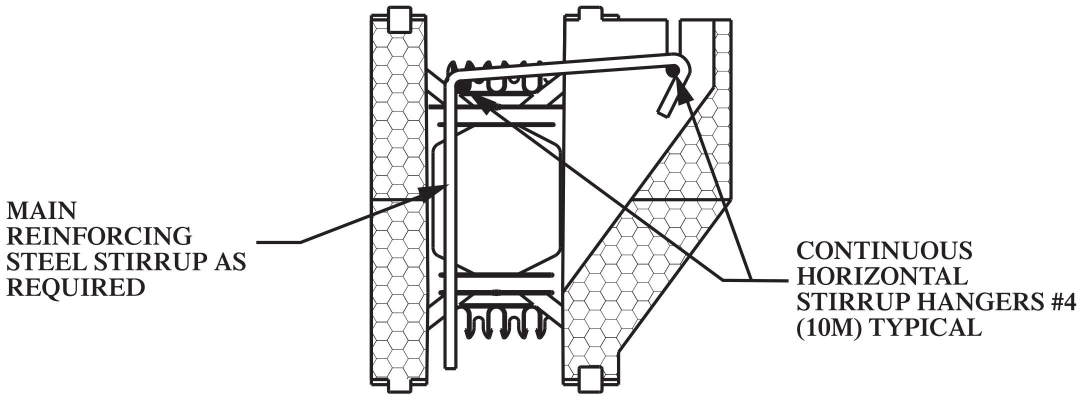


Figure 9.21 – Cross section of 8 inch brick ledge form with main reinforcing stirrup detail

Figure 9.22 – Amvic brick ledge form installed as a single course

Figure 9.23 – Completed brick ledge installation for exterior brick veneer support

9.5.2 – Custom Design Brick Ledge Forms

It is possible to build brick ledge forms if shop drawings and structural design requires a different design and profile than provided by the Amvic brick ledge form. Custom forms can be shaped using light gauge sheet metal or wood. A brief outline of the installation procedure is given below:

1. Use regular Amvic straight ICF blocks as normal.
2. As per shop drawing details cut out the EPS between the block webs at the correct elevation.

Figure 9.24 – Cutting out EPS between webs

3. Pre-bend the main steel stirrups for the brick ledge design as per the engineering requirements and install in place.

Figure 9.25 – Placing pre-bent brick ledge stirrups

4. Attach the custom brick ledge form to the Amvic straight forms using sheet metal strapping and screwing above and below the brick ledge at preferably 12 inch (305 mm) O/C.

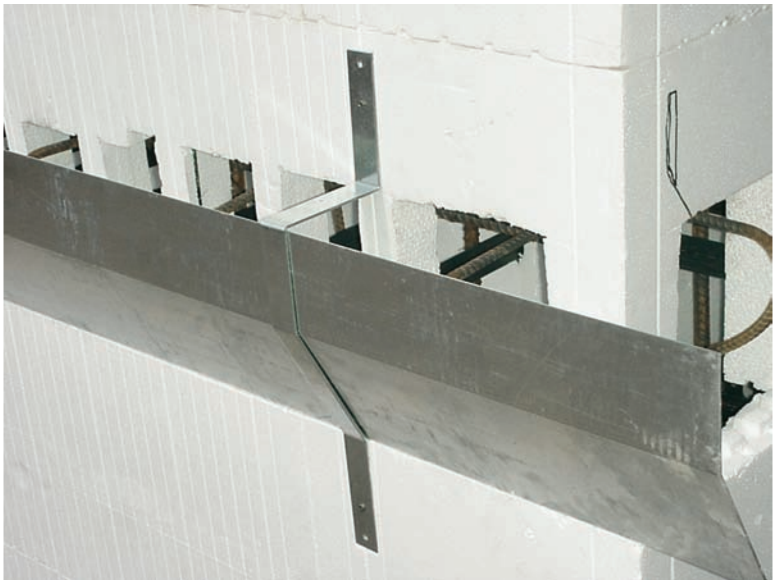


Figure 9.26 – Attaching custom metal forms to the Amvic ICF with sheet metal strapping

9.5.3 – Installing Standard Brick Veneer

Whether you have used the Amvic brick ledge forms or custom made forms, standard brick veneer can be installed in the same manner as regular construction bearing on the ledge support.

Figure 9.27 – Laying standard brick veneer on the brick ledge support

Follow building code requirements for typical flashing details with dripping edge, and minimum air space. Standard brick ties are screwed into the Amvic webs. Horizontal and vertical spacing of the brick ties to be determined by engineering requirements.

Figure 9.28 – Standard brick ties screwed into the Amvic webs

9.6 - Gable Ends

Gable ends can be formed using one of the two methods outlined below.

1. **Stepping Forms**

   Form the gable end by stepping the forms back as you stack to the peak. Block off the vertical ends of the forms and pour concrete. After the pour, the rest of the wall is framed in.

2. **Cutting the Forms**

   Form the gable end by cutting the forms to the appropriate slope of the roof. Secure lumber to each side of the forms so the top of the lumber is aligned with the top of the forms. This gives added form support and provides a furring surface to fasten plywood. Cap off the top of the forms if necessary.

Figure 9.29 – Cutting forms to the shape of the gable end pitch

9.7 - Pre-cast Concrete Floor Systems (Hollow Core/Spancrete)

Hollow Core (HC) slabs are a widely used flooring system, consisting of pre-cast elements in which tubular cores are hollowed out. The elements are typically 4 ft (1.2 m) wide and made of high quality concrete. They are reinforced by pre-stressed strands in the spanning direction only, which results in a very economical production process.

Note

Engineering is required for this floor system.

Installing a Pre-cast floor system:

1. Terminate the concrete wall at the desired height.
2. Set dowel bars as per slab manufacturer design and engineering.
3. Install the pre-cast slabs after the walls have gained enough strength.
4. Pour the floor topping.

Figure 9.30 – Maneuvering a pre-cast hollow core slab for placement on an ICF wall

Figure 9.31 – A pre-cast slab panel placed on an ICF wall

9.8 - Hambro® Composite Concrete Floors

The Hambro®flooring system consists of proprietary open web steel joists. The joists are shaped into a truss with a special top chord and are supported from wall to wall with a typical spacing of 4 1/4 ft (1.25 m). Concrete is poured on plywood sheets that are supported by the Hambro® joists. When the concrete has gained enough strength, the plywood sheets are stripped off and are re-used on other floors.

Installing the Hambro® floor on Amvic ICF walls:

1. Pour the concrete into the Amvic ICF wall to the underside of the concrete slab.
2. Wet set dowels connecting concrete slab to walls as per engineering requirements.
3. When the concrete has gained adequate strength, install the Hambro® flooring system including steel joists, plywood sheets, roll bars and steel reinforcement as recommended by Hambro® technical and/or engineering manual.

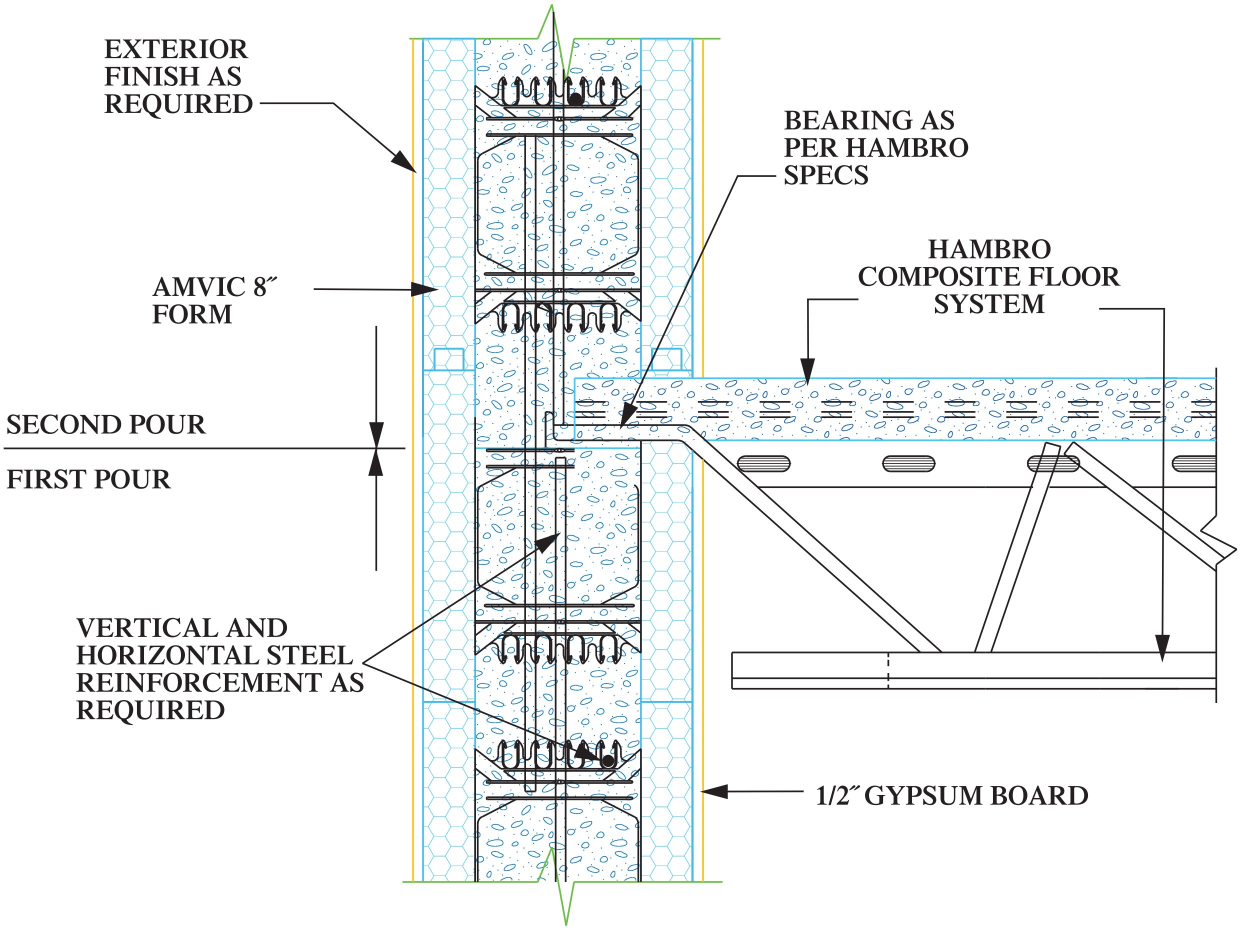


Figure 9.32 – Typical Amvic ICF wall with Hambro® Flooring

Link

Refer to www.hambrosystems.com for technical / engineering information

9.9 - Composite Steel Deck

Composite steel decks are made from plain or galvanized steel sheet rolled into ribbed profiles. The ribs are typically 3 inches (7.62 mm) deep and 6 inches (152.4 mm) wide and spaced at 12 inches (305 mm) on center.

The steel deck can be used strictly as a formwork for concrete or it can be fabricated to bond with concrete and act together to form a composite section.

For composite deck, no additional reinforcement is typically used. When non-composite deck is used, reinforcing steel bars are placed in the slab. Generally, 2 to 3 inches (50 to 76 mm) of concrete is placed over the ribbed deck to form a total slab thickness of 5 to 6 inches (125 to 15 mm).

Installing Composite Steel deck with Amvic ICF:

1. Pour concrete into the Amvic ICF walls to the underside of the concrete slab.
2. Wet set dowels to connecting concrete slab to walls as per engineering requirements.
3. When the concrete has gained adequate strength, install the steel decking and reinforcing steel as per manufacturer's technical/engineering manual or as specified by a local licensed engineer.
4. Pour concrete for the composite steel deck.

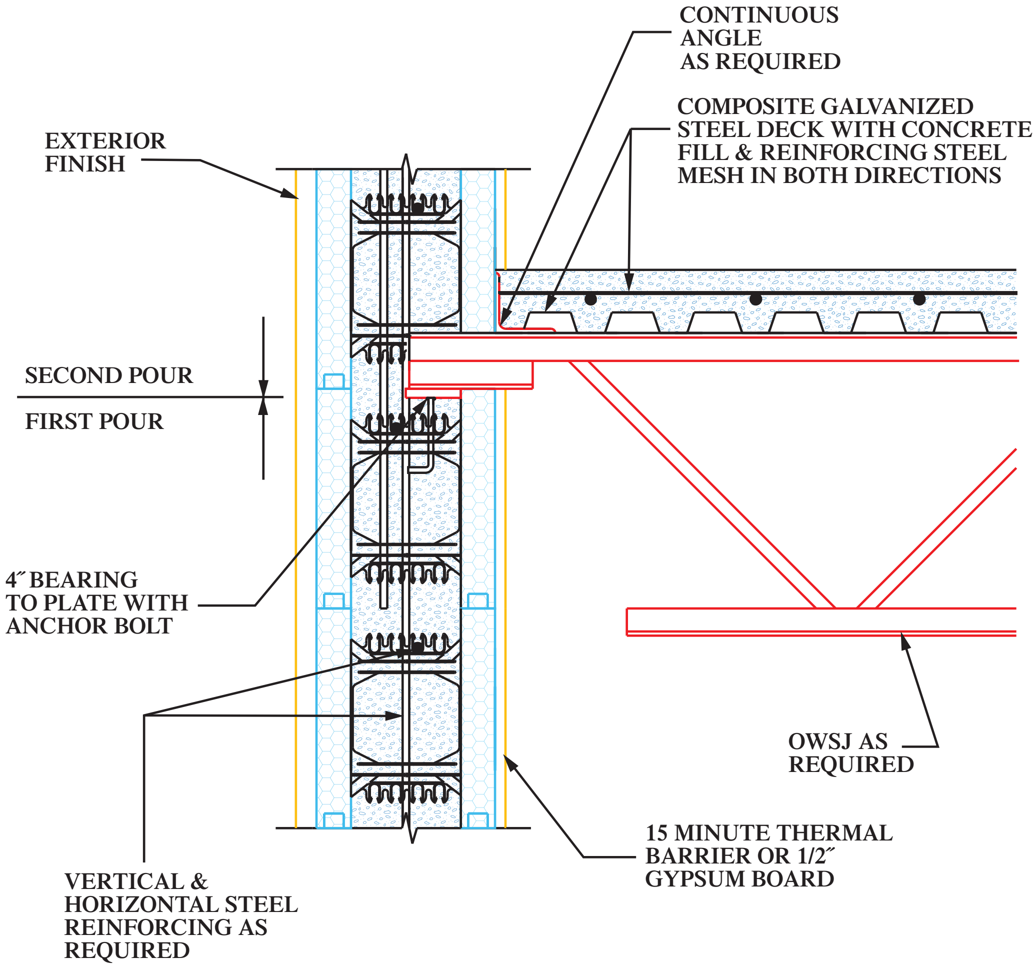


Figure 9.33 – Illustration of typical composite floor on Amvic ICF wall

9.10 – AmDeck® Floor and Roof System

The AmDeck® Floor and Roof System consists of modular Expanded Polystyrene (EPS) forms. When installed the EPS forms provide a stay in place formwork to construct one-way concrete pan joist floors or roofs. The system utilizes 10 inch (254 mm) deep light gauge steel framing studs to carry temporary construction loads until concrete has been poured and gained adequate strength. The light gauge steel joists also act as furring strips to attach ceiling interior finish such as sheetrock. Please refer to our separate technical manual for installation guidelines and engineering details.

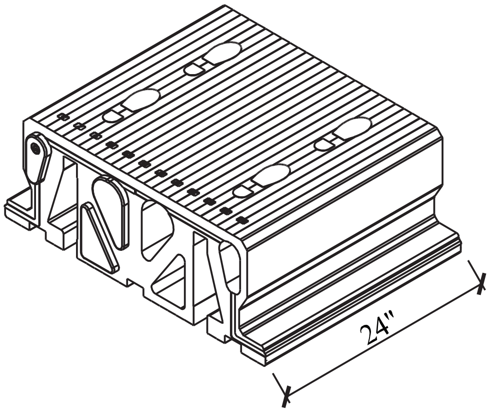


Figure 9.34 – AmDeck® Floor and Roof System

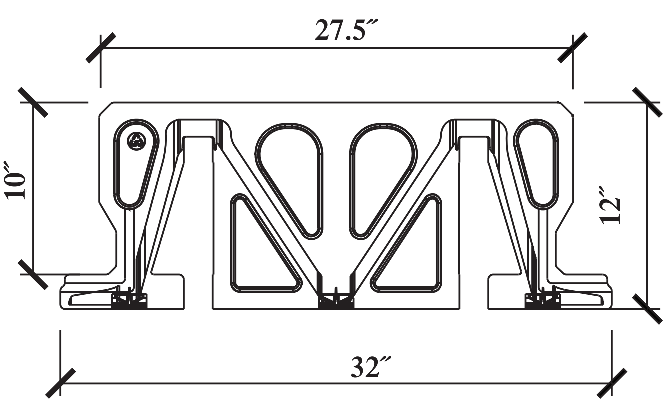


Figure 9.35 – Cross section of an AmDeck form

Figure 9.36 – Installing the AmDeck® Floor and Roof System

Part 10 – Concrete Basics

10.1 - Overview

This section of the manual covers the fundamentals of concrete. New Amvic ICF installers should review this information before proceeding to the following section which deals with concrete placement techniques recommended for Amvic ICF.

10.2 - Concrete Fundamentals

10.2.1 - Concrete Composition

Concrete is a mixture of **paste** and **aggregate**. The paste binds the aggregate (sand and gravel or crushed stone) into a rocklike mass.

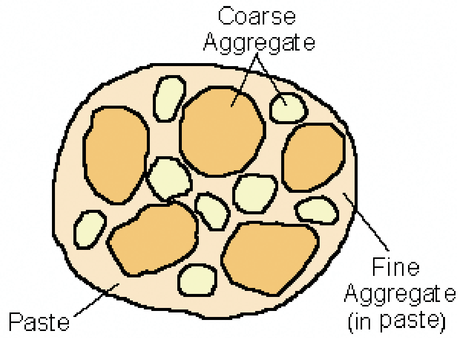


Figure 10.1 - Illustration of typical concrete mix constituents

Cement Paste (also known as binder)

The paste is composed of cement, supplementary cementitious materials, water, and purposely entrained air. Cement paste ordinarily constitutes about 25% to 40% of the total volume of concrete. The volume of cement is usually between 7% and 15% and the water between 14% and 21%. Air content ranges up to about 8% of the volume of the concrete.

There are many different types of cement available but for the purpose of this manual, we will concentrate on the most common, Portland Cement.

In the United States Portland cements will meet the specifications set forth by **ASTM C150**.

ASTM standards are the most widely used and referenced specifications for cement and concrete materials. **ASTM C150** covers eight (8) types of Portland cement:

Type I Normal
Type IA Normal, air-entraining
Type II Moderate sulphate resistance
Type IIA Moderate sulphate resistance, air-entraining
Type III High early strength
Type IIIA High early strength, air-entraining
Type IV Low heat of hydration
Type V High sulphate resistance

In Canada, Portland cements are manufactured to meet the specifications of the **Canadian Standards Association CSA A5**. The five (5) different types of cements covered under this standard are:

Type 10 Normal portland cement
Type 20 Moderate portland cement*
Type 30 High-early-strength portland cement
Type 40 Low-heat of hydration portland cement
Type 50 Sulphate-resistant portland cement

** Moderate with respect to the heat of hydration or sulphate resistance.*

Aggregates (also known as filler)

There are two categories of aggregate used in concrete:

Coarse aggregates (gravel) with particle sizes ranging in size from 6 inch (150 mm) to about 0.05 inch (1.3 mm).

Fine aggregate (sand) consist of natural or manufactured sand with particle sizes ranging from 3/8 inch to dust size.

The selection of aggregates used in concrete is important since it makes up approximately 60% to 75% of the total volume of concrete. Aggregates should consist of particles with adequate strength and resistance to exposure conditions and should not contain materials that will cause a chemical reaction with the paste that may lead to deterioration of the concrete (e.g. sulfates, chlorides etc.)

10.3 - Quality of a Concrete Mix

10.3.1 - Water/Cement Ratio (W/C)

The most important factor which determines the quality of a concrete mix is the quantity of water used versus the quantity of cement used (by weight), also known as the **Water/Cement ratio**.

Water is a critical ingredient in the cement paste. It causes the hardening of concrete through a process called **Hydration**. This is a chemical reaction in which the major compounds in cement form chemical bonds with water molecules and become hydrates or hydration products. This causes the paste to harden and binds the concrete ingredients together.

Too much water reduces concrete strength, while too little will make the concrete unworkable. Concrete needs to be **workable** so that it may be consolidated and shaped into different forms (i.e. walls, columns, etc.). Because concrete must be both strong and workable, a careful balance of the cement to water ratio is required when making concrete.

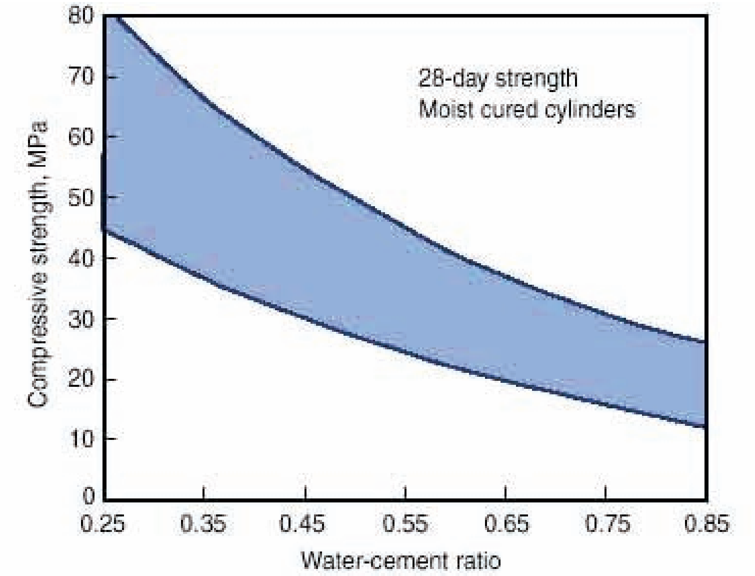


Figure 10.2 -Relationship between W/C and concrete strength.
©2006 Cement Association of Canada, EB101-7 figure 1-17.

10.3.2 - Concrete Strength

There are two types of concrete strengths: **Compressive** and **Flexural**. For most intended structural purposes the compression strength is what concerns the design engineer.

Compressive Strength Test

The cylinder test according to **ASTM C39 standard (CSA A23.2-9C test method)** is the test most commonly used for determining concrete compressive strength in the USA, Canada and continental Europe. A 12 inch (305mm) high by 6 inch (150mm) wide cylinder of concrete is cast and cured for the appropriate time (usually 28 days). It is then compressed between the two parallel faces. The stress at failure is taken to be the compressive strength of the concrete. It is generally expressed in pounds per square inch (**psi**) or Mega-Pascals (**MPa**) at an age of 28 days.

Concrete mix strengths used in ICF will most likely range between **2500 psi - 4000 psi (17 MPa - 30 MPa).**

Flexural Strength Test

Flexural strength is the strength of concrete to bending and is usually measured using **ASTM C78 standard (CSA A23.2-8C test method)** with a simple beam and third point loading. Most general-use concrete has a flexural strength between **500 psi - 700 psi (3.4 MPa - 4.8 Mpa)**.

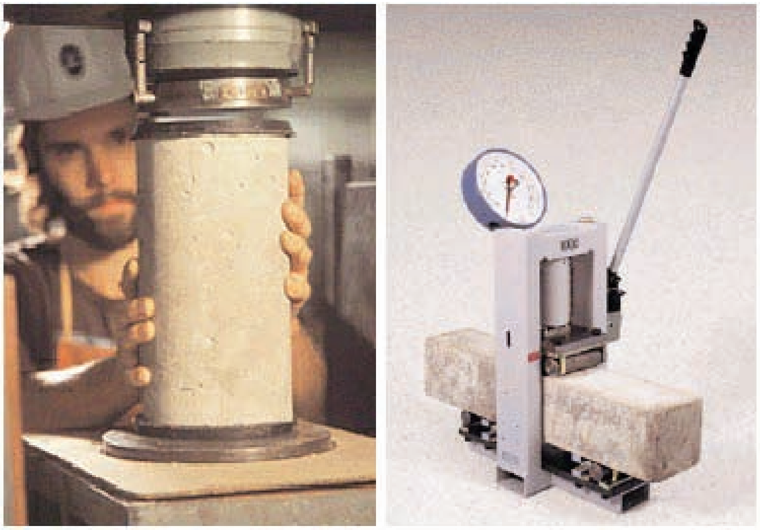


Figure 10.3 - Testing the concrete cylinder for compressive strength (left) and concrete beam for flexural strength (right). ©2006 Cement Association of Canada, EB101-7 figure 16-15

10.3.3 - Concrete Workability

Workability is the ease of transporting, placing, consolidating, and finishing freshly mixed concrete. Workability depends on water/cement ratio, admixtures, aggregate (shape and size distribution) and age (level of hydration). Raising the water content or adding plasticizer will increase the workability.

Slump Test

Workability is usually measured using the **slump** test according to **ASTM C 143** standard **(CSA A23.2-5C test method)** using the slump or Abrams cone. This is an inverted cone, 12 inch (305 mm) tall and is open on both ends. The top is 4 inch (100 mm) wide and the bottom 8 inch (200 mm) wide. Fresh concrete is placed in the cone and "rodded" with a steel rod to compact the concrete. The cone is removed and placed next to the pile of concrete. The difference between the top of the slump cone and the top of freshly molded concrete is the slump.

A relatively dry sample will slump very little, and be given a slump of 1 or 2 inches (25 or 50 mm), while a relatively wet concrete sample may slump as much as 6 or 7 inches (150 to 175 mm).

Figure 10.4 - Concrete mix with low slump. ©2006 Cement Association of Canada, EB 101-7 figure 16-2

Figure 10.5 - Concrete mix with high slump. ©2006 Cement Association of Canada, EB 101-7 figure 16-2

10.3.4 - Concrete Curing

This is the process by which the environment (temperature & humidity) enclosing the freshly poured concrete is controlled for a specific period of time to allow the concrete mix to achieve its design strength and durability.

The hydration process during which water and cement react and harden takes place generally over two stages. The first stage takes place quickly and is sometimes over in a few hours where the concrete mix basically turns into a solid mass. The second stage is a much slower one during which the hydration process continues and concrete keeps gaining strength. This can even take up to several years. Without water, this elongated hydration process would actually stop. Imagine if we were to leave freshly poured concrete in the open air. The humidity within the concrete mix would drop very quickly until there would not be enough to sustain the hydration process causing it to stop altogether. This would prevent the concrete from gaining its required design strength.

A major benefit in using Amvic Insulating Concrete Forms is that they are a stay in place forming system. The EPS panels enclose the concrete mass creating an optimum environment and preventing the moisture in the concrete from evaporating for an extended period of time as opposed to conventional forming systems. This means that the concrete will keep hardening and gaining strength over the long term without the need to use additional expensive curing methods or agents.

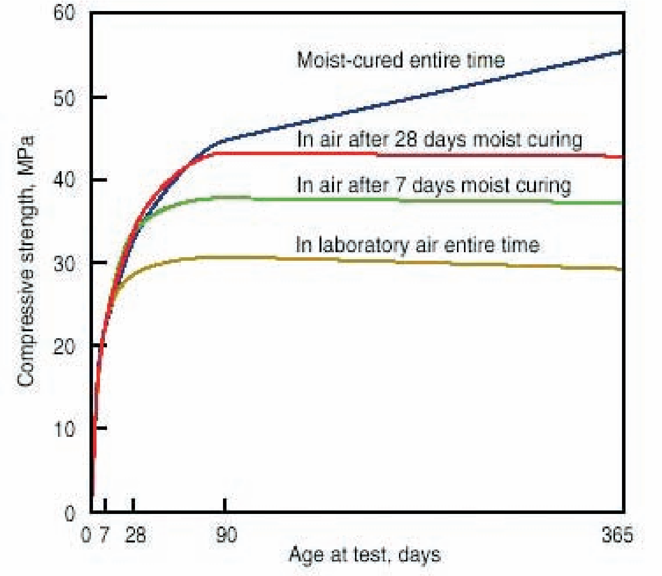


Figure 10.6 - Illustration showing effect of curing on concrete strength over time.
©2006 Cement Association of Canada, EB 101-7 figure 12-2

10.3.5 - Entrained Air (Micro air pockets)

Entrained air consists of microscopic air bubbles introduced in concrete by adding certain admixtures. The microscopic bubbles provide space within the paste to relieve hydraulic pressure when concrete freezes in cold weather. Without the bubbles, the paste may crack when it freezes because water expands 9% in volume when it turns to ice.

Entrained air also has the effect of improving the workability of fresh concrete.

10.3.6 - Entrapped Air (Macro air pockets)

Entrapped air consists of large air voids which get trapped in concrete during mixing and placing. Entrapped air lowers concrete quality and strength and proper concrete consolidation should always be used to eliminate the air voids as much as possible.

10.4 - Concrete Admixtures

Admixtures are materials other than cement, aggregate and water that are added to concrete either before or during its mixing to alter its properties such as workability, curing temperature range, set time or color. There are two main types of admixtures widely available in the market: **Chemical and Mineral**.

Tables 10.1 and 10.2 below outlines the uses of admixtures used in concrete.

Type of Chemical Admixture	Effect on Concrete Mix
Accelerators (ASTM C494, Type C)	Accelerate setting and early-strength development
Air-entraining admixtures	Improve durability in environments of freeze-thaw, deicing chemicals, sulfate, and alkali reactivity Improve workability
Alkali-reactivity reducers	Reduce alkali-reactivity expansion
Corrosion inhibitors	Reduce steel corrosion activity in a chloride environment
Permeability reducers	Decrease permeability
Retarders (ASTM C494, Type B)	Retard setting time
Super-plasticizers (ASTM C1017, Type 1)	Flowing concrete Reduce water-cement ratio Reduce water demand (minimum 12%)
Water reducer (ASTM C494, Type A)	Reduce water demand at least 5%
Workability agents	Improve workability

Table 10.1 - Commonly used chemical admixtures and their uses

Mineral admixtures affect the nature of the hardened concrete through hydraulic or pozzolanic activity. Pozzolans are cementitious materials and include natural pozzolans (such as the volcanic ash used in Roman concrete), fly ash and silica fume.

Type of Mineral Admixture	Effect on Concrete Mix
Cementitious	Hydraulic properties Partial cement replacement
Pozzolans	Pozzolanic activity Improve workability, plasticity, sulfate resistance Reduce alkali reactivity, permeability, heat of hydration Partial cement replacement Filler
Pozzolanic and cementitious	Same as cementitious and pozzolan categories
Nominally inert	Improve workability Filler

Table 10.2 - Commonly used mineral admixtures

10.5 - Specifications of Concrete for Amvic ICF

The following table provides suggested concrete mix specifications to be used with Amvic ICF. This table is only a guideline and the design engineer may choose to deviate from the given values as required.

Specification Description	Value			
	4 in. ICF 100 mm	6 in. ICF 150 mm	8 in. ICF 200 mm	10 in. ICF 254 mm
Min 28 day compressive strength F'c*	2500 psi 20 Mpa	2500 psi 20 Mpa	2500 psi 20 Mpa	2500 psi 20 Mpa
Recommended Slump**	6 in. 150 mm	6 in. 150 mm	5-6 in. 125-150 mm	5-6 in. 125-150 mm
Recommended max water to cement ration W/C	0.55	0.55	0.55	0.55
Recommended max aggregate size	3/8˝ 10 mm	1/2˝ 13 mm	3/4˝ 19 mm	3/4˝ 19 mm
Recommended air entrained %	3-5%	3-5%	3-5%	3-5%
Recommended cement type***	Type 10 Type I	Type 10 Type I	Type 10 Type I	Type 10 Type I

** Values given are minimum values based on USA and Canadian building codes.*
*** Slump values given are optimum for workability and hydrostatic pressure on the blocks during concrete pour*
**** Other types may be used with the consent and supervision of the design engineer.*

Table 10.3 - Guideline specifications for concrete mix

Part 11 – Concrete Placement

11.1 – Overview

This part of the manual covers the concrete pouring and consolidation process with best applied practices that have been acquired over the years. This information is a valuable resource to help you complete a successful project.

11.2 – Pre-Pouring Checklist

> **Tip**
>
> *Extra copies of the following checklist should be made to ensure everything is in order prior to pouring concrete.*

Checking Walls

- ❑ Make sure walls are straight, plumb, square and level.
- ❑ Check if corners are square and plumb.
- ❑ Check if top course of forms been secured.
- ❑ If there will be a second pour check if top of forms been covered to avoid concrete filling the interlocking system.
- ❑ Check if string lines have been placed around perimeter of wall.

Checking Wall Openings

- ❑ Check if wall openings are at the correct height elevation.
- ❑ Check if window and door openings are located correctly and if the openings are plumb and square.
- ❑ Check if anchorage for buck material has been provided.

Checking Reinforcing Steel

- ❑ Check if vertical and horizontal reinforcing steel comply with the specified engineering and/or local building code requirements.
- ❑ Check if reinforcing steel bars around wall openings are installed.
- ❑ Check if reinforcing steel bars for lintels (window/door headers) are installed and as per the specified engineering/local building code requirements.

Checking Floor Connections

- ❑ Check if all floor connections have been installed including anchor bolts, Simpson Strong Tie™ connections etc.
- ❑ Check if beam pockets have been provided (if required for the job).
- ❑ Check if sill plate anchor bolts and tie down straps have been located and are clearly marked for wet-setting into the concrete.

Checking Bracing & Alignment

- ❑ Check if alignment and bracing system is properly installed and planking has been secured.
- ❑ Check if all T-joints braced adequately and properly.
- ❑ Check if all offset joints, stack joints are braced adequately and properly.
- ❑ For bracing system higher than 10 feet off the supporting surface make sure to have a proper handrail system installed as per OSHA requirements in the USA or OHSA requirements in Canada.

Checking Wall Penetrations

- ❑ Check that all penetrations (Electric, plumbing, HVAC, dryer vent etc.) have been accommodated and all form support has been installed.

Checking Tool, Equipment and Materials

- ❑ Make sure that you have two working mechanical vibrators on the job site. One will be used to consolidate the concrete during the pour while the other will act as a standby should the first one break.
- ❑ Make sure the concrete ordered is acceptable for the method of placement and engineering or local building code requirements.
- ❑ Make sure that you have coordinated and confirmed the delivery times for both the boom pump and the concrete.
- ❑ Make sure you have a "blowout kit" prepared and ready. (Refer to section 11.12)

Checking Jobsite

- ❑ Check that the site is clean and there is enough room for trucks, workers, etc.

11.3 – Safety Tips for Handling and Placing concrete

The following are suggestions, precautions and safety measures recommended for anyone handling wet concrete.

Wear Hard Hats

Wear a hard hat for head protection. A construction site presents a variety of hazards that can cause serious head injury.

Protect your Skin

Wet fresh concrete is very abrasive to the skin. It can cause skin irritations, chemical burns and prolonged contact can cause third degree burns. Therefore we recommend to:

1. Wear waterproof gloves, long sleeve shirt, long pants and rubber boots.
2. Use waterproof pads to protect your skin, knees, elbows, or hands from contact with fresh concrete during finishing.
3. Flush eyes and skin that come in contact with fresh concrete immediately with clean water.
4. Rinse clothing saturated from contact with fresh concrete quickly with fresh water.

Protect your Eyes

Wear full cover goggles or safety glasses with side shields during the concrete pour.

11.4 – Rate of Pouring Concrete

When fresh concrete is poured into Amvic ICF, it exerts lateral pressure on the sides of the EPS panels. The intensity of this pressure depends on several factors including:

a. Rate of concrete pour

b. Unit weight of concrete

c. Type of cement

d. Concrete slump

e. Concrete temperature

f. Height of pour

g. Depth of internal vibration

Amvic ICF blocks have an ultimate forming capacity of **864 lbs/sq.ft (41.4 KPa)** as tested according to section 6.4.4 of the Canadian CCMC technical guide for modular expanded polystyrene concrete forms.

Table 11.1 below shows the design lateral pressure for newly placed concrete that should be used for the wall formworks. The pressures are based on the recommendations and formulas given by **ACI 347-04**.

Lateral Pressure of Vibrated Concrete[1,2]			
Pour Rate ft/hr	Pour Rate mm/hr	50° F 10° C	70° F 21° C
		To 14 ft (4.2 m) Pour Height	To 14 ft (4.2 m) Pour Height
1	305	600 psf	600 psf
2	610	600 psf	600 psf
3	914	690 psf	600 psf
4	1219	870 psf[3]	660 psf
5	1524	1050 psf[3]	720 psf

Recommended Pour Rate

1- Maximum pressure need not exceed w∗h, where "w" is the unit weight of concrete (lbs/ft^3) and "h" is maximum height of pour in feet

2- Based on Types I and III cement concrete density of 150 pcf (2400 Kg/m^3) and 7 inch (178 mm) maximum slump, without additives and a vibration depth of 4 feet (1.2 m) or less

3- Lateral Pressure exceeds Amvic ICF forming capacity

Table 11.1 – Concrete pressures for walls internally vibrated

The recommended pour rate for Amvic ICF is between **3 to 4 ft/hr (915 to 1200 mm/hr)**. However, for Amvic ICF concrete pour rates of up to 5 ft/hr (1.5 m/hr) are possible in warm temperatures (70° F or 21° C).

11.5 – Methods & Equipment for Pouring Concrete

Concrete can be placed in several ways depending on the application and job-site conditions available. The following table summarizes the most common methods for placing concrete in Amvic ICF.

Placement Method	Type of work best suited for	Advantages	Special Notes
Concrete Boom Pump	Used to convey concrete directly from discharge point like concrete truck mixer into Amvic ICF forms.	Different boom reaches available. Delivers concrete in continuous stream. Pump can move concrete vertically and horizontally. Pump mounted on truck has high mobility and very versatile to many pouring situations.	For maximum efficiency, schedule concrete trucks appropriately to provide continuous supply of concrete to the pump with minimal idle times. Employ 3", 2.5" or 2" reducers and flexible hose at end of pipeline to reduce rate of concrete pour.
Crane & Bucket	Used mainly for conveying concrete above ground level directly from discharge point into Amvic ICF forms.	Provides clean discharge and there are many bucket capacities available. Cranes may be used to convey other materials such as reinforcing steel.	Make sure bucket has a handle to control the rate of concrete discharge. Select fitting at bottom of bucket to suit placement in ICF walls.
Chutes on Truck Mixers	For conveying concrete to a lower level, usually below gound level directly from discharge point into Amvic ICF forms.	Very economic and easy to maneuver. No power required since gravity does most of work.	Slopes should range between 1:2 and 1:3. Chute should be adequately supported in all positions. End discharge arrangements required to prevent segregation.
Belt Conveyors	For conveying concrete horizontally or to a higher or lower level. May be used to discharge concrete directly into Amvic ICF but usually positioned between main discharge and second discharge point	Belt conveyors have adjustable reach, traveling diverter and variable speed for forward and reverse. Can place large volumes of concrete for limited access situations.	End discharge arrangements needed to prevent segregation. In extreme weather conditions, long reaches of belt may need cover to protect concrete.

Table 11.2 – Most common methods for concrete placement used with Amvic ICF

Figure 11.1 – Using boom pump to pour concrete in Amvic ICF

11.5.1 – Placing Concrete with a Boom Pump

It is highly recommended to use a double "S" bend or double 90° fitting at the discharge point of the pump line. This will help reduce the flow rate of concrete to the desired levels. A flexible hose of appropriate length is always recommended for controlling flow rates and for safety issues.

Tip

Using a boom pump to pour concrete is the most preferred and efficient method.

Many ICF contractors also use 3, $2^1/_2$ or 2 inch reducer fittings with a flexible hose. Although the reducers may make it more convenient to pour the concrete, they can also have the effect of increasing the pressure and flow rate at which the concrete is discharged.

It is up to the contractor to use whatever fittings he is comfortable with as long as the concrete is poured at the recommended rates and without damaging the forms.

Tip

Discuss your pour thoroughly with your pump operator when you place your order. Make sure the concrete ready mix company has the pump line fittings required like "S" bend connection, reducers and flexible hose.

11.5.2 – Crew Size

On pour day a crew of 4 is the minimum to work with plus the pump operator. At least three crew members are needed on the scaffolds; one handling the hose and two working the vibrator. One crew member is required on the ground for filling and blocking window bucks, cleaning slops, untangling the electrical cords of the vibrator, etc. A crew of 5-6 is optimal.

11.6 – Pouring the Concrete

Important Notes!

Remember, concrete should always be poured at a steady rate and in lifts between 3 to 4 ft (915 to 1200 mm) maximum at a time. Using the recommended pour rate of 3 to 4ft/hr a typical 9 ft (2.7 meters) high wall should be poured within a minimum span of 3 hours.

If you are using a boom pump, it is important to have the operator dump the "pump prime" (sludge that initially comes out of the hose) outside of the forms or back into the pump.

Pouring Concrete in 90° Corners

It is advisable to start pouring concrete at a corner and then work your way around the wall perimeter in a circular manner. However, corners require special attention during the pour because of their geometry. Corner blocks are always subjected to more lateral pressure due to concrete placement than the straight blocks. The key is to equalize the concrete pressure on both sides of corner blocks as much as possible. The following steps should be followed:

Warning!

DO NOT allow concrete to accumulate on one side of a corner block at any time. This may cause a blowout during the concrete pour.

1. Start by pouring concrete at approximately a distance of 2 to 3 ft (0.6 to 0.9 meters) away from the corner center.
2. When filling the walls to the required lift height, make sure to pour concrete at approximately the same rate on both sides of the corner block by moving the pump hose or discharge point in a back and forth rhythm.

Figure 11.2 – Pouring concrete for 90° Corner

3. Concrete should not be poured for a subsequent lift in and around the same corner block until at least an hour has passed.
4. Ensure proper concrete consolidation.

Pouring Concrete around Windows/ Doors & Straight Sections

1. Typically, contractors will start by bringing the boom hose down and filling the bottom of the window bucks first. Each window bottom should be **consolidated** using a concrete vibrator (refer to section 11.7 for details on concrete consolidation) and then screeded off.

Tip

Depending on your slump, it is advisable to nail or screw an OSB cap over the opening(s) in the bottom of the window buck, to prevent the concrete from bulging up or overflowing when you pour down the sides from above in the next passes.

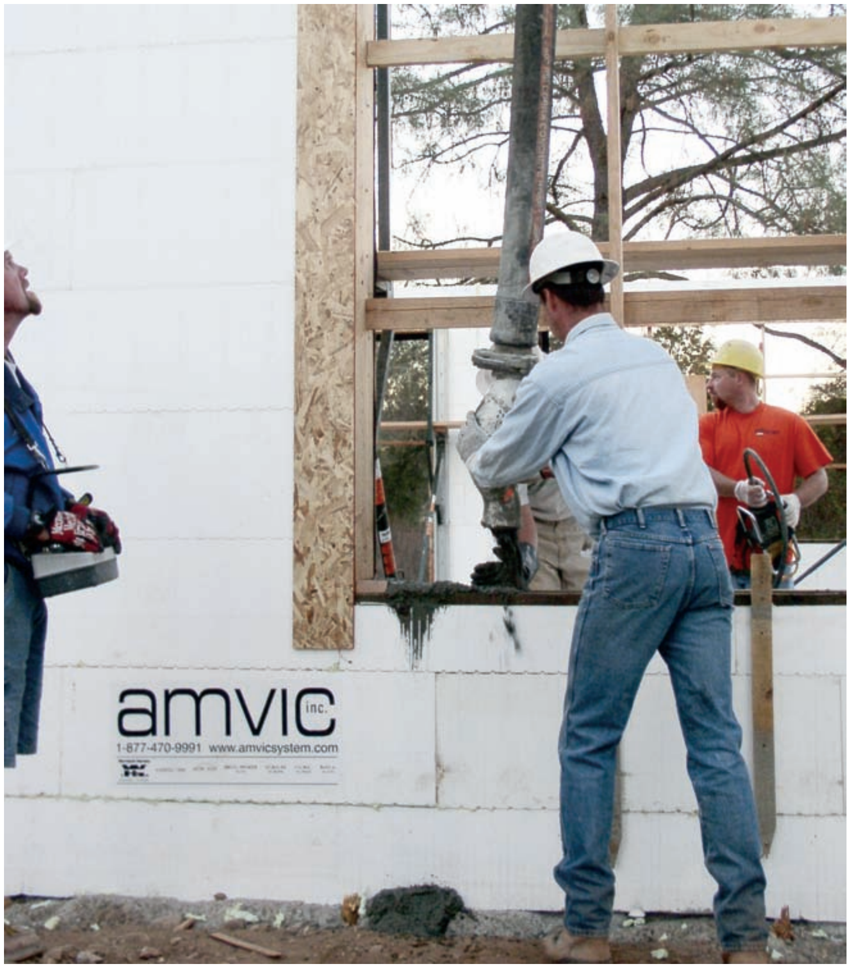


Figure 11.3 – Pouring concrete at window sills

2. Window and door bucks should not be completely filled on one side at one time. Fill both sides of the opening using a back-and-forth rhythm. Avoid spilling concrete into the window and door headers (also known as lintels).

3. Pour concrete normally into straight sections up to the required lift height.

4. As you fill the walls to a lintel, ensure a continuous pour along its entire length without creating any cold joints. Proper and adequate concrete **consolidation** in lintels is of paramount concern.

Tip

With a 2-3 inch (50 -76 mm) reducer on the pump hose, it frequently is possible to hold back the concrete briefly by placing your rubber-gloved hand over the end of the nozzle and quickly swinging the hose to the other side of the window or door.

Figure 11.4 – Using internal vibrator to consolidate concrete

5. Stop short of pouring concrete into a second corner by approximately 2 to 3 ft (0.6-0.9 m). Follow the recommendations given above for concrete placement in corner blocks.

11.7 – Quality Control

11.7.1 – Slump

It is recommended to perform a field slump test on the first batch of concrete that arrives on the jobsite. If the slump is too low or too high, then you can immediately inform the concrete supplier to adjust the concrete mix appropriately for the subsequent batches. This will also give a good feel for what the consistency of a proper concrete mix should be like with Amvic ICF.

If a special inspection is required by the local building code then an engineer will be on the jobsite and this test may become a requirement not an option.

Figure 11.5 – Performing the slump test in the field

11.7.2 – Compressive Strength

It is recommended to randomly retain fresh concrete into proper size cylinders. The cylinders will later be tested by a certified concrete laboratory for compressive strength at 28 days to ensure that concrete used on a specific jobsite meets the specified compressive strength by the local licensed engineer/building code requirements.

If a special inspection is required by the local building code then an engineer will be on the jobsite. Taking random samples of concrete for compressive strength testing becomes a requirement and not an option.

Figure 11.6 – Random sampling of concrete for compressive strength testing at 28 days

11.8 – Concrete Consolidation

11.8.1- What is Consolidation

Consolidation is the process of compacting freshly poured concrete. Concrete ***MUST*** be consolidated to:

1. Eliminate stone pockets, honey-comb, and entrapped air.
2. Mold concrete within the forms and around embedded items.
3. Ensure reinforcing steel is properly embedded and bonded to the concrete paste.

11.8.2 – Methods of Consolidation

The concrete industry has accepted 2 types of concrete consolidation – internal and external.

Internal Consolidation

1. Mechanically using a proper size immersion type concrete vibrator (also known as poker or spud vibrators). This is the most preferred method for adequate consolidation.
2. Manually using steel rods and "rodding" the concrete. This is not a practical method for use with Amvic ICF and does not provide adequate consolidation of the concrete.

Important Note!

Ensure that you use the proper size concrete vibrator for adequate concrete consolidation. Using hand rodding to consolidate concrete in Amvic ICF walls should be AVOIDED.

External Consolidation

This method involves attaching a mechanical vibrating device to the outside of the Amvic ICF forms. Although this method may be acceptable, it is not as effective as internal mechanical vibration.

Important Note!

Tapping on the outside of the forms is not an acceptable method of consolidating concrete in Amvic ICF.

11.9 – Using Concrete Vibrators

11.9.1 – Recommended Specifications

Vibrators consist of a vibrating head connected to a driving motor by a flexible shaft. Inside the head, an unbalanced weight connected to the shaft rotates at high speed, causing the head to revolve in a circular orbit. The motor can be powered by electricity, gasoline, or air. The vibrating head is usually cylindrical with a diameter ranging from $^3/_4$ to 7 inches (20 to 180 mm). The dimensions of the vibrator head as well as its frequency and amplitude in conjunction with the workability of the mixture affect the performance of a vibrator.

Figure 11.7 – Immersion type concrete vibrator with gasoline engine

The table below provides the recommended specifications for concrete vibrators used with Amvic ICF.

Value	4 & 6 inch ICF	8 & 10 inch ICF
Maximum vibrator head diameter	1 inch (25 mm)	1.25 inch (38 mm)
Frequency (vibrations per minute)	10000 vpm	9000 vpm
Minimum Radius of Action	4 inch (100 mm)	6 inch (152 mm)
Insertion on center spacing	6 inch (152 mm)	9 inch (228 mm)
Centrifugal Force	220 lbs (100 Kg)	500 lbs (225 Kg)
Compaction rate	2 - 4 cu.yds / hr (1.5 - 3 m^3 / hr)	2 to 5 cu.yds / hr (1.5 to 3.8 cu. m^3 / hr)

Table 11.3 – Recommended immersion type concrete vibrator specifications for use with Amvic ICF

11.9.2 – Guidelines for Concrete Consolidation

Recommended Practices:

- Consolidation ***MUST*** be done immediately after fresh concrete is poured and before it sets.
- Completely immerse vibrator head in concrete during consolidation.
- Insert vibrator vertically and let it sink as **quickly** as possible under its own weight to the desired depth.

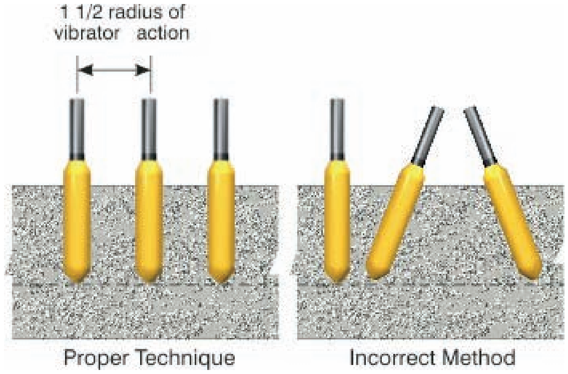


Figure 11.8 – Vibrator head placement

- Hold the vibrator 5 to 15 seconds then **slowly** lift up, approximately 3 inches/sec (76 mm/sec) staying behind the trapped air's upward movement.
- Move vibrator and re-insert at a distance 1.5 times the radius of action as shown in diagram below.

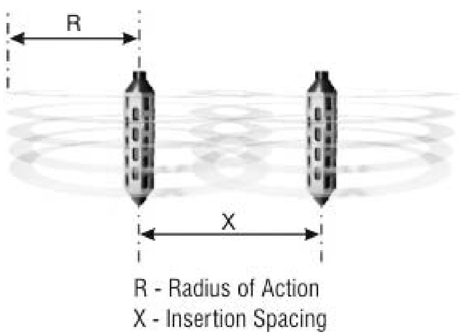


Figure 11.9 – Radius of action of concrete vibrator

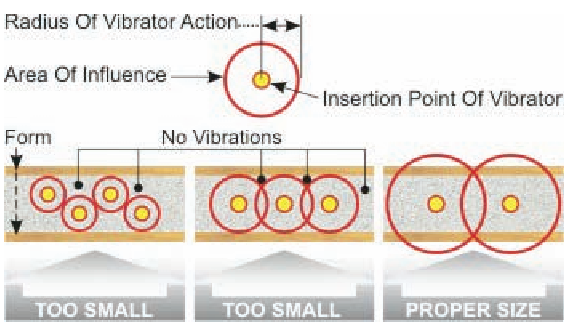


Figure 11.10 – Insert vibrator head at 1.5 times radius of action

- Allow the vibrator to penetrate 6 inches (152 mm) into the previous layer to ensure proper bond and eliminate cold joints.
- Pour concrete into the walls in lifts of 3-4 ft (915 – 1.2 m) per hour. For proper consolidation, each of the lifts should be poured in layers of the same thickness as the vibrator head length minus depth of penetration into previous layer, typically 6 inches (152 mm).
- Stop vibration when the surface becomes shiny and there are no more breaking air bubbles.

Practices to Avoid:

- Do not use the vibrator to move concrete laterally. This causes segregation.
- The vibrator head should not touch the sides of the ICF forms. It should only be in contact with concrete.
- Do not immerse the vibrator head down the same path more than once.
- Do not run the vibrator in air for more than 15 seconds. This will cause overheating.
- Avoid sticking the vibrator head into the top of a concrete heap. To flatten a concrete heap, insert the head around the perimeter. Do this carefully to avoid segregation.

Tip

- *Ensure the vibrator flexible shaft has enough length to match the wall height being poured.*
- *Make sure there are enough workers for placing and consolidating concrete during the pour. A two-man crew should be handling the concrete vibrator and immediately following the person working the pump hose as each layer is poured.*

11.10 – Finishing the Concrete Pour

If a second storey will be constructed above the height being poured, stop filling the top course of block at least 2 inches below the block top. Vibrate it thoroughly but leave it rough so that the next pour will have a good mechanical bonding surface. An excellent bond will develop by leaving the concrete unfinished.

If this is the final course of block that will be poured, then the concrete should be troweled down smoothly, (recommend the use of a laser level at this point) and anchor bolts should be put into the wet concrete after finishing. We recommend you wet set the anchor bolts into the screeded top of the wall, and install the mudsill after the concrete has set. Mudsills or top plates can either be installed to be full width and extend all of the way to the surface of the blocks (13 inch or 11 inch) or it can be recessed *within* the block cavity so that the EPS foam extends unbroken to the rafter tails.

Tip

It gets very busy towards the end of the pour. Mark anchor bolt locations on the sides of the form before the pour and place them on the scaffolds near where they will be installed.

11.11 – After the Pour: Recheck Wall Straightness and Adjust

After pouring is complete, immediately check the corners again for plumb and the wall for straightness. There is a short window in which the bracing system can push and move the wall. If realignment is required adjust the bracing to do so. Have 3 to 4 spare braces ready in the event you need to quickly install an additional adjustable brace to push the wall in an area that you didn't expect.

11.12 – Preparing for a Blow-out

In the unlikely event of a blow-out, prepare a kit which contains the following:

- A few pieces of OSB or plywood, 24 by 24 inches (600 x 600 mm) or so.
- A container of sheetrock screws.
- A fully charged electric driver drill.
- A portable ladder sufficient to reach whatever height is involved.

Before all pours, brief the crew on how to handle a blow-out. If a blow-out occurs, the ground man should:

- Wave off the pump and vibrator.
- If the foam has only bulged and not separated from the webs, install a piece of form support at the location. Use an extra brace for that purpose.
- If the EPS is broken, remove it, clean out concrete and reinsert the broken piece of EPS so that it is flush with the wall.
- Install one or more pieces of OSB with *multiple* screws into intact webs or bucks on either side of the failure location.

Part 12 – Below Grade Moisture Protection

12.1 – Code Requirements

All building codes in the US and Canada require walls below grade to have damp-proofing or waterproofing protection.

12.1.1 – Damp-proofing vs Waterproofing

Damp-proof applications will slow or retard water and water vapor penetration through the foundation walls. When applied properly, damp-proofing can keep basements in a dry condition as long as there is no hydrostatic pressure due to ground water table.

Waterproof applications stop water from infiltrating foundation walls. Waterproof applications in most cases are more expensive than damp-proofing. The investment is well worth it considering the repair costs involved, if a basement wall starts to leak water.

12.1.2 – Damp-proofing or Waterproofing According to Building Codes

Damp-proofing is required for foundation walls enclosed within soils where hydrostatic pressure does NOT occur.

If it is determined by a soil investigation report that hydrostatic pressure conditions exist, then the enclosed foundation walls shall be waterproofed. When walls are waterproofed, no damp-proofing is required.

12.1.3 – Foundation / Subsoil drainage system as per Building Codes

Proper drainage of the subsoil is required for all walls which retain soil and enclose habitable space. The drain shall be placed around the perimeter of the foundation wall at or below the footing or SOG level. The drains can be made of drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems. The drains shall discharge water by gravity or mechanical means into an approved drainage system.

Figure 12.1 below illustrates a typical “French Drain” system which has been used successfully for residential construction in North America.

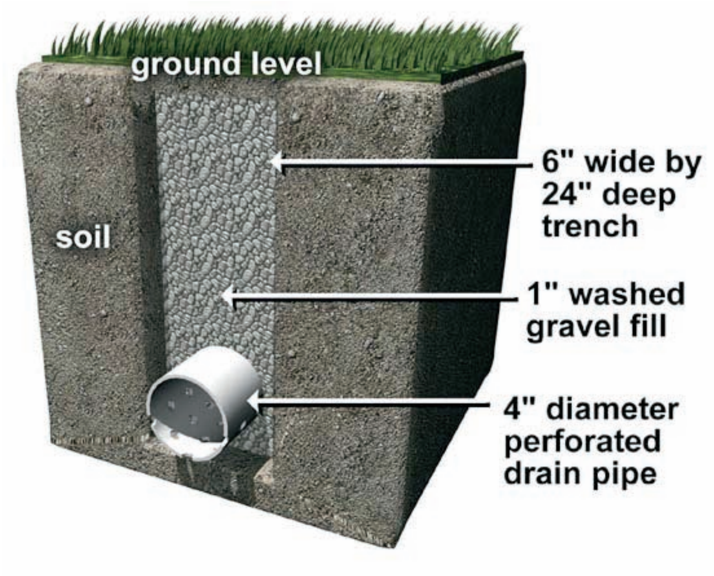


Figure 12.1 – Typical French drain system.
©1993-2006, Tim Carter Image courtesy of Tim Carter, AsktheBuilder.com

12.1.4 – Recommendations for Maintaining a Dry Basement

The following are suggestions to help maintain your basement dry and moisture free:

1. Make the extra investment and insist on full waterproofing for your foundation or basement walls. Terminate the waterproofing membrane 2 to 3 inches (50 to 75mm) above grade.
2. Build up the ground around your house so that water flows ***AWAY*** from your basement walls. Also examine sidewalks, patios, decks, and driveways. These can settle over time and cause water to drain back towards your basement walls (See figure 12.2 below).
3. Extend downspouts so that water flows away from the structure and does not pool next to the basement walls or basement windows (see figure 12.2 below). If downspouts are connected to the sewer system, disconnect them.

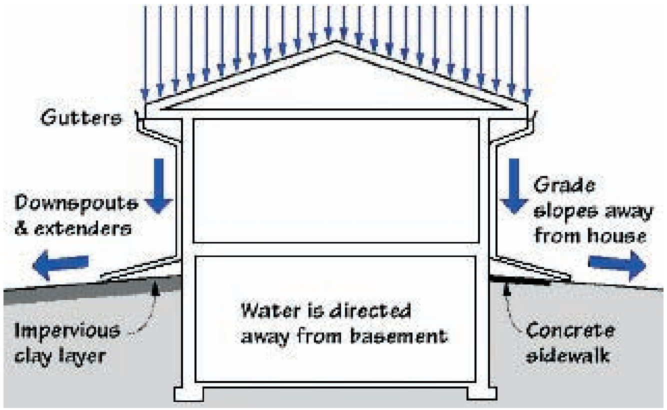


Figure 12.2 – Recommendations for dry basement

12.2 – Damp-proofing & Waterproofing Applications for Amvic ICF

There are 3 types of membranes that can be applied to Amvic ICF including liquid applied membranes, peel & stick membranes and dimple sheets.

Each of the three types has advantages and disadvantages. Before deciding on which one to use, consider the following:

> **Note**
>
> *Always follow the manufacturer installation procedures for ICF application.*

1. **Local availability** – Check with the local Amvic distributor for appropriate product availability.
2. **Product Technical Information** – Ensure that product of choice has the proper technical information with regards to specifications, installation instructions and meets the local building code requirements.
3. **Manufacturer warranty** – The product manufacturer should have a product warranty against production deficiencies. Some manufacturers offer up to 30 years of warranty on their products.
4. **Installer Warranty** – The contractor installing the product should offer an installation warranty to guarantee installation and performance for a certain period of time.
5. **Installer Experience** – It is recommended to ask your installer about his experience using the products available.
6. **Price** – Higher performance products will almost always cost more. Carefully weigh the benefits against the costs before making a decision on which product to use.

12.3 – Liquid Applied Damp-proofing / Waterproofing systems

Liquid applied membranes usually come in pails of 5 US gallons each. Depending on which product is being used, the membrane can be applied using a trowel, brush, roller or spray.

To protect the liquid applied membrane from sharp/heavy gravel in the backfill soil, Amvic recommends installing protective boards or drainage composites. The protective boards/drainage composites will be applied over the liquid applied membrane and have the added benefits of additional moisture protection and provide air channels for water to be carried by gravity to the footing drain.

Figure 12.3 – Spraying liquid applied membrane on Amvic ICF

Recommended liquid applied membrane products for Amvic ICF include:

1. Blue Seal Waterproof Rubber Membrane – www.bluesealwaterproofing.com
2. BAKOR, Aqua-Bloc® 720-38 – www.bakor.com
3. Carlisle, BARRICOAT-R – www.carlisle-ccw.com
4. Epro, Ecoline-R and Ecoline-S – www.eproserv.com

Warning!

Liquid applied damp-proofing / waterproofing membranes MUST be water based and free of any solvents. Follow the manufacturer installation requirements.

12.4 – Peel & Stick Damp-proofing / Waterproofing systems

Peel and Stick systems are made of membranes which adhere directly to the EPS on Amvic ICF. One side of the membrane has a thin film of glue which is protected by a paper sheet. Once the paper sheet is peeled off, the membrane is adhered in place as per the specific installation guide of the manufacturer.

Warning!

Any primer used prior to the peel and stick application MUST be water based and free of any solvents.

In most cases the manufacturer will also recommend a specially formulated primer to be applied to the face of the EPS before applying the membranes which will help improve their adhesion. Peel and stick membranes may require a protection layer against sharp/heavy gravel. Check manufacturer specifications.

Figure 12.4 – Peel and stick waterproofing membrane installed and ready to be backfilled

Recommended peel and stick membrane products for Amvic ICF include:

1. SOPREMA, COLPHENE ICF – www.soprema.ca
2. BAKOR, Blueskin® WP 200 – www.bakor.com
3. CARISLE, MiraDri 860/861 – www.carlisle-ccw.com
4. Polyguard, POLYGUARD 650 MEMBRANE – www.polyguardproducts.com
5. Polyguard, POLYGUARD 650 XT MEMBRANE, for waterproofing AND termite protection – www.polyguardproducts.com

12.5 – Dimple sheet Damp-proofing / Waterproofing Systems

Dimple sheet membranes are wrapped around the foundation walls with the dimple side facing the EPS on the Amvic ICF creating an air gap between the back fill soil and the walls. This air gap prevents the build up of direct hydrostatic pressure over the walls and thus moisture in the soil cannot penetrate through to the inside of the basement. When installed properly, dimple sheet membranes have been used with success throughout North America.

Figure 12.5 – Installed dimple sheet membrane

Recommended dimple sheet damp-proofing / waterproofing products for Amvic ICF include:

1. Armtec Limited, System Platon – www.systemplaton.com
2. DMX PLASTICS – DMX FlexsheetTM – www.dmxplastics.com

12.6 – Parging

Most building codes in North America will require the exterior finish siding to start at a distance not less than 6 to 8 inches (150 to 200 mm) above grade level. The exposed EPS area between the grade and the exterior siding finish must be covered. A parge coat (cementitious coat) is most often used to cover the EPS to protect it from weathering effects.

Before applying the parge coat, the EPS must be clean of any dirt or debris and dry to ensure proper adhesion. Amvic recommends using **Durock Prep-Coat B-2000** with reinforcing fiber mesh or equivalent. The parging coat should overlap the damp-proofing/waterproofing membrane by 2 inches (50 mm).

Steps for applying parge coat:

1. Prep the EPS surface.
2. Using a trowel, spread a skim coat of the parging material on the EPS.
3. Embed the reinforcing mesh into the skim coat while still wet. Allow to cure.
4. Apply a second coat of parging and allow to cure.
5. The finished surface may be left as is or painted as required for architectural purposes.

Part 13 – Interior & Exterior Finish

13.1 – Interior Drywall

Currently all building codes in North America require foam plastics to be separated from the interior living spaces, any habitable spaces and some crawl spaces by a thermal barrier (fire protection) that will remain in place for 15 minutes based on specific testing criteria.

The most common type of interior finish material that will meet the thermal barrier requirements as stipulated by the building codes is a $^{1}/_{2}$ inch (12.7mm) gypsum board also known as Drywall®.

The Amvic ICF polypropylene webs provide a horizontal and vertical furring strip to which the Drywall® can be directly attached. The spacing and size of the screws should follow the local building code requirements. Drywall sheets can be installed vertically or horizontally.

For the purpose of meeting the building code requirements regarding Drywall® installation, Amvic has conducted the following tests which are available upon request:

1. Drywall type "S" fine thread and type "W" coarse thread screw pullout and shear in accordance with **ICBOES AC 116** in conjunction with **ASTM D1761.**
2. Room fire test standard in accordance with **UBC-1997** standard **26-3** for protection of interior foam plastics using 1/2 inch (13mm) gypsum board.
3. Fire test in accordance with **CAN/ULC S101-04** and **ASTM E119-00a** "Standard test methods for fire tests of building construction and materials using 1/2 inch (12.7mm) gypsum board.

13.2 – Traditional Stucco (Exterior)

Stucco is a cement based wall cladding system that can be used as an exterior or interior finish. Traditionally stucco is applied over wood stud with sheathing, cast in place concrete or masonry substrates. Modern stucco applications have advanced and adapted to other substrate materials including Amvic ICF.

Stucco cladding for insulating concrete forms is mainly composed of metal wire lathe, a base coat and a finish coat. The metal wire lathe is attached to the Amvic propylene webs using approved drywall fine thread or coarse thread screws.

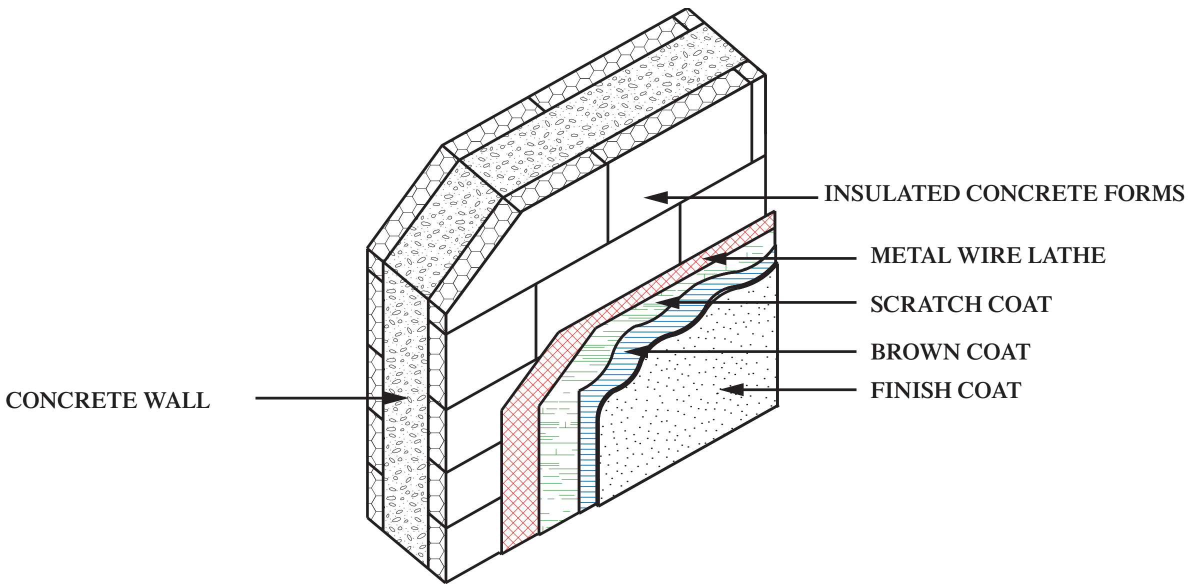


Figure 13.1 – Typical Stucco Application over ICF

Currently there are two main types of stucco used in North America:

Three Coat Stucco

The stucco base itself is applied in two coats and followed by a third coat. Each of the two base coats is typically $^3/_8$ inch (10 mm) thick resulting in a finish stucco base of $^3/_4$ inch (20 mm).

The first base coat is known as scratch coat. This coat keys into the metal wire lathe, covering it completely. Horizontal and vertical grooves are introduced in this coat as it cures. The grooves will provide a good gripping surface for the coat to follow.

The second base coat is known as the brown coat. It is keyed into the grooves in the scratch coat and is often smoothed in preparation for the final coat.

One-Coat Stucco

The stucco base is applied in a single coat or $^3/_8$ – $^5/_8$ inch (10 – 16 mm) thick. A finish coat is then applied.

Important Notes!

1. *When applying stucco cladding, always follow the manufacturer's installation and/or technical instructions.*
2. *Check manufacturer details for sealing windows and doors to ensure moisture and seepage control.*
3. *Check local building having jurisdiction for the following:*
   a. *Use of weather resistive barrier before applying wire metal lathe, and*
   b. *Compliance with any other specific requirements related to stucco applications.*

Stucco finish coats can have a variety of textures and colors and generally produce a pleasing look.

Figure 13.2 – Stucco Finish

13.3 – EIFS (Exterior Insulation & Finish System)

EIFS (**also known as synthetic stucco**) is a multi-component exterior finish for walls. The system has traditionally been installed over wood frame substrates with appropriate sheathing. Some EIFS manufacturers have changed the name of their products to distinguish it for ICF application e.g. Dryvit® EIFS products for ICF has changed to **TAFS** (Textured Acrylic Finishing System)

The typical EIFS cladding system consists of:

1. Foam Insulation Layer
2. A polymer base coat
3. Fiber mesh reinforcing layer embedded in the polymer base
4. Acrylic, Textured finish coat

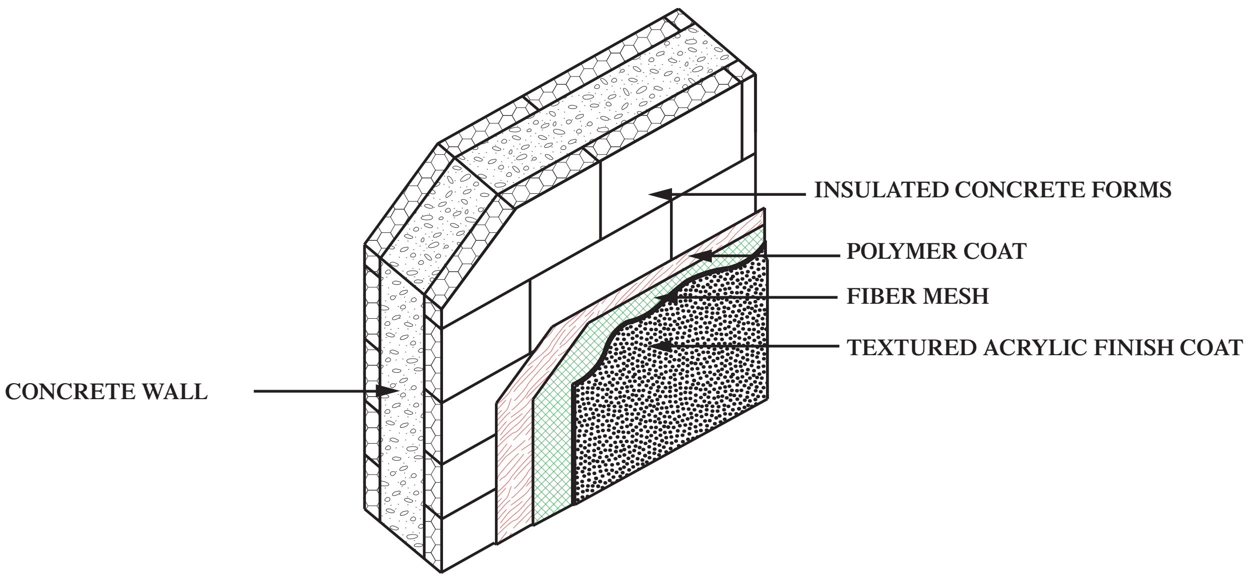


Figure 13.3 – Typical EIFS installation over ICF

The EPS that makes up the Amvic ICF panels is a suitable substrate for applying EIFS cladding directly without the need for an additional foam board.

Important Notes!

1. *When applying EIFS cladding, always follow the manufacturer installation instructions and inspection guidelines for proper installation.*
2. *Check manufacturer details for sealing window and doors to ensure moisture seepage control.*
3. *Check local building code and ensure compliance with any requirements regarding EIFS applications.*

EIFS wall claddings, like stucco, have many textures and colors that can be applied to the finish acrylic coat to produce the desired architectural effect.

Figure 13.4 – EIFS finish

13.4 – Anchored Masonry Veneer

Masonry or brick veneer can be applied to Amvic ICF wall in the same manner as regular wood frame or steel stud construction. A ledge support is required to carry the masonry veneer gravity loads (**Please refer to part 9.5 of the manual).** The masonry veneer ties shall be screwed directly to the Amvic polypropylene webs using approved fine thread or coarse thread screws. The horizontal and vertical spacing of the masonry veneer ties shall comply with engineering and/or local building requirements. Amvic has retained a consulting engineering firm to prepare an engineering analysis report on masonry veneer ties under different wind and seismic load conditions. A copy of the report is available upon request and can also be downloaded from our website. (Amvic Masonry Ties Structural Report.)

Figure 13.5 – Brick veneer construction on Amvic ICF

Code Requirements

Follow the standard building code requirements for:

a. Weep holes.

b. Flashing with dripping edge.

c. Proper material specifications for anchored masonry veneer ties.

13.5 – Wood, Vinyl, and Fiber Cement Siding

Amvic ICF can also be finished with exterior siding planks such as wood, vinyl and fiber cement.

For wood and fiber cement siding products, wood or metal strapping will have to be installed on the Amvic EPS surface by screwing directly to the block propylene webs. The wood or fiber cement siding can then be installed over the strapping using approved nails or screws.

Vinyl siding in most cases can be installed by directly screwing into the Amvic ICF propylene webs with no furring straps.

Note

Always follow installation instructions given by the siding manufacturer for ICF applications.

Code Requirements

Check local building code requirements for use of weather resistive barrier before installing wood, vinyl or fiber cement sidings over Amvic ICF.

References

1. **Prescriptive Method for Insulating Concrete Forms in Residential Construction**
   Prepared by NAHB (National Association of Home Builders) Research Center Inc.
   Upper Marlboro, Maryland
   Published by PCA (Portland Cement Association), 5420 Old Orchard Road, Skokie, Illinois, EB118.
2. **Structural Design of Insulating Concrete Form Walls in Residential Construction**
   Prepared by NAHB (National Association of Home Builders) Research Center Inc.
   Upper Marlboro, Maryland
   Published by PCA (Portland Cement Association), 5420 Old Orchard Road, Skokie, Illinois, EB212.
3. **American Concrete Institute (ACI)**
   ACI 318 Building Code Requirements for Structural Concrete
   ACI 332 Requirements for Residential Concrete,
   ACI 347 Guide to Formwork for Concrete
4. **Canadian Standards Association (CSA)**
   A23.3 – 94 Design of Concrete Structures
   A23.1 – 94 Concrete Material and Methods for Concrete Construction
5. **International Code Council (ICC)**
   Evaluation report no. ESR-1269
6. **Canadian Construction Materials Centre**
   Evaluation report no. 13043-R
7. **State of Florida Building Code**
   Application # FL814
8. **City of Los Angeles**
   Research Report No. RR 25477

Appendix B – Wall Engineering

B1.0 – Canada

Currently we have two main engineering resources for walls to be constructed with Amvic ICF.

1. **CCMC report no. 13043-R** which can be used as a reference for all Canadian provinces.
2. **National Building Code of Canada 2005** (**NBC 2005**) upon which the individual provincial building codes of Canada's provinces are based.

Reinforced or plain concrete walls to be constructed using Amvic ICF and which are outside the applicability limits of **CCMC 13043-R** and **NBC 2005** shall be designed and approved by a local licensed/registered engineer.

B1.1 – CCMC 13043-R

This report can be used and is recognized by most building departments of local cities, throughout Canada. Since at the time of printing this manual the provincial building code models have not had time to adopt or adapt to the new NBC 2005, this report will remain an essential engineering resource that can readily be used.

The report is available upon request and can be either downloaded from the Amvic website or from **Canadian Construction Material Centre** website as given below:

www.irc.nrc-cnrc.gc.ca/ccmc/regprodeval_e.shtml

B1.2 – National Building Code of Canada 2005

The following articles and/or tables are reproduced from NBC 2005 and will have the specific NBC 2005 reference from which they were obtained.

B1.2.1 – Application

All information given under section **B1.2** is applicable to structures which fall under **Part 9 Housing and Small Buildings of NBC 2005.**

B1.2.2 – Materials

1. **Concrete**

    a) [**NBC 2005 - 9.3.1.1 (4)**] For flat insulating concrete form walls not exceeding 2 storeys and having a maximum floor to floor height of 3m, in buildings of light frame construction containing only a single dwelling unit, the concrete and reinforcing shall comply with Part 4 or :

    CAN/CSA-A23.1 "Concrete Materials and Methods of Concrete Construction" and maximum aggregate size of 19mm

    b) [**NBC 2005 – 9.3.1.6 (1)**] Compressive strength of un-reinforced concrete after 28 days shall be not less than **15 MPa** for walls, columns, fireplaces and chimneys, footings, foundation walls, grade beams and piers

2. **Reinforcing Steel**
    [**NBC 2005 – 9.3.1.1 (4)**] Reinforcing shall:

    a) Conform to **CAN/CSA-G30.18-M** "Billet-Steel Bars for Concrete Reinforcement"

    b) Have a minimum Specified yield strength of **400 MPa,** and

    c) Be lapped a minimum of 450 mm for 10M bars and 650 mm for 15M bars

B1.2.3 – Footings and Foundations

B1.2.3.1 – Application

The articles and/or tables given in section B1.2.3 applies to:

[**NBC 2005 – 9.15.1.1 (C)**] Flat insulating concrete form foundation walls and concrete footings not subject to surcharge and:

i) on stable soils with an allowable bearing pressure of 100 KPa (2000 lbs/sq.ft) or greater

ii) for buildings of light frame or flat insulating concrete form construction that are not more than 2 storeys in building height, with a maximum floor to floor height of 3m, and containing only a single dwelling unit.

[**NBC 2005 – 9.15.3.3**] Minimum footing width shall apply to footings where

a) the footings support

i) foundation walls of masonry, concrete or flat insulating concrete form walls

ii) above-ground walls of masonry, flat insulating concrete form walls or light wood frame construction and

iii) floors and roofs of light wood frame construction

b) The span of supported joists does not exceed 4.9m, and

c) The specified live load on any floor supported by the footing does not exceed 2.4 KPa.

B1.2.3.2 – Minimum Footing Sizes

Footing Width

NBC 2005 - Table 9.15.3.4
Minimum Footing Sizes

No. of Floors Supported	Minimum Width of Strip Footings, mm		Minimum Footing Area for Columns Spaced 3m o.c.
	Supporting Exterior Walls (*1)	Supporting Interior Walls (*2)	
1	250	200	0.4
2	350	350	0.75
3	450	500	1.0

(*1) Adjustments to Footing Widths for Exterior Walls

[**NBC 2005 – 9.15.3.5**] The strip footing for exterior walls shown in table **9.15.3.4** shall be increased by

a) 65 mm for each storey of masonry veneer over wood-frame construction supported by the foundation wall,

b) 130 mm for each storey of masonry construction supported by the foundation wall, and

c) 150 mm for each storey of flat insulating concrete form wall construction supported by the foundation wall

(*2) Adjustments to Footing Widths for Interior Walls

[**NBC 2005 – 9.15.3.6 (1)**] The minimum strip footing widths for interior load-bearing masonry walls shown in Table 9.15.3.4 shall be increased by 100 mm for each storey of masonry construction supported by the footing.

[**NBC 2005 – 9.15.3.6 (2)**] Footings for interior non-loadbearing masonry walls shall be not less than 200 mm wide for walls up to 5.5 m high and the widths shall be increased by 100 mm for each additional 2.7 m of height.

Footing Thickness

[**NBC 2005 – 9.15.3.8**] Footing thickness shall be not less than the greater of

a) 100 mm, or

b) the width of the projection of the footing beyond the supported element

B1.2.4 – Foundation Walls

B1.2.4.1 – Application

Application of the articles and/or tables given in section B1.2.4 is subject to the following conditions:

1. [**NBC 2005 – 9.15.4.1 (1)**] Insulating concrete form units shall be manufactured of polystyrene conforming to the performance requirements of CAN/ULC-S701 "Thermal Insulation Polystyrene, Boards and Pipe Covering" for type 2, 3 or 4 polystyrene.
2. [**NBC 2005 – 9.15.4.2 (2)**] The thickness of concrete in flat insulating concrete form foundation walls shall be not less than the greater of

    a) 140 mm, or

    b) the thickness of the concrete in the wall above
3. [**NBC 2005 – 9.15.4.2 (3)**] Foundation walls made of flat insulating concrete form units shall be laterally supported at the top and at the bottom. Please refer to articles 9.15.4.3 and 9.15.4.4 for determining bottom and top lateral support of walls.

B1.2.4.2 – Reinforcement for Flat Insulating Concrete Form Foundation Walls

Horizontal Reinforcement

[NBC 2005 – 9.15.4.5 (1)] Horizontal reinforcement in flat insulating concrete form foundation walls shall

a) consist of

  ii) one 10M bar placed not more than 300 mm from the top of the wall, and

  ii) 10M bars at 600 mm o.c. and

b) be located

  i) in the inside half of the wall section and

  ii) with a minimum cover of 30 mm from the inside face of the concrete

Vertical Reinforcement

[NBC 2005 – 9.15.4.5 (2)] Vertical reinforcement in flat insulating concrete form foundation walls shall be

a) provided in accordance with

  i) **Table 9.15.4.5.A for 140 mm walls [use for 6 inch (152 mm) Amvic forms]**

  ii) **Table 9.15.4.5.B for 190 mm walls [use for 8 inch (203 mm) Amvic forms]**

  iii) **Table 9.15.4.5.C for 240 mm walls [use for 10 inch (254 mm) Amvic forms]**

b) located in the inside half of the wall section with a minimum cover of 30 mm from the inside face of the concrete wall, and

c) where interrupted by wall openings, placed not more than 600 mm from each side of the openings

Table 9.15.4.5.A
Vertical Reinforcement for 140 mm Flat Insulating Concrete Foundation Walls
[Amvic 6 inch (152 mm) Forms]

Max. Height of Finished Ground Above Finished Basement Floor, M	Minimum Vertical Reinforcement		
	Maximum Unsupported Basement Wall Height		
	2.44 m	2.75 m	3.0 m
1.35	10M at 400 mm o.c	10M at 400 mm o.c.	10M at 400 mm o.c.
1.6	10M at 400 mm o.c	10M at 380 mm o.c.	10M at 380 mm o.c.
2	10M at 380 mm o.c	10M at 380 mm o.c.	10M at 380 mm o.c.
2.2	10M at 250 mm o.c	10M at 250 mm o.c.	10M at 250 mm o.c.
2.35	n/a	10M at 250 mm o.c.	10M at 250 mm o.c.
2.6	n/a	10M at 250 mm o.c.	10M at 250 mm o.c.
3	n/a	n/a	10M at 250 mm o.c.

NBC 2005 - Table 9.15.4.5.B
Vertical Reinforcement for 190 mm Flat Insulating Concrete Foundation Walls
[Amvic 8 inch (203 mm) Forms]

Max. Height of Finished Ground Above Finished Basement Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported Basement Wall Height		
	2.44 m	2.75 m	3.0 m
2.2	Not required	10M at 400 mm o.c.	10M at 400 mm o.c.
2.35	n/a	10M at 300 mm o.c.	10M at 300 mm o.c.
2.6	n/a	10M at 300 mm o.c.	10M at 400 mm o.c.
3	n/a	n/a	10M at 400 mm o.c.

NBC 2005 - Table 9.15.4.5.C
Vertical Reinforcement for 240 mm Flat Insulating Concrete Foundation Walls
[Amvic 10 inch (254 mm) Forms]

Max. Height of Finished Ground Above Finished Basement Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported Basement Wall Height		
	2.44 m	2.75 m	3.0 m
2.2	Not required	10M at 400 mm o.c.	10M at 400 mm o.c.
2.35	n/a	10M at 300 mm o.c.	10M at 300 mm o.c.
2.6	n/a	10M at 300 mm o.c.	10M at 400 mm o.c.
3	n/a	n/a	10M at 400 mm o.c.

[**NBC 2005 -9.15.4.5** (**3**)] Cold joints in flat insulating concrete form foundation walls shall be reinforced with no less than one 15M bar spaced at not more than 600 mm o.c. and embedded 300 mm on both sides of the joint.

B1.2.5 – Above Grade Walls

B1.2.5.1 – Application

The articles and/or tables given in section B1.2.5 applies to:

[**NBC 2005 – 9.20.1.1 (1) (B)**] Flat insulating concrete form walls not in contact with the ground that;

i) have a maximum floor to floor height of 3m,

ii) are erected in buildings not more than 2 storeys in building height and containing only a single dwelling unit, and

iii) are erected in locations where the seismic spectral response accelerations, Sa(0.2), is not greater than 0.4

B1.2.5.2 – Thickness for Flat Insulating Concrete Form Walls

[**NBC 2005 - 9.20.17.1 (1)**] The thickness of the concrete in flat insulating concrete form walls not in contact with the ground shall be

a) not less than 140 mm, and

b) constant for the entire height of the wall

B1.2.5.3 – Reinforcement for Flat Insulating Concrete Form Walls

Horizontal Reinforcement

[**NBC 2005 – 9.20.17.2 (1)**] Horizontal reinforcement in above-grade flat insulating concrete form walls shall

a) consist of

   i) one 10M bar placed not more than 300 mm from the top of the wall, and

   ii) 10M bars at 600 mm o.c. and

b) be placed in the middle third of the wall section

Vertical Reinforcement

[NBC 2005 – 9.20.17.2 (2)] Vertical reinforcement in above-grade flat insulating concrete form walls shall

a) consist of 10M bars at 400 mm o.c. and

b) be placed in the middle third of the wall section

[NBC 2005 – 9.20.17.2 (3)] Vertical reinforcement required by above sentence and interrupted by wall openings shall be placed not more than 600 mm from each side of the opening.

B1.2.5.4 – Openings in Non-Loadbearing Flat ICF walls

[NBC 2005 – 9.20.17.3]

1. No openings shall occur within 1200 mm of interior and exterior corners of exterior non-load-bearing flat ICF walls
2. Portions of walls above openings in non-load-bearing flat ICF walls shall have a minimum depth of concrete of no less than 200 mm across the width of the opening.
3. Openings that are more than 600 mm but not more than 3000 mm in width in non-load-bearing flat ICF walls shall be reinforced at the top and bottom with one 10M bar.
4. Openings more than 3000 mm in width in non-load-bearing flat ICF walls shall be reinforced on all four sides with two 10M bars.
5. Reinforcing bars described in sentences (3) and (4) shall extend 600 mm beyond the edges of the opening.
6. The cumulative width of openings in non-load-bearing flat ICF walls shall not make up more than 70% of the length of any wall.

B1.2.5.5 – Lintels over Openings in Load-bearing Flat ICF walls

[NBC 2005 – 9.20.17.4]

1. In load-bearing flat ICF walls, lintels shall be provided over all openings wider than 900 mm.
2. Lintels described in above sentence over openings wider than 1200 mm shall be reinforced for shear with 10M stirrups at a maximum spacing of half the distance from the bottom reinforcing bar to the top of the lintel.

B1.2.5.6 – Framing Supported on Flat ICF walls

[NBC 2005 – 9.20.71.5]

1. Floor joists supported on the side of flat insulating concrete from walls shall be supported with joist hangers secured to wood ledger boards.
2. The ledger boards referred to in above sentence shall be not less than
   a) 38 mm thick, and
   b) the depth of the floor joists
3. Anchor bolts shall be used to secure ledger boards to flat ICF walls and shall be
   a) embedded in the wall to a depth not less than 100 mm, and
   b) spaced in accordance with table **9.20.17.5 (below)**

NBC 2005 - Table 9.20.17.5
Maximum Anchor Bolt Spacing for the Connection of Floor Ledgers to Flat ICF walls

Maximum Clear Floor Span, m	Maximum Anchor Bolt Spacing, mm	
	Staggerred 12.7 mm Diameter Anchor Bolts	Staggered 16 mm Diameter Anchor Bolts
2.44	450	500
3.0	400	450
4.0	300	400
5.0	275	325

B1.2.5.7 – Anchoring of Roof Framing to Top Of Flat ICF walls

[NBC 2005 – 9.20.17.6]

1. Roof framing supported on the top of flat ICF walls shall be fixed to the top plates, which shall be anchored to the wall with anchor bolts
   a) not less than 12.7 mm in diameter, and
   b) spaced at not more than 1200 mm o.c
2. The anchor bolts described in above sentence shall be placed in the centre of the flat ICF wall and shall be embedded no less than 100 mm into the concrete.

B2.0 – USA

There are two main resources for the engineering of flat ICF walls in the United States:

1. **Prescriptive Method for Insulating Concrete Forms in Residential Construction** prepared by NAHB (National Association of Home Builders) and PCA (Portland Cement Association). This document is widely recognized across most of the states, and is stated in the Amvic ICC (International Code Council) legacy report ESR-1269 as an approved engineering source.
2. **ACI 318 "Building Code Requirements for Structural Concrete"** is used for walls which are outside the scope and applicability limits of the Prescriptive Method. A local licensed/registered engineer is required to approve the design using this resource.

B2.1 – Prescriptive Method

The prescriptive method book can be downloaded online from the following link:

www.huduser.org/publications/destech/icf_2ed.html

The articles and/or tables contained herein are reproduced from the prescriptive method and each will have the specific reference from which they were obtained.

B2.1.1 – Scope

[Prescriptive Method 1.3]

1. The provisions of the *Prescriptive Method* apply to the construction of detached one- and two-family homes, townhouses, and other attached single-family dwellings in compliance with the general limitations of Table 1.1 (below).

Prescriptive Method - TABLE 1.1
APPLICABILITY LIMITS

ATTRIBUTE	MAXIMUM LIMITATION
General	
Number of Stories	2 stories above grade plus a basement
Design Wind Speed	150 mph (241 km/hr) 3-second gust (130 mph (209 km/hr) fastest-mile)
Ground Snow Load	70 psf (3.4 kPa)
Seismic Design Category	A, B, C, D1, and D2 (Seismic Zones 0, 1, 2, 3, and 4)
Foundations	
Unbalanced Backfill Height	9 feet (2.7 m)
Equivalent Fluid Density of Soil	60 pcf (960 kg/m3)
Presumptive Soil Bearing Value	2,000 psf (96 kPa)
Walls	
Unit Weight of Concrete	150 pcf (23.6 kN/m3)
Wall Height (unsupported)	10 feet (3 m)
Floors	
Floor Dead Load	15 psf (0.72 kPa)
First-Floor Live Load	40 psf (1.9 kPa)
Second-Floor Live Load (sleeping rooms)	30 psf (1.4 kPa)
Floor Clear Span (unsupported)	32 feet (9.8 m)
Roofs	
Maximum Roof Slope	12:12
Roof and Ceiling Dead Load	15 psf (0.72 kPa)
Roof Live Load (ground snow load)	70 psf (3.4 kPa)
Attic Live Load	20 psf (0.96 kPa)
Roof Clear Span (unsupported)	40 feet (12 m)

For SI: 1 foot = 0.3048 m; 1 psf = 47.8804 Pa; 1 pcf = 157.0877 N/m3 = 16.0179 kg/m3; 1 mph = 1.6093 km/hr

2. An engineered design shall be required for houses built along the immediate, hurricane-prone coastline subjected to storm surge (i.e., beach front property) or in near-fault seismic hazard conditions (i.e., Seismic Design Category E).

3. The provisions of the *Prescriptive Method* shall not apply to irregular structures or portions of structures in Seismic Design Categories C, D1, and D2.

B2.1.2 – Material Specifications

ICF Size

[Prescriptive Method 2.1.1]

1. Flat ICF wall systems shall have a minimum concrete thickness of 5.5 inches (140 mm) for basement walls and 3.5 inches (89 mm) for above-grade walls.

Concrete Slump

[Prescriptive Method 2.2.1]

Ready-mixed concrete for ICF walls shall meet the requirements of ASTM C 94 [13]. Maximum slump shall not be greater than 6 inches (152 mm) as determined in accordance with ASTM C 143 [11]. Maximum aggregate size shall not be larger than 3/4 inch (19 mm).

> **Exception:** Maximum slump requirements may be exceeded for approved concrete mixtures resistant to segregation, meeting the concrete compressive strength requirements, and in accordance with the ICF manufacturer's recommendations.

Concrete Compressive Strength

[Prescriptive Method 2.2.2]

1. The minimum specified compressive strength of concrete, *fc'*, shall be 2,500 psi (17.2 MPa) at 28 days as determined in accordance with ASTM C 31 [8] and ASTM C 39 [9].
2. For Seismic Design Categories D_1 and D_2, the minimum compressive strength of concrete, *fc'*, shall be 3,000 psi.

Reinforcing Steel

[Prescriptive Method 2.2.3]

1. Reinforcing steel used in ICFs shall meet the requirements of ASTM A 615 [14], ASTM A 996 [15], or ASTM A 706 [16].
2. In Seismic Design Categories D1 and D2, reinforcing steel shall meet the requirements of ASTM A706 [16] for low-alloy steel.

3. The minimum yield strength of the reinforcing steel shall be 40,000 psi, Grade 40 (300 MPa) except in Seismic Design Categories D1 and D2 where reinforcing steel shall have a minimum yield strength of 60,000 psi (Grade 60) (414 MPa).
4. Steel reinforcement shall have a minimum 3/4-inch (19mm) concrete cover.

EPS Materials

[Prescriptive Method 2.3]

1. Insulating concrete forms shall be constructed of rigid foam plastic meeting the requirements of ASTM C 578 [17].
2. Flame-spread rating of ICF forms that remain in place shall be less than 75 and smoke-development rating of such forms shall be less than 450, tested in accordance with ASTM E 84.

B2.1.3 – Footings

[Prescriptive Method 3.1]

1. Minimum sizes for concrete footings shall be as set forth in Table 3.1 (below)

Prescriptive Method - TABLE 3.1
APPLICABILITY LIMITS
FOOTINGS FOR ICF WALLS [1,2,3] (Inches)

Maximum Number of Storeys[4]	MINIMUM LOAD BEARING VALUE OF SOIL (psf) 2,000	2,500	3,000	3,500	4,000
5.5 Inch Flat, 6-Inch Waffle Grid, or 6 Inch Screen Grid ICF Wall Thickness[5]					
One Storey[6]	15	12	10	9	8
Two Storey[6]	20	16	13	12	10
7.5-Inch Flat or 8-Inch Waffle-Grid, or 8-Inch Screen-Grid ICF Wall Thickness[5]					
One Storey[7]	18	14	12	10	8
Two Storey[7]	24	19	16	14	12
9.5-Inch Flat ICF Wall Thickness[5]					
One Storey	20	16	13	11	10
Two Storey	27	22	18	15	14

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 psf = 47.8804 Pa

1-Minimum footing thickness shall be the greater of one-third of the footing width, 6 inches (152 mm), or 11 inches (279 mm) when a dowel is required in accordance with Section 6.0.

2-Footings shall have a width that allows for a nominal 2-inch (51-mm) projection from either face of the concrete in the wall to the edge of the footing.

3-Table values are based on 32 ft (9.8 m) building width (floor and roof clear span).

4-Basement walls shall not be considered as a story in determining footing widths.

5-Actual thickness is shown for flat walls while nominal thickness is given for waffle- and screen-grid walls. Refer to Section 2.0 for actual waffle- and screen-grid thickness and dimensions.

6-Applicable also for 7.5-inch (191-mm) thick or 9.5-inch (241-mm) thick flat ICF foundation wall supporting 3.5-inch (88.9-mm) thick flat ICF stories.

7-Applicable also for 9.5-inch (241-mm) thick flat ICF foundation wall story supporting 5.5-inch (140-mm) thick flat ICF stories.

2. Foundations erected on soils with a bearing value of less than 2,000 psf (96 KPa) shall be designed in accordance with accepted engineering practice.

B2.1.3.1 – ICF Foundation Wall-to-Footing Connection

[Prescriptive Method – 6.1]

1. No vertical reinforcement (i.e. dowels) across the joint between the foundation wall and the footing is required when one of the following exists:
   - The unbalanced backfill height does not exceed 4 feet (1.2 m)
   - The interior floor slab is installed in accordance with Figure 3.3 before backfilling.
   - Temporary bracing at the bottom of the foundation wall is erected before backfilling and remains in place during construction until an interior floor slab is installed in accordance with Figure 3.3 or the wall is backfilled on both sides (i.e. stem wall).
2. For foundation walls that do not meet one of the above requirements, vertical reinforcement (i.e. dowel) shall be installed across the joint between the foundation wall and the footing at 48 inches (1.2 m) on center in accordance with Figure 6.1.
3. Vertical reinforcement (i.e. dowels) shall be provided for all foundation walls for buildings located in regions with 3 second gust design wind speeds greater than 130 mph (209 km/hr) or located in Seismic Design Categories D1 and D2 at 18 inches (457 mm) on center.

   Exception: The foundation wall's vertical wall reinforcement at intervals of 4 feet (1.2 m) on center shall extend 8 inches (203 mm) into the footing in lieu of using a dowel as shown in Figure 6.1.

B2.1.4 – Foundation Wall Requirements

Crawlspace Walls

[Prescriptive Method – 3.2.2]

Applicable to walls 5 feet (1.5m) or less in height with a maximum unbalanced backfill height of 4 feet (1.2m) for a one-storey construction with floor bearing on top of crawlspace wall.

1. ICF crawlspace walls shall be laterally supported at the top and bottom of the wall in accordance with Section 6.0.
2. A minimum of one horizontal no. 4 bar shall be placed within 12 inches (305mm) of the top of the crawlspace wall.

3. Vertical reinforcement shall be as per table 3.2 (below). For crawlspace walls carrying ICF wall on top, vertical reinforcement shall be the greater of that required in table 3.2 or table 4.2 in the following section

Prescriptive Method - TABLE 3.2
MINIMUM VERTICAL WALL REINFORCEMENT FOR
ICF CRAWLSPACE WALLS [1,2,3,4,5,6]

SHAPE OF CONCRETE WALLS	WALL THICKNESS[7] (inches)	MINIMUM VERTICAL REINFORCEMENT		
		MAXIMUM EQUIVALENT FLUID DENSITY 30 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 45 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 60 pcf
Flat	3.5 [8]	#3 @ 16″; #4 @ 32″	#3 @ 18″; #4 @ 28″; #5@38″	#3 @ 12″; #4 @ 22″; #5 @ 28″
	5.5	#3 @ 24″; #4 @ 48″	#3 @ 24″; #4 @ 48″	#3 @ 24″; #4 @ 48″
	7.5	N/R	N/R	N/R

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 pcf = 16.0179 kg/m³

1 - Table values are based on reinforcing bars with a minimum yield strength of 40,000 psi (276 MPa) and concrete with a minimum specified compressive strength of 2,500 psi (17.2 MPa).

2 - N/R indicates no vertical wall reinforcement is required.

3 - Spacing of rebar shall be permitted to be multiplied by 1.5 when reinforcing steel with a minimum yield strength of 60,000 psi (414 MPa) is used. Reinforcement, when required, shall not be less than one #4 bar at 48 inches (1.2 m) on center.

4 - Applicable only to crawlspace walls 5 feet (1.5 m) or less in height with a maximum unbalanced backfill height of 4 feet (1.2 m).

5 - Interpolation shall not be permitted.

6 - Walls shall be laterally supported at the top before backfilling.

7 - Actual thickness is shown for flat walls while nominal thickness is given for waffle-and screen-grid walls. Refer to Section 2.0 for actual waffle- and screen-grid thickness and dimensions.

8 - Applicable only to one-story construction with floor bearing on top of crawlspace wall.

Basement Walls

[Prescriptive Method – 3.2.3]

1. Basement walls shall be laterally supported at the top and bottom of the wall in accordance with section 6.0.
2. Minimum horizontal reinforcement shall be as per table 3.3 (below)

Prescriptive Method - TABLE 3.3
MINIMUM HORIZONTAL WALL REINFORCEMENT FOR ICF BASEMENT WALLS

MAXIMUM HEIGHT OF BASEMENT WALL FEET (METERS)	LOCATION OF HORIZONTAL REINFORCEMENT
8 (2.4)	One No.4 bar within 12 inches (305 mm) of the top of the wall storey and one No.4 bar near mid-height of the wall story
9 (2.7)	One No.4 bar within 12 inches (305 mm) of the top of the wall storey and one No.4 bar near third points in the wall story
10 (3.0)	One No.4 bar within 12 inches (305 mm) of the top of the wall storey and one No.4 bar near third points in the wall story

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 pcf = 16.0179 kg/m³

Horizontal reinforcement requirements are for reinforcing bars with a minimum yield strength from 40,000 psi (276 MPa) and concrete with a minimum concrete compressive strength of 2,500 psi (17.2 Mpa)

3. Vertical wall reinforcement shall be as per the following tables:
   a) Prescriptive Method Table 3.4 – For use with Amvic 6 inch (152 mm) basement walls.
   b) Prescriptive Method Table 3.5 – For use with Amvic 8 inch (203 mm) basement walls.
   c) Prescriptive Method Table 3.6 – For use with Amvic 10 inch (254 mm) basement walls.

Prescriptive Method - TABLE 3.4
MINIMUM VERTICAL WALL REINFORCEMENT FOR
5.5 inch (140 mm) THICK FLAT ICF BASEMENT WALLS [1,2,3,4,5]

MAX WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT [6] (feet)	MINIMUM VERTICAL REINFORCEMENT		
		MAXIMUM EQUIVALENT FLUID DENSITY 30 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 45 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 60 pcf
8	4	#4@48″	#4@48″	#4@48″
	5	#4@48″	#3@12″; #4@22″; #5@32″; #6@40″	#3@8″; #4@14″; #5@20″; #6@26″
	6	#3@12″; #4@22″; #5@30″; #6@40″	#3@8″; #4@14″; #5@20″; #6@24″	#3@6″; #4@10″; #5@14″; #6@20″
	7	#3@8″; #4@14″; #5@22″; #6@26″	#3@5″; #4@10″; #5@14″; #6@18″	#3@4″; #4@6″; #5@10″; #6@14″
9	4	#4@48″	#4@48″	#4@48″
	5	#4@48″	#3@12″; #4@20″; #5@28″; #6@36″	#3@8″; #4@14″; #5@20″; #6@22″
	6	#3@10″; #4@20″; #5@28″; #6@34″	#3@6″; #4@12″; #5@18″; #6@20″	#4@8″; #5@14″; #6@16″
	7	#3@8″; #4@14″; #5@20″; #6@22″	#4@8″; #5@12″; #6@16″	#4@6″; #5@10″; #6@12″
	8	#3@6″; #4@10″; #5@14″; #6@16″	#4@6″; #5@10″; #6@12″	#4@4″; #5@6″; #6@8″
10	4	#4@48″	#4@48″	#4@48″
	5	#4@48″	#3@10″; #4@18″; #5@26″; #6@30″	#3@6″; #4@14″; #5@18″; #6@20″
	6	#3@10″; #4@18″; #5@24″; #6@30″	#3@6″; #4@12″; #5@16″; #6@18″	#3@4″; #4@8″; #5@12″; #6@14″
	7	#3@6″; #4@12″; #5@16″; #6@18″	#3@4″; #4@8″; #5@12″	#4@6″; #5@8″; #6@10″
	8	#3@4″; #4@8″; #5@12″; #6@14″	#4@6″; #5@8″; #6@12″	#4@4″; #5@6″; #6@8″
	9	#3@4″; #4@6″; #5@10″; #6@12″	#4@4″; #5@6″; #6@8″	#5@4″; #6@6″

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 pcf = 16.0179 kg/m³

1 - Table values are based on reinforcing bars with a minimum yield strength of 40,000 psi (276 MPa) and concrete with a minimum specified compressive strength of 2,500 psi (17.2 MPa).

2 - Spacing of rebar shall be permitted to be multiplied by 1.5 when reinforcing steel with a minimum yield strength of 60,000 psi (414 MPa) is used. Reinforcement shall not be less than one #4 bar at 48 inches (1.2 m) on center.

3 - Deflection criterion is L/240, where L is the height of the basement wall in inches.

4 - Interpolation shall not be permitted.

5 - Walls shall be laterally supported at the top before backfilling.

6 - Refer to Section 1.0 for the definition of unbalanced backfill height.

Prescriptive Method - TABLE 3.5
MINIMUM VERTICAL WALL REINFORCEMENT FOR
7.5 inch (191 mm) THICK FLAT ICF BASEMENT WALLS [1,2,3,4,5,6]

MAX WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT [7] (feet)	MINIMUM VERTICAL REINFORCEMENT		
		MAXIMUM EQUIVALENT FLUID DENSITY 30 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 45 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 60 pcf
8	4	N/R	N/R	N/R
	5	N/R	N/R	N/R
	6	N/R	N/R	N/R
	7	N/R	#4@14″; #5@20″; #6@28″	#4@10″; #5@16″; #6@20″
9	4	N/R	N/R	N/R
	5	N/R	N/R	N/R
	6	N/R	N/R	#4@14″; #5@20″; #6@28″
	7	N/R	#4@12″; #5@18″; #6@26″	#4@8″; #5@14″; #6@18″
	8	#4@14″; #5@22″; #6@28″	#4@8″; #5@14″; #6@18″	#4@6″; #5@10″; #6@14″
10	4	N/R	N/R	N/R
	5	N/R	N/R	N/R
	6	N/R	N/R	#4@12″; #5@18″; #6@26″
	7	N/R	#4@12″; #5@18″; #6@24″	#4@8″; #5@12″; #6@18″
	8	#4@12″; #5@20″; #6@26″	#4@8″; #5@12″; #6@16″	#4@6″; #5@8″; #6@12″
	9	#4@10″; #5@14″; #6@20″	#4@6″; #5@10″; #6@12″	#4@4″; #5@6″; #6@10″

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 pcf = 16.0179 kg/m³

1 - Table values are based on reinforcing bars with a minimum yield strength of 40,000 psi (276 MPa) and concrete with a minimum specified compressive strength of 2,500 psi (17.2 MPa).

2 - Spacing of rebar shall be permitted to be multiplied by 1.5 when reinforcing steel with a minimum yield strength of 60,000 psi (414 MPa) is used. Reinforcement, when required, shall not be less than one #4 bar at 48 inches (1.2 m) on center.

3 - N/R indicates no reinforcement is required.

4 - Deflection criterion is L/240, where L is the height of the basement wall in inches.

5 - Interpolation shall not be permitted.

6 - Walls shall be laterally supported at the top before backfilling.

7 - Refer to Section 1.0 for the definition of unbalanced backfill height.

Prescriptive Method - TABLE 3.6
MINIMUM VERTICAL WALL REINFORCEMENT FOR
9.5 inch (241 mm) THICK FLAT ICF BASEMENT WALLS [1,2,3,4,5,6]

MAX WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT [7] (feet)	MINIMUM VERTICAL REINFORCEMENT		
		MAXIMUM EQUIVALENT FLUID DENSITY 30 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 45 pcf	MAXIMUM EQUIVALENT FLUID DENSITY 60 pcf
8	4	N/R	N/R	N/R
	5	N/R	N/R	N/R
	6	N/R	N/R	N/R
	7	N/R	N/R	N/R
9	4	N/R	N/R	N/R
	5	N/R	N/R	N/R
	6	N/R	N/R	N/R
	7	N/R	N/R	#4@12″; #5@18″; #6@26″
	8	N/R	#4@12″; #5@18″; #6@26″	#4@8″; #5@14″; #6@18″
10	4	N/R	N/R	N/R
	5	N/R	N/R	N/R
	6	N/R	N/R	#4@18″; #5@26″; #6@36″
	7	N/R	N/R	#4@10″; #5@18″; #6@24″
	8	N/R	#4@12″; #5@16″; #6@24″	#4@8″; #5@12″; #6@16″
	9	N/R	#4@8″; #5@12″; #6@18″	#4@6″; #5@10″; #6@12″

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 pcf = 16.0179 kg/m³

1 - Table values are based on reinforcing bars with a minimum yield strength of 40,000 psi (276 MPa) and concrete with a minimum specified compressive strength of 2,500 psi (17.2 MPa).

2 - Spacing of rebar shall be permitted to be multiplied by 1.5 when reinforcing steel with a minimum yield strength of 60,000 psi (414 MPa) is used. Reinforcement, when required, shall not be less than one #4 bar at 48 inches (1.2 m) on center.

3 - N/R indicates no reinforcement is required.

4 - Deflection criterion is L/240, where L is the height of the basement wall in inches.

5 - Interpolation shall not be permitted.

6 - Walls shall be laterally supported at the top before backfilling.

7 - Refer to Section 1.0 for the definition of unbalanced backfill height.

Seismic Requirements for Basement Walls

[Prescriptive Method – 3.2.4]

1. Concrete foundation walls supporting above-grade ICF walls in Seismic Design Category C shall be reinforced with minimum No. 5 rebar at 24 inches (610 mm) on center (both ways) or a lesser spacing if required by Tables 3.2 through 3.6

2. Concrete foundation walls supporting above grade ICF walls in Seismic Design Categories D1 and D2 shall be reinforced with minimum No. 5 rebar at a maximum spacing of 18 inches (457 mm) on center (both ways) or a lesser spacing if required by Tables 3.2 through 3.6 and the minimum concrete compressive strength shall be 3,000 psi (20.5 MPa). Vertical reinforcement shall be continuous with ICF above grade wall vertical reinforcement. Alternatively, the reinforcement shall extend a minimum of 40db into the ICF above grade wall, creating a lap-splice with the above-grade wall reinforcement or extend 24 inches (610 mm) terminating with a minimum 90º bend of 6 inches in length.

B2.1.5 – Above Grade Walls

Wind Pressures

[Prescriptive Method – 4.1]

1. Design Wind pressures of table 4.1 (below) shall be used to determine the vertical wall reinforcement requirements.

Prescriptive Method - TABLE 4.1
DESIGN WIND PRESSURE FOR USE WITH MINIMUM VERTICAL WALL REINFORCEMENT TABLES FOR ABOVE GRADE WALLS[1]

WIND SPEED (mph)	DESIGN WIND PRESSURE (psf)					
	ENCLOSED [2]			PARTIALLY ENCLOSED		
	Exposure [3]			Exposure [3]		
	B	C	D	B	C	D
85	18	24	29	23	31	37
90	20	27	32	25	35	41
100	24	34	39	31	43	51
110	29	41	48	38	52	61
120	35	48	57	45	62	73
130	41	56	66	53	73	854
140	47	65	77	61	844	994
150	54	75	884	70	964	1144

For SI: 1 psf = 0.0479 kN/m2; 1 mph = 1.6093 km/hr

1 - This table is based on ASCE 7-98 components and cladding wind pressures using a mean roof height of 35 ft (10.7 m) and a tributary area of 10 ft2 (0.9 m2).

2 - Enclosure Classifications are as defined in Section 1.5.

3 - Exposure Categories are as defined in Section 1.5.

4 - For wind pressures greater than 80 psf (3.8 kN/m2), design is required in accordance with accepted practice and approved manufacturer guidelines.

2. If relying on fastest mile speed maps or design provisions based on fastest wind speeds, the designer should convert wind speeds to 3 second gust wind in accordance with Table C1.1 for use with the given tables in this section.

Prescriptive Method - TABLE C1.1
WIND SPEED CONVERSIONS

Fastest Mile (mph)	70	75	80	90	100	110	120	130
3-second Gust (mph)	85	90	100	110	120	130	140	150

Prescriptive Method - TABLE 4.2
MINIMUM VERTICAL WALL REINFORCEMENT FOR FLAT ICF ABOVE-GRADE WALLS[1,2,3]

DESIGN WIND PRESSURE (TABLE 4.1) (psf)	MAXIMUM WALL HEIGHT PER STORY (feet)	MINIMUM VERTICAL REINFORCEMENT [4,5]					
		SUPPORTING ROOF OR NON-LOAD-BEARING WALL		SUPPORTING LIGHT FRAME SECOND STORY AND ROOF		SUPPORTING ICF SECOND STORY AND LIGHT FRAME ROOF	
		MINIMUM WALL THICKNESS (inches)					
		3.5	5.5	3.5	5.5	3.5	5.5
20	8	#4@48″	#4@48″	#4@48″	#4@48″	#4@48″	#4@48″
	9	#4@48″	#4@48″	#4@48″	#4@48″	#4@48″	#4@48″
	10	#4@38″	#4@48″	#4@40″	#4@48″	#4@42″	#4@48″
30	8	#4@42″	#4@48″	#4@46″	#4@48″	#4@48″	#4@48″
	9	#4@32;″ #5@48″	#4@48″	#4@34″; #5@48″	#4@48″	#4@34″; #5@48″	#4@48″
	10	Design Required	#4@48″	Design Required	#4@48″	Design Required	#4@48″
40	8	#4@30″; #5@48″	#4@48″	#4@30″; #5@48″	#4@48″	#4@32″; #5@48″	#4@48″
	9	Design Required	#4@42″	Design Required	#4@46″	Design Required	#4@48″
	10	Design Required	#4@32″; #5@48″	Design Required	#4@34″; #5@48″	Design Required	#4@38″
50	8	#4@20″; #5@30″	#4@42″	#4@22″; #5@34″	#4@46″	#4@24″; #5@36″	#4@48″
	9	Design Required	#4@34″; #5@48″	Design Required	#4@34″; #5@48″	Design Required	#4@38″
	10	Design Required	#4@26″; #5@38″	Design Required	#4@26″; #5@38″	Design Required	#4@28″; #5@46″
60	8	Design Required	#4@34″; #5@48″	Design Required	#4@36″	Design Required	#4@40″
	9	Design Required	#4@26″; #5@38″	Design Required	#4@28″; #5@46″	Design Required	#4@34″; #5@48″
	10	Design Required	#4@22″; #5@34″	Design Required	#4@22″; #5@34″	Design Required	#4@26″; #5@38″
70	8	Design Required	#4@28″; #5@46″	Design Required	#4@30″; #5@48″	Design Required	#4@34″; #5@48″
	9	Design Required	#4@22″; #5@34″	Design Required	#4@22″; #5@34″	Design Required	#4@24″; #5@36″
	10	Design Required	#4@16″; #5@26″	Design Required	#4@18″; #5@28″	Design Required	#4@20″; #5@30″
80	8	Design Required	#4@26″; #5@38″	Design Required	#4@26″; #5@38″	Design Required	#4@28″; #5@46″
	9	Design Required	#4@20″; #5@30″	Design Required	#4@20″; #5@30″	Design Required	#4@21″; #5@34″
	10	Design Required	#4@14″; #5@24″	Design Required	#4@14″; #5@24″	Design Required	#4@16″; #5@26″

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 mph = 1.6093 km/hr

1 - This table is based on reinforcing bars with a minimum yield strength of 40,000 psi (276 Mpa) and concrete with a minimum specified compression strength of 2,500 psi (17.2 Mpa)

2 - Deflection criterion is L/240 where L is the height of the wall storey in inches.

3 - Interpolation shall not be permitted.

4 - Reinforcement spacing for 3.5 inch (88.9 mm) walls shall be permitted to be multiplied by 1.6 when reinforcing steel with a minimum yield strength of 60,000 psi (414 Mpa) is used. Reinforcement shall not be less than one #4 bar at 48 inches (1.2m) on center.

5 - Reinforcement spacing for 5.5 inch (139.7 mm) walls shall be permitted to be multiplied by 1.5 when reinforcing steel with a minimum yield strength of 60,000 psi (414 Mpa) is used. Reinforcement shall not be less than one #4 bar at 48 inches (1.2m) on center.

6 - A 3.5 inch wall shall not be permitted if wood ledgers are used to support floor or roof loads.

Above Grade Wall Reinforcement

[Prescriptive Method – 4.1]

1. Horizontal wall reinforcement shall be required in the form of one No. 4 rebar within 12 inches (305 mm) from the top of the wall, one No. 4 rebar within 12 inches (305 mm) from the finish floor, and one No. 4 rebar near one-third points throughout the remainder of the wall.
2. The vertical wall reinforcement shall be as per the Prescriptive Method table 4.2 (below). This table can be used for Amvic 4 inch (100 mm) and 6 inch (152 mm) above grade ICF walls.

Seismic & Wind Requirements

[Prescriptive Method – 4.1]

1. In Seismic Design Category C, the minimum vertical and horizontal reinforcement shall be one No. 5 rebar at 24 inches (610 m) on center or lesser spacing if required by table 4.2.
2. In Seismic Design Categories D1 and D2, the minimum vertical and horizontal reinforcement shall be one No. 5 rebar at a maximum spacing of 18 inches (457 mm) on center or lesser spacing if required by table 4.2 and the minimum concrete compressive strength shall be 3,000 psi (20.5 MPa).
3. For design wind pressure greater than 40 psf (1.9 kPa) or Seismic Design Category C or greater, all vertical wall reinforcement in the top-most ICF story shall be terminated with a 90 degree bend. The bend shall result in a minimum length of 6 inches (152 mm) parallel to the horizontal wall reinforcement and lie within 4 inches (102 mm) of the top surface of the ICF wall. In addition, horizontal wall reinforcement at exterior building corners shall be terminated with a 90 degree bend resulting in a minimum lap splice length of 40db with the horizontal reinforcement in the intersecting wall. The radius of bends shall not be less than 4 inches (102 mm).

Seismic & Wind Wall Opening Requirements

[Prescriptive Method – 5.1]

1. For minimum amount of solid wall length for different wind pressures, please refer to prescriptive tables 5.1, 5.2A, 5.2B and 5.2C (below).

Prescriptive Method - TABLE 5.1
WIND VELOCITY PRESSURE FOR DETERMINATION OF MINIMUM SOLID WALL LENGTH[1]

WIND SPEED (mph)	VELOCITY PRESSURE (psf)		
	Exposure [2]		
	B	C	D
85	14	19	23
90	16	21	25
100	19	26	31
110	23	32	37
120	27	38	44
130	32	44	52
140	37	51	60
150	43	59	69 [3]

For SI: 1 psf = 0.0479 kN/m2; 1 mph = 1.6093 km/hr

1 - Table values are based on ASCE 7-98 Figure 6-4 wind velocity pressures for low-rise buildings using a mean roof height of 35 ft (10.7 m).

2 - Exposure Categories are as defined in Section 1.5.

3 - Design is required in accordance with acceptable practice and approved manufacturer guidelines.

Prescriptive Method - TABLE 5.2A
MINIMUM SOLID END WALL
REQUIREMENTS FOR FLAT ICF WALLS
(WIND PERPENDICULAR TO RIDGE)[1,2,3,4,5]

DESIGN VELOCITY PRESSURE (psf)			20	25	30	35	40	45	50	60
WALL CATEGORY	BUILDING SIDE WALL LENGTH, L (feet)	ROOF SLOPE	MINIMUM SOLID WALL LENGTH ON BUILDING END WALL (feet)							
One-storey or Top Storey of Two-Storey	16	≤ 1:12	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		5:12	4.00	4.00	4.00	4.00	4.00	4.00	4.25	4.50
		7:12[4]	4.00	4.25	4.25	4.50	4.75	4.75	5.00	5.50
		12:12[4]	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.25
	24	≤ 1:12	4.00	4.00	4.00	4.00	4.00	4.00	4.25	4.50
		5:12	4.00	4.00	4.00	4.25	4.25	4.50	4.50	4.75
		7:12[4]	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.25
		12:12[4]	4.75	5.00	5.25	5.75	6.00	6.50	6.75	7.50
	32	≤ 1:12	4.00	4.00	4.00	4.00	4.25	4.25	4.50	4.75
		5:12	4.00	4.00	4.25	4.50	4.50	4.75	5.00	5.25
		7:12[4]	4.50	5.00	5.25	5.50	6.00	6.25	6.50	7.25
		12:12[4]	5.00	5.50	6.00	6.50	7.00	7.25	7.75	8.75
	40	≤ 1:12	4.00	4.00	4.25	4.25	4.50	4.50	4.75	5.00
		5:12	4.00	4.25	4.50	4.75	4.75	5.00	5.25	5.50
		7:12[4]	4.75	5.25	5.75	6.00	6.50	7.00	7.25	8.00
		12:12[4]	5.50	6.00	6.50	7.25	7.75	8.25	8.75	10.00
	50	≤ 1:12	4.00	4.25	4.25	4.50	4.75	4.75	5.00	5.50
		5:12	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
		7:12[4]	5.25	5.75	6.25	6.75	7.25	7.75	8.25	9.25
		12:12[4]	6.00	6.75	7.50	8.00	8.75	9.50	10.25	11.50
	60	≤ 1:12	4.00	4.25	4.50	4.75	5.00	5.25	5.25	5.75
		5:12	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.75
		7:12[4]	5.50	6.25	6.75	7.50	8.00	8.50	9.25	10.25

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 psf = 0.0479 kN/m^2

1 - Table values are based on reinforcing bars with a minimum yield strength of 40,000 psi (276 MPa) and concrete with a minimum specified compressive strength of 2,500 psi (17.2 MPa).

2 - Table values are based on a 3.5 in (88.9 mm) thick flat wall. For a 5.5 in (139.7 mm) thick flat wall, multiply the table values by 0.9. The adjusted values shall not result in solid wall lengths less than 4 ft.

3 - Table values are based on a maximum unsupported wall height of 10 ft (3.0 m).

4 - Values are based on a 30 foot (9.1 m) building end wall width. For a 45 ft (13.7 m) building end wall and roof pitches greater than 7:12, multiply the table values by 1.2. For a 60 ft (18.3 m) building end wall and roof pitches greater than 7:12, multiply the table values by 1.4.

5 - Linear interpolation shall be permitted.

Prescriptive Method - TABLE 5.2B
MINIMUM SOLID END WALL REQUIREMENTS FOR FLAT ICF WALLS (WIND PERPENDICULAR TO RIDGE)[1,2,3,4,5]

DESIGN VELOCITY PRESSURE (psf)			20	25	30	35	40	45	50	60
WALL CATEGORY	BUILDING SIDE WALL LENGTH, L (feet)	ROOF SLOPE	MINIMUM SOLID WALL LENGTH ON BUILDING END WALL (feet)							
First Storey of Two-Storey	16	≤ 1:12	4.00	4.25	4.50	4.75	5.00	5.25	5.25	5.75
		5:12	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.75
		7:12 [4]	4.50	5.00	5.25	5.75	6.00	6.25	6.75	7.25
		12:12 [4]	5.00	5.25	5.75	6.25	6.50	7.00	7.25	8.25
	24	≤ 1:12	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.75
		5:12	4.75	5.25	5.50	6.00	6.25	6.75	7.00	7.75
		7:12 [4]	5.25	5.75	6.25	6.75	7.00	7.50	8.00	9.00
		12:12 [4]	5.50	6.25	6.75	7.25	8.00	8.50	9.00	10.25
	32	≤ 1:12	4.75	5.00	5.50	5.75	6.25	6.50	6.75	7.50
		5:12	5.25	5.75	6.25	6.75	7.25	7.50	8.00	9.00
		7:12 [4]	5.75	6.50	7.00	7.75	8.25	9.00	9.50	10.75
		12:12 [4]	6.25	7.00	7.75	8.50	9.25	10.00	10.75	12.25
	40	≤ 1:12	5.00	5.50	5.75	6.25	6.75	7.25	7.50	8.50
		5:12	5.50	6.25	6.75	7.25	8.00	8.50	9.00	10.25
		7:12 [4]	6.25	7.00	7.75	8.75	9.50	10.25	11.00	12.50
		12:12 [4]	7.00	8.00	8.75	9.75	10.75	11.50	12.50	14.25
	50	≤ 1:12	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.50
		5:12	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.75
		7:12 [4]	7.00	8.00	9.00	10.00	10.75	11.75	12.75	14.50
		12:12 [4]	7.75	9.00	10.00	11.25	12.25	13.50	14.75	17.00
	60	≤ 1:12	5.75	6.50	7.00	7.50	8.25	8.75	9.50	10.75
		5:12	6.75	7.50	8.25	9.25	10.00	10.75	11.75	13.25
		7:12 [4]	7.75	9.00	10.00	11.00	12.25	13.25	14.50	16.75

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 psf = 0.0479 kN/m²

1 - Table values are based on reinforcing bars with a minimum yield strength of 40,000 psi (276 MPa) and concrete with a minimum specified compressive strength of 2,500 psi (17.2 MPa).

2 - Table values are based on a 3.5 in (88.9 mm) thick flat wall. For a 5.5 in (139.7 mm) thick flat wall, multiply the table values by 0.9. The adjusted values shall not result in solid wall lengths less than 4 ft.

3 - Table values are based on a maximum unsupported wall height of 10 ft (3.0 m).

4 - Values are based on a 30 foot (9.1 m) building end wall width. For a 45 ft (13.7 m) building end wall and roof pitches greater than 7:12, multiply the table values by 1.2. For a 60 ft (18.3 m) building end wall and roof pitches greater than 7:12, multiply the table values by 1.4.

5 - Linear interpolation shall be permitted.

Prescriptive Method - TABLE 5.2C
MINIMUM SOLID WALL LENGTH REQUIREMENTS FOR FLAT ICF WALLS (WIND PARALLEL TO RIDGE)[1,2,3,4,5]

DESIGN VELOCITY PRESSURE (psf)		20	25	30	35	40	45	50	60
WALL CATEGORY	BUILDING END WALL WIDTH, W (feet)	MINIMUM SOLID WALL LENGTH ON BUILDING SIDE WALL (feet)							
One Storey of Top Storey of Two-Storey	16	4	4	4	4	4.25	4.25	4.5	4.75
	24	4	4.25	4.5	4.75	4.75	5	5.25	5.5
	32	4.5	4.75	5	5.25	5.5	6	6.25	6.75
	40	5	5.5	5.75	6.25	6.75	7	7.5	8.25
	50	5.75	6.25	7	7.5	8.25	8.75	9.5	10.75
	60	6.5	7.5	8.25	9.25	10	10.75	11.75	13.25
First Storey of Two-Storey	16	4.25	4.5	4.75	5	5.25	5.5	5.75	6.5
	24	4.75	5.25	5.5	6	6.25	6.75	7	8
	32	5.5	6	6.5	7	7.5	8	8.75	9.75
	40	6.25	7	7.5	8.25	9	9.75	10.5	12
	50	7.25	8.25	9.25	10.25	11.25	12.25	13.25	15.25
	60	8.5	9.75	11	12.25	13.5	15	16.25	18.75

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 psf = 0.0479 kN/m²

1 - Table values are based on reinforcing bars with a minimum yield strength of 40,000 psi (276 MPa) and concrete with a minimum specified compressive strength of 2,500 psi (17.2 MPa).

2 - Table values are based on a 3.5 in (88.9 mm) thick flat wall. For a 5.5 in (139.7 mm) thick flat wall, multiply the table values by 0.9. The adjusted values may not result in solid wall lengths less than 4 ft.

3 - Table values are based on a maximum unsupported wall height of 10 ft (3.0 m).

4 - Table values are based on a maximum 12:12 roof pitch.

5 - Linear interpolation shall be permitted.

2. Minimum amount of solid wall length for Seismic Design Categories C, D1 and D2 shall be as per table 5.5 (below).

Prescriptive Method - TABLE 5.5
MINIMUM PERCENTAGE OF SOLID WALL LENGTH
ALONG EXTERIOR WALL LINES FOR SEISMIC DESIGN CATEGORY C AND D[1,2]

ICF WALL TYPE AND MINIMUM WALL THICKNESS (inches)	MINIMUM SOLID WALL LENGTH (percent)		
	ONE-STORY OR TOP STORY OF TWO-STORY	WALL SUPPORTING LIGHT FRAME SECOND STORY AND ROOF	WALL SUPPORTING ICF SECOND STORY AND ROOF
Seismic Design Category C[3]	20 percent	25 percent	35 percent
Seismic Design Category D1[4]	25 percent	30 percent	40 percent
Seismic Design Category D2[4]	30 percent	35 percent	45 percent

For SI: 1 inch = 25.4 mm;   1 mph = 1.6093 km/hr

1 - Base percentages are applicable for maximum unsupported wall height of 10-feet (3.0-m), light-frame gable construction, all ICF wall types in Seismic Design Category C, and all ICF wall types with a nominal thickness greater than 5.5 inches (140 mm) for Seismic Design Category D1 and D2. These percentages assume that the maximum weight of the interior and exterior wall finishes applied to ICF walls do not exceed 8 psf (0.38 KN/m3)

2 - For all walls, the minimum required length of solid walls shall be based on the table percent value multiplied by the minimum dimensions of a rectangle inscribing the overall building plan.

3 - Walls shall be reinforced with minimum No.5 rebar (grade 40 or 60) spaced a maximum of 24 inches (609.6 mm) on center each way or No.4 rebar (Grade 40 or 60) spaced at a maximum of 16 inches (406.4 mm) on center each way.

4 - Walls shall be constructed with a minimum concrete compressive strength of 3,000 psi (20.7 Mpa) and reinforced with minimum #5 rebar (Grade 60, ASTM A706) spaced a maximum of 18 inches (457.2 mm) on center each way or No. 4 rebar (Grade 60, ASTM A706) spaced at a maximum of 12 inches (304.8 mm) on center each way.

3. The larger amount of solid wall length as required by tables 5.2A, 5.2B, 5.2C and 5.5 shall be used.

B2.1.6 – Floor Joist Connections

[Prescriptive Method – 6.2.2]

1. Wood ledger board shall be anchored to flat ICF walls in accordance with table 6.1 (below).

Prescriptive Method - TABLE 6.1
FLOOR LEDGER-ICF WALL CONNECTION (SIDE-BEARING CONNECTION) REQUIREMENTS[1,2,3]

MAXIMUM FLOOR CLEAR SPAN[4] (feet)	MAXIMUM ANCHOR BOLT SPACING5 (inches)			
	STAGGERED 1/2 INCH DIAMETER ANCHOR BOLTS	STAGGERED 5/8 INCH DIAMETER ANCHOR BOLTS	TWO 1/2 INCH DIAMETER ANCHOR BOLTS[6]	TWO 5/8 INCH DIAMETER ANCHOR BOLTS[6]
8	18	20	36	40
10	16	18	32	36
12	14	18	28	36
14	12	16	24	32
16	10	14	20	28
18	9	13	18	26
20	8	11	16	22
22	7	10	14	20
24	7	9	14	18
26	6	9	12	18
28	6	8	12	16
30	5	8	10	16
32	5	7	10	14

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm

1 - Minimum ledger board nominal depth shall be 8 inches (203 mm). The actual thickness of the ledger board shall be a minimum of 1.5 inches (38 mm). Ledger board shall be minimum No. 2 Grade.

2 - Minimum edge distance shall be 2 inches (51 mm) for 1/2-inch-(13-mm-) diameter anchor bolts and 2.5 inches (64 mm) for 5/8-inch-(16-mm) diameter anchor bolts.

3 - Interpolation is permitted between floor spans.

4 - Floor span corresponds to the clear span of the floor structure (i.e., joists or trusses) spanning between load-bearing walls or beams.

5 - Anchor bolts shall extend through the ledger to the center of the flat ICF wall thickness or the center of the horizontal or vertical core thickness of the waffle-grid or screen-grid ICF wall system.

6 - Minimum vertical clear distance between bolts shall be 1.5 inches (38 mm) for 1/2-inch-(13-mm-) diameter anchor bolts and 2 inches (51 mm) for 5/8-inch-(16 mm) diameter anchor bolt

2. Please refer to Prescriptive Method Section 6 for additional requirements on floor, roof, and minimum wall thickness requirements for high wind pressures and seismic design categories C, D1 and D2.

Appendix C – Coursing and Corner Dimensions

Table C1.1 - Vertical Course Chart for 4, 6 & 8 inch Amvic Blocks

No. of Courses	Total Height (Inch)	Total Height (ft - inch)	Plus 2 inch Height Adjuster (Inch)	Plus 3 inch Height Adjuster (Inch)	Plus 4 inch Height Adjuster (Inch)
1	16″	1′ 4″	18″	19″	20″
2	32″	2′ 8″	34″	35″	36″
3	48″	4′ 0″	50″	51″	52″
4	64″	5′ 4″	66″	67″	68″
5	80″	6′ 8″	82″	83″	84″
6	96″	8′ 0″	98″	99″	100″
7	112″	9′ 4″	114″	115″	116″
8	128″	10′ 8″	130″	131″	132″
9	144″	12′ 0″	146″	147″	148″
10	160″	13′ 4″	162″	163″	164″
11	176″	14′ 8″	178″	179″	180″
12	192″	16′ 0″	194″	195″	196″
13	208″	17′ 4″	210″	211″	212″
14	224″	18′ 8″	226″	227″	228″
15	240″	20′ 0″	242″	243″	244″
16	256″	21′ 4″	258″	259″	260″
17	272″	22′ 8″	274″	275″	276″
18	288″	24′ 0″	300″	301″	302″
19	304″	25′ 4″	306″	307″	308″
20	320″	26′ 8″	322″	323″	324″

Table C1.2 - Vertical Course Chart for 10 inch Amvic Blocks

No. of Courses	Total Height (Inch)	Total Height (ft - inch)	Plus 2 inch Height Adjuster (Inch)	Plus 3 inch Height Adjuster (Inch)	Plus 4 inch Height Adjuster (Inch)
1	24″	2′ 0″	26″	27″	28″
2	48″	4′ 0″	50″	51″	52″
3	72″	6′ 0″	74″	75″	76″
4	96″	8′ 0″	98″	99″	100″
5	120″	10′ 0″	122″	123″	124″
6	144″	12′ 0″	146″	147″	148″
7	168″	14′ 0″	170″	171″	172″
8	192″	16′ 0″	194″	195″	196″
9	216″	18′ 0″	218″	219″	220″
10	240″	20′ 0″	242″	243″	244″
11	264″	22′ 0″	266″	267″	268″
12	288″	24′ 0″	290″	291″	292″
13	312″	26′ 0″	314″	315″	316″
14	336″	28′ 0″	338″	339″	340″
15	360″	30′ 0″	362″	363″	364″
16	384″	32′ 0″	386″	387″	388″
17	408″	34′ 0″	410″	411″	412″
18	432″	36′ 0″	434″	435″	436″
19	456″	38′ 0″	458″	459″	460″
20	480″	40′ 0″	482″	483″	484″

Table C1.3 - Preferred 90° Corner Dimensions for 4 inch Amvic Block (3)

Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)	Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)
1´ 4″ (1)	2´ 1″ (1)	7″ (1)	13´ 4″	14´ 1″	12´ 7″
1´ 10″ (1)	2´ 7″ (1)	1´ 1″ (1)	13´ 10	14´ 7″	13´ 1″
2´ 4″ (2)	3´ 1″ (2)	1´ 7″ (2)	14´ 4″	15´ 1″	13´ 7″
2´ 10″	3´ 7″	2´ 1″	14´ 10″	15´ 7″	14´ 1″
3´ 4″	4´ 1″	2´ 7″	15´ 4″	16´ 1″	14´ 7″
3´ 10″	4´ 7″	3´ 1″	15´ 10″	16´ 7″	15´ 1″
4´ 4″	5´ 1″	3´ 7″	16´ 4″	17´ 1″	15´ 7″
4´ 10″	5´ 7″	4´ 1″	16´ 10″	17´ 7″	16´ 1″
5´ 4″	6´ 1″	4´ 7″	17´ 4″	18´ 1″	16´ 7″
5´ 10″	6´ 7″	5´ 1″	17´ 10″	18´ 7″	17´ 1″
6´ 4″	7´ 1″	5´ 7″	18´ 4″	19´ 1″	17´ 7″
6´ 10″	7´ 7″	6´ 1″	18´ 10″	19´ 7″	18´ 1″
7´ 4″	8´ 1″	6´ 7″	19´ 4″	20´ 1″	18´ 7″
7´ 10″	8´ 7″	7´ 1″	19´ 10″	20´ 7″	19´ 1″
8´ 4″	9´ 1″	7´ 7″	20´ 4″	21´ 1″	19´ 7″
8´ 10″	9´ 7″	8´ 1″	20´ 10″	21´ 7″	20´ 1″
9´ 4″	10´ 1″	8´ 7″	21´ 4″	22´ 1″	20´ 7″
9´ 10″	10´ 7″	9´ 1″	21´ 10″	22´ 7″	21´ 1″
10´ 4″	11´ 1″	9´ 7″	22´ 4″	23´ 1″	21´ 7″
10´ 10″	11´ 7″	10´ 1″	22´ 10″	23´ 7″	22´ 1″
11´ 4″	12´ 1″	10´ 7″	23´ 4″	24´ 1″	22´ 7″
11´ 10″	12´ 7″	11´ 1″	23´ 10″	24´ 7″	23´ 1″
12´ 4″	13´ 1″	11´ 7″	24´ 4″	25´ 1″	23´ 7″
12´ 10″	13´ 7″	12´ 1″	24´ 10″	25´ 7″	24´ 1″

(1) Minimum dimension required for a short corner with a stack joint

(2) Minimum dimension required for a short corner with a running bond pattern

(3) Red dimensions indicate use of full size Amvic blocks and no cutting required

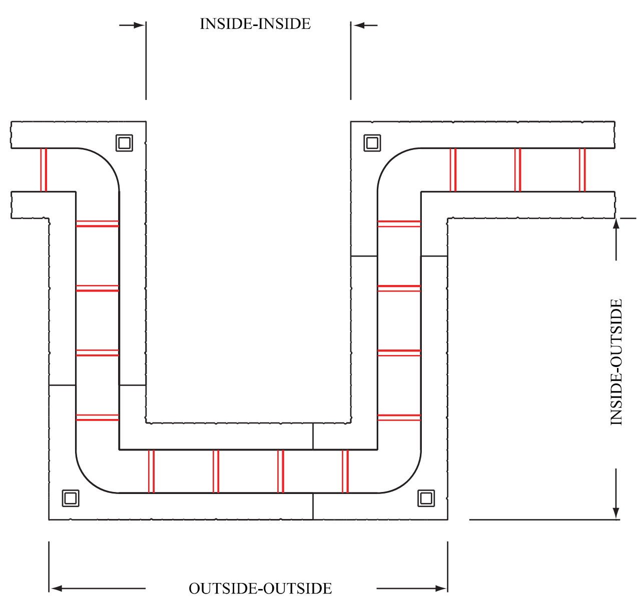


Table C1.4 - Preferred 90° Corner Dimensions for 6 inch Amvic Block (3)

Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)
1´ 6˝ (1)	2´ 5˝ (1)	0´ 7˝ (1)
2´ 0˝ (1)	2´ 11˝ (1)	1´ 1˝ (1)
2´ 6˝ (2)	3´ 5˝ (2)	1´ 7˝ (2)
3´ 0˝	3´ 11˝	2´ 1˝
3´ 6˝	4´ 5˝	2´ 7˝
4´ 0˝	4´ 11˝	3´ 1˝
4´ 6˝	5´ 5˝	3´ 7˝
5´ 0˝	5´ 11˝	4´ 1˝
5´ 6˝	6´ 5˝	4´ 7˝
6´ 0˝	6´ 11˝	5´ 1˝
6´ 6˝	7´ 5˝	5´ 7˝
7´ 0˝	7´ 11˝	6´ 1˝
7´ 6˝	8´ 5˝	6´ 7˝
8´ 0˝	8´ 11˝	7´ 1˝
8´ 6˝	9´ 5˝	7´ 7˝
9´ 0˝	9´ 11˝	8´ 1˝
9´ 6˝	10´ 5˝	8´ 7˝
10´ 0˝	10´ 11˝	9´ 1˝
10´ 6˝	11´ 5˝	9´ 7˝
11´ 0˝	11´ 11˝	10´ 1˝
11´ 6˝	12´ 5˝	10´ 7˝
12´ 0˝	12´ 11˝	11´ 1˝
12´ 6˝	13´ 5˝	11´ 7˝
13´ 0˝	13´ 11˝	12´ 1˝

Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)
13´ 6˝	14´ 5˝	12´ 7˝
14´ 0´	14´ 11˝	13´ 1˝
14´ 6˝	15´ 5˝	13´ 7˝
15´ 0˝	15´ 11˝	14´ 1˝
15´ 6˝	16´ 5˝	14´ 7˝
16´ 0˝	16´ 11˝	15´ 1˝
16´ 6˝	17´ 5˝	15´ 7˝
17´ 0˝	17´ 11˝	16´ 1˝
17´ 6˝	18´ 5˝	16´ 7˝
18´ 0˝	18´ 11˝	17´ 1˝
18´ 6˝	19´ 5˝	17´ 7˝
19´ 0˝	19´ 11˝	18´ 1˝
19´ 6˝	20´ 5˝	18´ 7˝
20´ 0˝	20´ 11˝	19´ 1˝
20´ 6˝	21´ 5˝	19´ 7˝
21´ 0˝	21´ 11˝	20´ 1˝
21´ 6˝	22´ 5˝	20´ 7˝
22´ 0˝	22´ 11˝	21´ 1˝
22´ 6˝	23´ 5˝	21´ 7˝
23´ 0˝	23´ 11˝	22´ 1˝
23´ 6˝	24´ 5˝	22´ 7˝
24´ 0˝	24´ 11˝	23´ 1˝
24´ 6˝	25´ 5˝	23´ 7˝
25´ 0˝	25´ 11˝	24´ 1˝

(1) Minimum dimension required for a short corner with a stack joint

(2) Minimum dimension required for a short corner with a running bond pattern

(3) Red dimensions indicate use of full size Amvic blocks and no cutting required

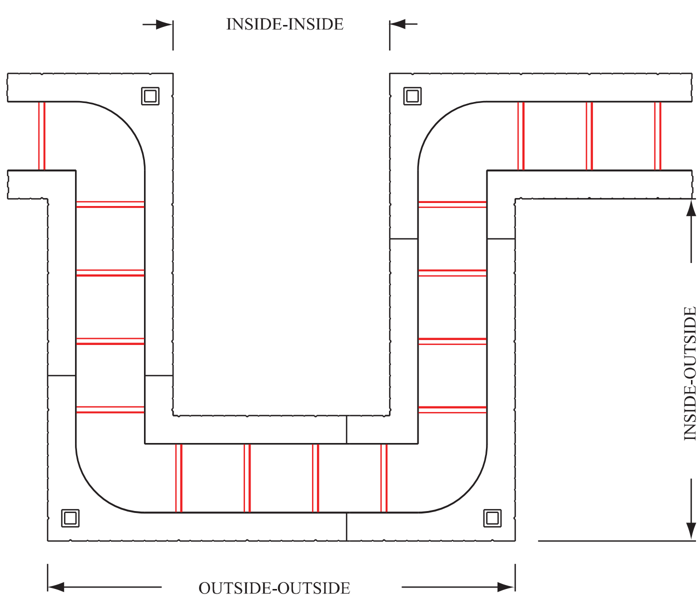


Table C1.5 - Preferred 90° Corner Dimensions for 8 inch Amvic Block (3)

Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)	Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)
1´ 8˝ (1)	2´ 9˝ (1)	0´ 7˝ (1)	13´ 8˝	14´ 9˝	12´ 7˝
2´ 2˝ (1)	3´ 3˝ (1)	1´ 1˝ (1)	14´ 2˝	15´ 3˝	13´ 1˝
2´ 8˝ (2)	3´ 9˝ (2)	1´ 7˝ (2)	14´ 8˝	15´ 9˝	13´ 7˝
3´ 2˝	4´ 3˝	2´ 1˝	15´ 2˝	16´ 3˝	14´ 1˝
3´ 8˝	4´ 9˝	2´ 7˝	15´ 8˝	16´ 9˝	14´ 7˝
4´ 2˝	5´ 3˝	3´ 1˝	16´ 2˝	17´ 3˝	15´ 1˝
4´ 8˝	5´ 9˝	3´ 7˝	16´ 8˝	17´ 9˝	15´ 7˝
5´ 2˝	6´ 3˝	4´ 1˝	17´ 2˝	18´ 3˝	16´ 1˝
5´ 8˝	6´ 9˝	4´ 7˝	17´ 8˝	18´ 9˝	16´ 7˝
6´ 2˝	7´ 3˝	5´ 1˝	18´ 2˝	19´ 3˝	17´ 1˝
6´ 8˝	7´ 9˝	5´ 7˝	18´ 8˝	19´ 9˝	17´ 7˝
7´ 2˝	8´ 3˝	6´ 1˝	19´ 2˝	20´ 3˝	18´ 1˝
7´ 8˝	8´ 9˝	6´ 7˝	19´ 8˝	20´ 9˝	18´ 7˝
8´ 2˝	9´ 3˝	7´ 1˝	20´ 2˝	21´ 3˝	19´ 1˝
8´ 8˝	9´ 9˝	7´ 7˝	20´ 8˝	21´ 9˝	19´ 7˝
9´ 2˝	10´ 3˝	8´ 1˝	21´ 2˝	22´ 3˝	20´ 1˝
9´ 8˝	10´ 9˝	8´ 7˝	21´ 8˝	22´ 9˝	20´ 7˝
10´ 2˝	11´ 3˝	9´ 1˝	22´ 2˝	23´ 3˝	21´ 1˝
10´ 8˝	11´ 9˝	9´ 7˝	22´ 8˝	23´ 9˝	21´ 7˝
11´ 2˝	12´ 3˝	10´ 1˝	23´ 2˝	24´ 3˝	22´ 1˝
11´ 8˝	12´ 9˝	10´ 7˝	23´ 8˝	24´ 9˝	22´ 7˝
12´ 2˝	13´ 3˝	11´ 1˝	24´ 2˝	25´ 3˝	23´ 1˝
12´ 8˝	13´ 9˝	11´ 7˝	24´ 8˝	25´ 9˝	23´ 7˝
13´ 2˝	14´ 3˝	12´ 1˝	25´ 2˝	26´ 3˝	24´ 1˝

(1) Minimum dimension required for a short corner with a stack joint

(2) Minimum dimension required for a short corner with a running bond pattern

(3) Red dimensions indicate use of full size Amvic blocks and no cutting required

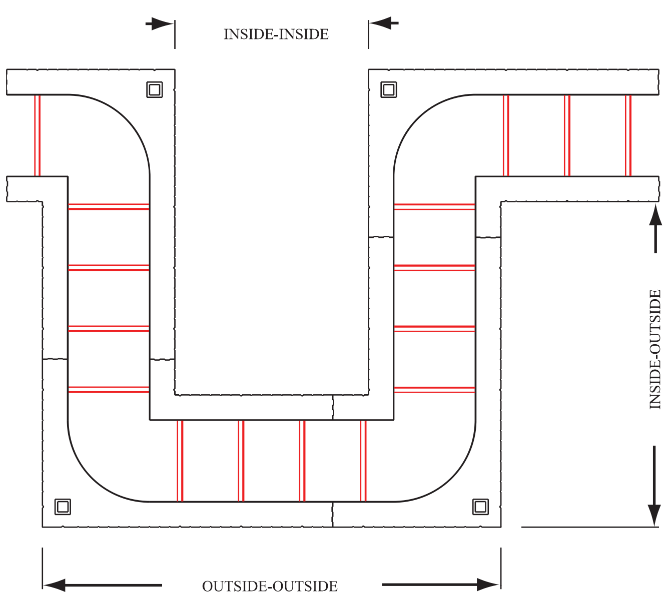


Table C1.6 - Preferred 90° Corner Dimensions for 10 inch Amvic Block (3)

Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)
1′ 10″ (1)	3′ 1″ (1)	0′ 7″ (1)
2′ 4″ (1)	3′ 7″ (1)	1′ 1″ (1)
2′ 10″ (1)	4′ 1″ (1)	1′ 7″ (1)
3′ 4″ (1)	4′ 7″ (1)	2′ 1″ (1)
3′ 10″ (2)	5′ 1″ (2)	2′ 7″ (2)
4′ 4″	5′ 7″	3′ 1″
4′ 10″	6′ 1″	3′ 7″
5′ 4″	6′ 7″	4′ 1″
5′ 10″	7′ 1″	4′ 7″
6′ 4″	7′ 7″	5′ 1″
6′ 10″	8′ 1″	5′ 7″
7′ 4″	8′ 7″	6′ 1″
7′ 10″	9′ 1″	6′ 7″
8′ 4″	9′ 7″	7′ 1″
8′ 10″	10′ 1″	7′ 7″
9′ 4″	10′ 7″	8′ 1″
9′ 10″	11′ 1″	8′ 7″
10′ 4″	11′ 7″	9′ 1″
10′ 10″	12′ 1″	9′ 7″
11′ 4″	12′ 7″	10′ 1″
11′ 10″	13′ 1″	10′ 7″
12′ 4″	13′ 7″	11′ 1″
12′ 10″	14′ 1″	11′ 7″
13′ 4″	14′ 7″	12′ 1″

Inside - Outside Corner Dimension (ft - in)	Outside - Outside Corner Dimension (ft - in)	Inside - Inside Corner Dimension (ft - in)
13′ 10″	15′ 1″	12′ 7″
14′ 4″	15′ 7″	13′ 1″
14′ 10″	16′ 1″	13′ 7″
15′ 4″	16′ 7″	14′ 1″
15′ 10″	17′ 1″	14′ 7″
16′ 4″	17′ 7″	15′ 1″
16′ 10″	18′ 1″	15′ 7″
17′ 4″	18′ 7″	16′ 1″
17′ 10″	19′ 1″	16′ 7″
18′ 4″	19′ 7″	17′ 1″
18′ 10″	20′ 1″	17′ 7″
19′ 4″	20′ 7″	18′ 1″
19′ 10″	21′ 1″	18′ 7″
20′ 4″	21′ 7″	19′ 1″
20′ 10″	22′ 1″	19′ 7″
21′ 4″	22′ 7″	20′ 1″
21′ 10″	23′ 1″	20′ 7″
22′ 4″	23′ 7″	21′ 1″
22′ 10″	24′ 1″	21′ 7″
23′ 4″	24′ 7″	22′ 1″
23′ 10″	25′ 1″	22′ 7″
24′ 4″	25′ 7″	23′ 1″
24′ 10″	26′ 1″	23′ 7″
25′ 4″	26′ 7″	24′ 1″

(1) Minimum dimension required for a short corner with a stack joint

(2) Minimum dimension required for a short corner with a running bond pattern

(3) Red dimensions indicate use of full size Amvic blocks and no cutting required

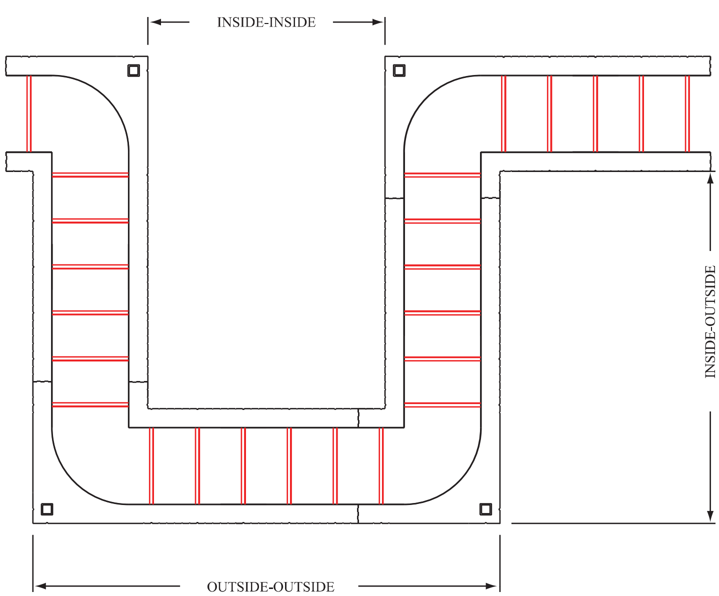


Table C1.7 - Preferred 45° Corner Dimensions for 4 inch Amvic Block(3)

Bay Projection Dimension C (ft - in)	Outside - Outside Bay Dimension A (ft - in)	Inside - Inside Bay Dimension B (ft - in)
10 1/16″ (1)	1´ 6″ (1)	10 9/16″ (1)
1´ 2 5/16″ (1)	2´ 0″ (1)	1´ 4 9/16″ (1)
1´ 6 9/16″ (2)	2´ 6″ (2)	1´ 10 9/16″ (2)
1´ 10 13/16″	3´ 0″	2´ 4 9/16″
2´ 3 1/16″	3´ 6″	2´ 10 9/16″
2´ 7 5/16″	4´ 0″	3´ 4 9/16″
2´ 11 9/16″	4´ 6″	3´ 10 9/16″
3´ 3 13/16″	5´ 0″	4´ 4 9/16″
3´ 8 1/16″	5´ 6″	4´ 10 9/16″
4´ 5/16″	6´ 0″	5´ 4 9/16″
4´ 4 9/16″	6´ 6″	5´ 10 9/16″
4´ 8 13/16″	7´ 0″	6´ 4 9/16″
5´ 1 1/16″	7´ 6″	6´ 10 9/16″
5´ 5 5/16″	8´ 0″	7´ 4 9/16″
5´ 9 9/16″	8´ 6″	7´ 10 9/16″
6´ 1 13/16″	9´ 0″	8´ 4 9/16″

(1) Minimum dimension required for a short corner with a stack joint

(2) Minimum dimension required for a short corner with a running bond pattern

(3) Red dimensions indicate use of full size Amvic blocks and no cutting required

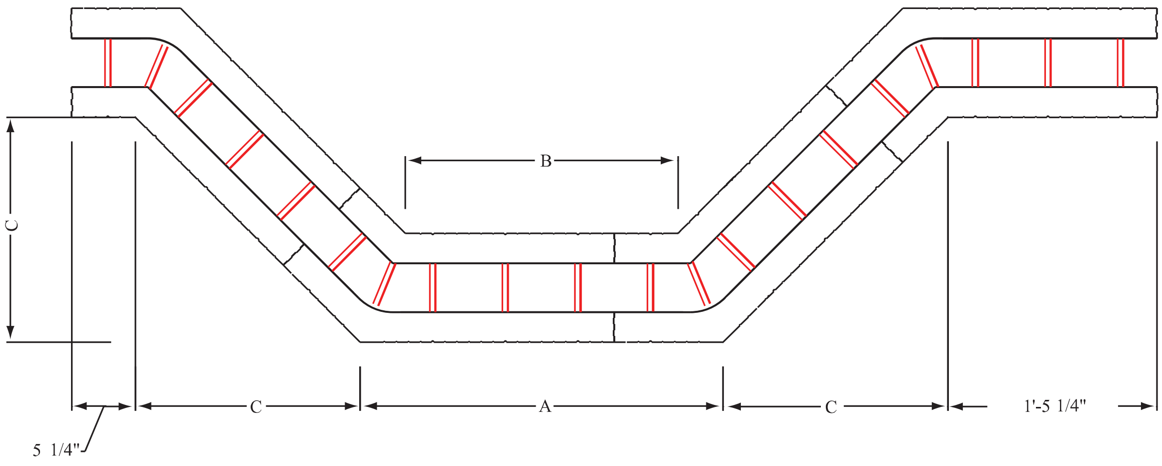


Table C1.8 - Preferred 45° Corner Dimensions for 6 inch Amvic Block(3)

Bay Projection Dimension C (ft - in)	Outside - Outside Bay Dimension A (ft - in)	Inside - Inside Bay Dimension B (ft - in)
9 13/16″ (1)	1′ 6 7/16″ (1)	9 5/16″ (1)
1′ 2 1/16″ (1)	2′ 7/16″ (1)	1′ 3 5/16″ (1)
1′ 6 5/16″ (2)	2′ 6 7/16″ (2)	1′ 9 5/16″ (2)
1′ 10 9/16″	3′ 7/16″	2′ 3 5/16″
2′ 2 13/16″	3′ 6 7/16″	2′ 9 5/16″
2′ 7 1/16″	4′ 7/16″	3′ 3 5/16″
2′ 11 5/16″	4′ 6 7/16″	3′ 9 5/16″
3′ 3 9/16″	5′ 7/16″	4′ 3 5/16″
3′ 7 13/16″	5′ 6 7/16″	4′ 9 5/16″
4′ 1/16″	6′ 7/16″	5′ 3 5/16″
4′ 4 5/16″	6′ 6 7/16″	5′ 9 5/16″
4′ 8 9/16″	7′ 7/16″	6′ 3 5/16″
5′ 13/16″	7′ 6 7/16″	6′ 9 5/16″
5′ 5 1/16″	8′ 7/16″	7′ 3 5/16″
5′ 9 5/16″	8′ 6 7/16″	7′ 9 5/16″
6′ 3 9/16″	9′ 7/16″	8′ 3 5/16″

(1) Minimum dimension required for a short corner with a stack joint

(2) Minimum dimension required for a short corner with a running bond pattern

(3) Red dimensions indicate use of full size Amvic blocks and no cutting required

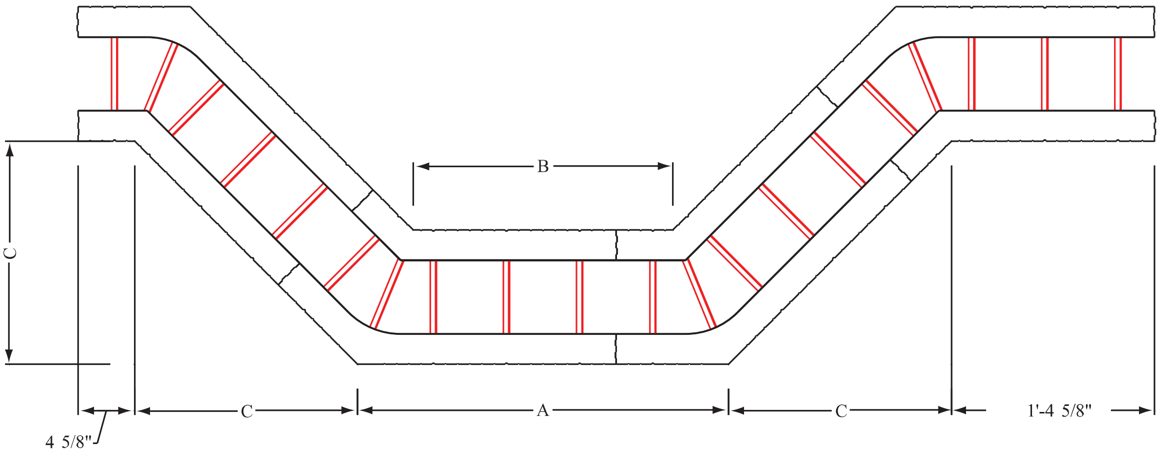


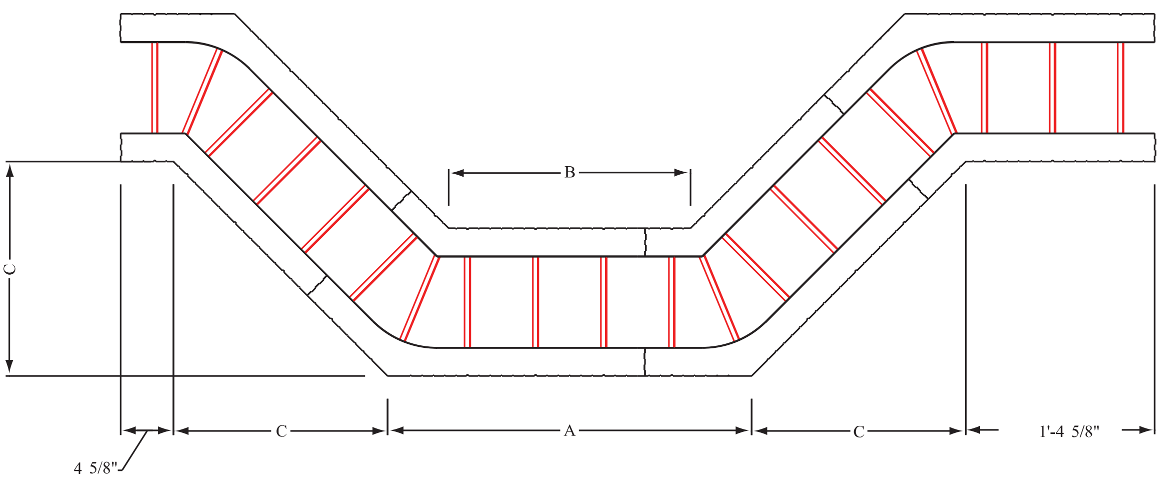
Table C1.9 - Preferred 45° Corner Dimensions for 8 inch Amvic Block(3)

Bay Projection Dimension C (ft - in)	Outside - Outside Bay Dimension A (ft - in)	Inside - Inside Bay Dimension B (ft - in)
10 3/8″ (1)	1´ 8 1/16″ (1)	9 5/16″ (1)
1´ 2 5/8″ (1)	2´ 2 1/16″ (1)	1´ 3 5/16″ (1)
1´ 6 7/8″ (2)	2´ 8 1/16″ (2)	1´ 9 5/16″ (2)
1´ 11 1/8″	3´ 2 1/16″	2´ 3 5/16″
2´ 3 3/8″	3´ 8 1/16″	2´ 9 5/16″
2´ 7 5/8″	4´ 2 1/16″	3´ 3 5/16″
2´ 11 7/8″	4´ 8 1/16″	3´ 9 5/16″
3´ 4 1/8″	5´ 2 1/16″	4´ 3 5/16″
3´ 8 3/8″	5´ 8 1/16″	4´ 9 5/16″
4´ 5/8″	6´ 2 1/16″	5´ 3 5/16″
4´ 4 7/8″	6´ 8 1/16″	5´ 9 5/16″
4´ 9 1/8″	7´ 2 1/16″	6´ 3 5/16″
5´ 1 3/8″	7´ 8 1/16″	6´ 9 5/16″
5´ 5 5/8″	8´ 2 1/16″	7´ 3 5/16″
5´ 9 7/8″	8´ 8 1/16″	7´ 9 5/16″
6´ 2 1/8″	9´ 2 1/16″	8´ 3 5/16″

(1) Minimum dimension required for a short corner with a stack joint

(2) Minimum dimension required for a short corner with a running bond pattern

(3) Red dimensions indicate use of full size Amvic blocks and no cutting required



Appendix D – Termites and ICF Construction

D1.0 – Termite Types

There are three main types of termites currently found in North America:

1. Dampwood termites
2. Drywood termites
3. Subterranean termites

Dampwood Termites

These are prevalent in the Pacific Northwest and coastal British Columbia and primarily attack decaying wood. Eliminating the moisture source leading to the decay will normally control their spread.

Drywood Termites

This type does not require a significant moisture source. They can fly directly into buildings and start colonies in dry wood. They are found in the southern part of North America such as Hawaii and Mexico. Use of treated wood is usually more effective against this type.

Subterranean Termites

Subterranean termites most commonly live in the soil to avoid temperature extremes as well as obtaining moisture essential to their existence. They can attack any dry wood or other source of cellulose within a foraging distance of their colony such as untreated fence posts, utility poles, cardboard, paper, fiberboard which are close to the ground.

Where a wood source is not in contact with the soil, workers will build earthen 'shelter tubes' over concrete foundation walls or in cracks in the concrete through which they can travel to and from the food source and soil moisture.

Besides gaining entry via wood touching or close to the ground, termites can enter through cracks in concrete foundations and slabs, and through spaces around utility pipes cutting through concrete foundations.

Subterranean termites are the most important type since they cause the most damage to building structures. Within this group the Formosan subterranean termite is the most aggressive and destructive in nature. Formosan termites are typically smaller in size than other species, but can consume more wood faster because of their sheer numbers.

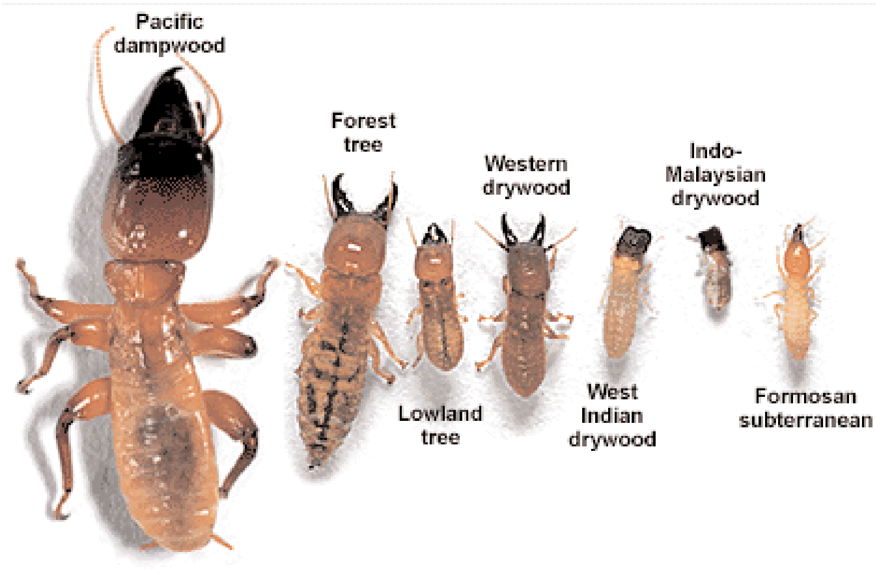


Figure D1.1 – Termites found in North America.
Copyright ©2000-2005, University of Hawaii Termite Project, www2.hawaii.edu/~entomol/index.htm

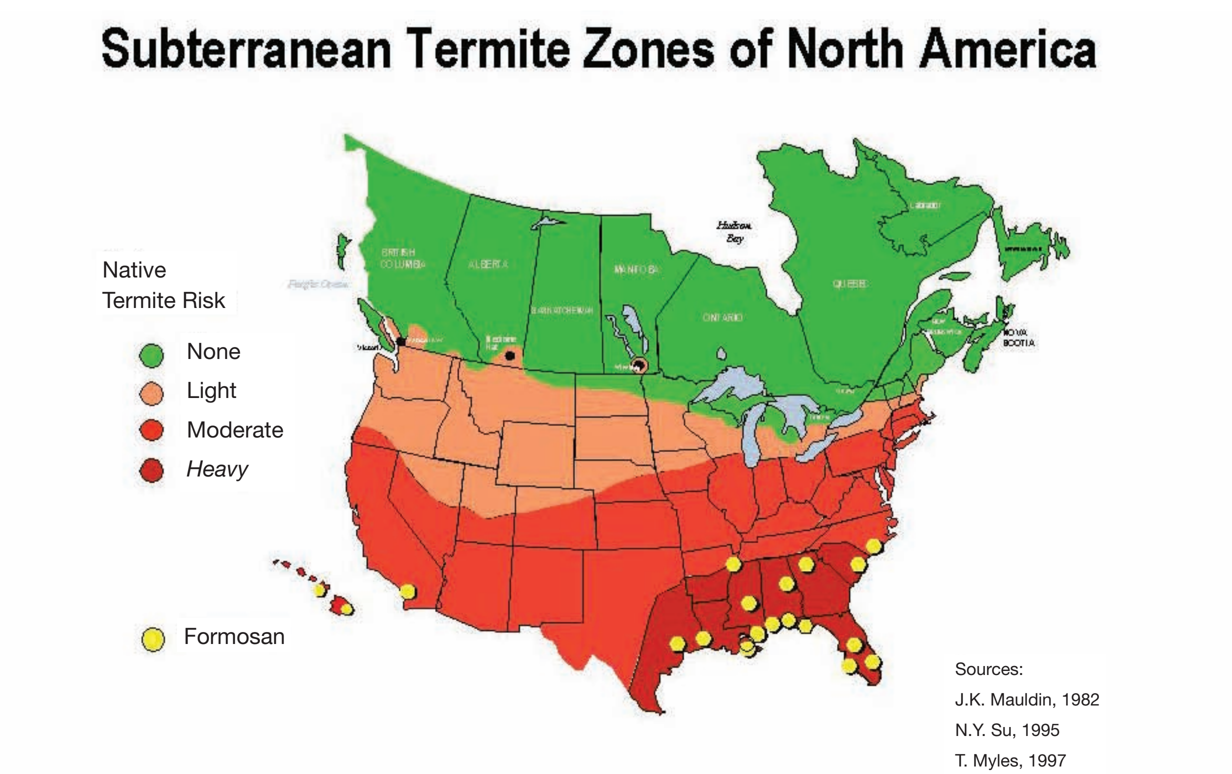


Figure D1.2 – Termite risk map of North America

D1.1 – Termites and ICF construction

The EPS foam and concrete which make up the Amvic ICF do not constitute a food source for any of the three types of termites found in North America. However subterranean termites can burrow through the EPS foam to reach areas of the building structure where there is a food source such as roof wood trusses, wood floor joists and hardwood flooring.

When ICF walls are used below grade in areas of very heavy termite infestations, it becomes more difficult to track their existence since termites can start burrowing through the EPS foam starting from below grade and upwards to the roof without being discovered.

D1.2 – Code Issues and EPS Foam Below Grade

The subterranean termites' ability to burrow through below grade EPS foam undiscovered led several national and local building codes in North America to ban the use of EPS foam below grade in areas considered to be very heavily infested. However the building codes have made exceptions and suggested measures which if used, will make the use of EPS foam acceptable.

D1.2.1 – International Residential Code 2003, Termite Control and EPS Protection

[R320.1] Subterranean termite control.

In areas favorable to termite damage as per table R301.2(1) methods of protection shall be any of the following:

1. Chemical soil treatment
2. Pressure preservatively treated wood in accordance with AWPA standards
3. Naturally termite resistant wood
4. Physical barriers such as metal or plastic termite shields
5. Any combination of above

[R320.4] Foam Plastic Protection.

In areas where the probability of termite infestation is 'very heavy' as per figure **R301.2(6)** [refer to figure D1.3 below], EPS foam shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below grade. There should be a minimum clearance of at least 6 inches (152 mm) between foam plastics installed above grade and exposed earth.

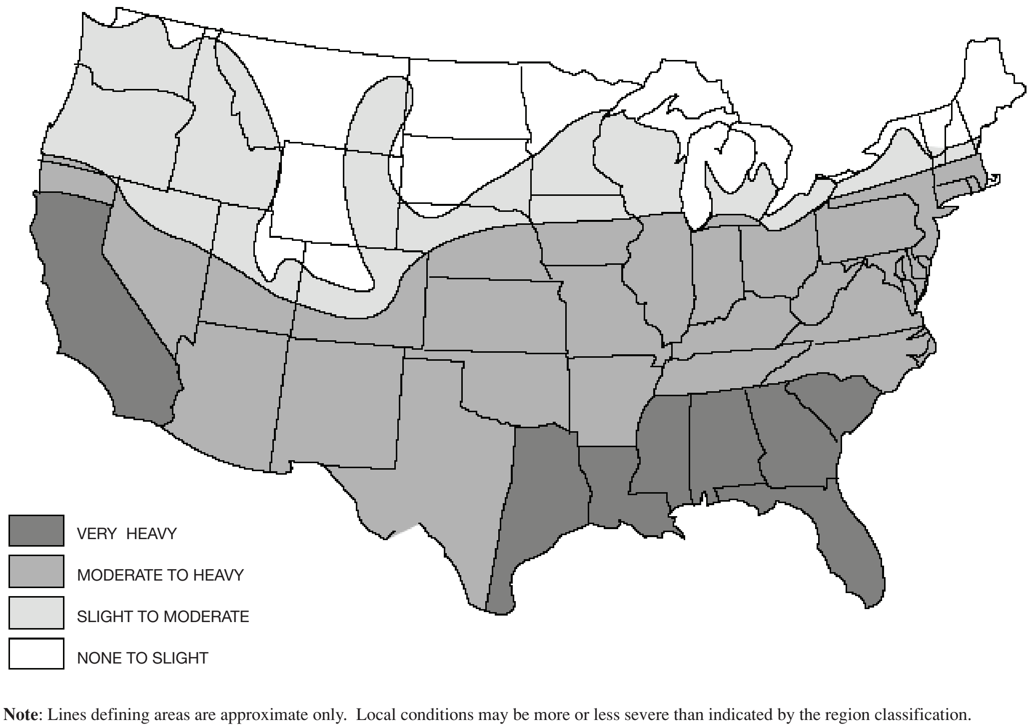


Figure D1.3 – Illustration R301.2(6) as per IRC 2003

Exceptions:

1. Building structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or pressure preservatively treated wood.
2. In addition to requirements of R320.1 an approved method of protecting the foam plastic and structure from subterranean termite damage is provided.
3. On the interior side of basement walls.

D1.2.2 – National Building Code of Canada 2005, Termite Control and EPS Protection

[NBC 2005 – 9.12.1.1 (2)]

In localities where termite infestation is known to be a problem, all stumps, roots and other wood debris shall be removed from the soil to a depth of not less than 300 mm in unexcavated areas under a building.

[NBC 2005 – 9.3.2.9 (1)]

In localities where termites are known to occur,

a) clearance between structural wood elements and finished ground level directly below them shall be not less than 450 mm and, except as provided in sentence (2), all sides of the supporting elements shall be visible to permit inspection, or

b) structural wood elements, supported by elements in contact with the ground or exposed over bare soil, shall be pressure treated with a chemical that is toxic to termites.

[NBC 2005 – 9.3.2.9 (2)]

In localities where termites are known to occur and foundations are insulated or finished in a manner that could conceal termite infestation,

a) a metal or plastic barrier shall be installed through the insulation and any other separation of finish materials above finished ground level to control the passage of termites behind or through the insulation, separation or finish materials, and

b) all sides of the finished supporting assembly shall be visible to permit inspection.

D2.0 – Termite Protection and Control

There are several methods for protecting below grade and above grade structures including EPS foam from termites. The following are the most common methods currently being used in the market and are categorized according to their specific application techniques.

D2.1 – Physical Barriers

D2.1.1 – Waterproofing and Termite Barrier System.

Polyguard 650 XT membrane is specifically designed for ICF foundation walls and can be used for foundation waterproofing as well as termite protection.

Compliance of Polyguard 650 XT membranes with building codes issues pertaining to waterproofing and termite protection is covered under the International Code Council ***ICC-ES Legacy Report #2136 (Formerly SBCCI Evaluation Report #2136*** which can be downloaded from the following website:

www.polyguardproducts.com/products/architectural/datasheets/ICC-ESreport2136.pdf

For more information on Polyguard 650 XT refer to the following website:

www.polyguardproducts.com/products/architectural/icf.htm

D2.1.2 – Chemical Treatment of Soil

Adding chemicals (termiticide) to the soil surrounding the building structure has been a traditional and primary method of termite control. Subsequent follow up treatment at regular periodic intervals is required to continuously keep any termite population near the structure in check.

Certain city by-laws have been known to ban this method in areas where the water-table level is very high and there is an environmental danger of the chemical agents seeping through.

D2.1.3 – Metal Termite Shield

Metal termite shields are physical barriers to termites which prevent them from building invisible tunnels. When installed properly, the metal termite shields will force subterranean termites to build tunnels on the outside of the shields which are easily detected.

Metal shields are installed on top of concrete walls, and are fabricated of sheet metal which is unrolled and attached over the foundation walls. The edges are then bent at a 45 degree angle. Metal shields must be very tightly constructed, and all joints must be completely sealed. Joints may be sealed by soldering, or with a tar-like bituminous compound.

Figure D1.4 – Metal termite shield using copper metal on top of foundation wall.
Copyright ©1998-2005, Urban Entomology Program, University of Toronto
www.utoronto.ca/forest/termite/termite.htm

Figure D1.5 – Detail of metal shield at corner.
Copyright ©1998-2005, Urban Entomology Program, University of Toronto
www.utoronto.ca/forest/termite/termite.htm

D2.1.4 – Particle Sized Barrier

A physical barrier consisting of particle-sized rocks, such as crushed basalt, silica sand, natural sand, granite, glass shards, limestone, quartz and coral sand, can be used to prevent termite entry. There are three basic requirements that must exist for a particle sized barrier to be effective:

1. Granules size must be small enough so that when compacted together, the space between them is too small for the termites to squeeze through.
2. Granules must be big and heavy enough so that the termites can't pick them up and move them using their mandibles.
3. Granules must be too hard for the termites to chew.

The current studies conducted by entomologists reveal that particle sizes between 1.4 - 2.8 mm are impenetrable to subterranean termites.

Particle-sized barriers are used under slabs, around foundations, and around plumbing to create a physical barrier against termites.

An example of a successful particle sized barrier is the Basaltic Termite Barrier (BTB) made of crushed and/or sieved basalt. BTB was invented in Hawaii and is currently being used extensively throughout the state for new commercial and residential construction. BTB is made commercially available by Ameron and under license from the University of Hawaii. For more information on the availability of BTB please refer to the following website:

Ameron, Basaltic Termite Barrier (BTB) – www.ameronhawaii.com/plagg.html

D2.1.5 – Termimesh

Termimesh is a marine grade 316 stainless steel wire mesh which protects the foundation walls and slab on grade of a structure from termite penetration. The aperture grille of the mesh is too small for the termites to penetrate and too hard for them to chew. Termimesh will not kill or eliminate termites. It will physically prevent termites from penetrating a building structure.

Termimesh can be installed during construction on the exterior of foundation walls, under the slab on grade, and around service pipes penetrating the structure. For the system to be effective, proper installation is critical. Termimesh can only be installed by licensed professionals who have been trained by the company to specifically install Termimesh.

Compliance of Termimesh with building code requirements for termite protection is covered by the ***Southern Building Code legacy report No. 9713B*** which can be downloaded from the following website:

www.icc-es.org/reports/pdf_files/SBCCI-ES/9713B.pdf

For more information on this product and its availability please refer to following website:

www.termi-mesh.com

D2.2 – Suppression

D2.2.1 – Termite Baits

Termite bait systems were developed based on the social behavior of insects to groom and feed each other thereby transferring chemical toxicants to a termite colony and eventually eliminating it.

Wood or some other type of cellulose is used in termite baits, to attract foraging termite workers. The cellulose is impregnated with a slow-acting toxicant that cannot be detected by the termites. The toxicant must be slow acting because termites tend to avoid sites where sick and dead termites accumulate. Termite workers feed on the treated material and carry it back to other colony members, where it slowly poisons the termites and eventually reduces or eliminates the entire colony.

Typically, in-ground stations are inserted in the soil next to the structure and in the vicinity of known or suspected sites of termite activity. Initially the stations contain untreated wood to serve as a monitoring device. Once termites locate and start feeding on it, the wood is replaced with the slow acting chemical toxicant. In addition, aboveground stations may be installed inside or on the structure in the vicinity of damaged wood and shelter tubes.

Figure D1.6 – Inserting a termite trap containing wood as bait

Termite baits are used for controlling termite infestations rather than being a barrier to prevent termites from penetrating a structure.

There are several commercial termite bait systems available on the market including:

1. Dow AgroSciences LLC - **Sentricon® Colony Elimination System**
   www.sentricon.com
2. FMC Corporation - **FirstLine® Termite Defense System**
   www.fmc-apgspec.com
3. BASF Corporation - **Subterfuge® Termite Bait**
   www.spd.basf-corp.com/default.asp?page=pestpro/products/subterfuge
4. Ensystex Inc. - **EXTERRA™ Termite Interception and Baiting System**
   www.ensystex.com

D2.2.2 – Trap Treat Release (TTR)

TTR is similar to termite baits in that it uses their social behavior to spread slow acting chemical toxicants into a termite colony.

With TTR, termite traps are placed in suitable locations near the structure. The traps are checked regularly for termite presence. Once termites hit a trap, it is removed and the termites are extracted for treatment. A slow acting chemical toxicant is applied externally to termite bodies as a groomable coating. After treatment the termites are released back to their colonies. Coated termites carry effectively larger loads of toxicant than do bait-fed termites.

These topically treated termites act as a delivery system, spreading the toxicant throughout the colony. Cleaning and grooming by other members of the colony, result in the ingestion of the pesticide by the grooming individuals. After ingestion, the pesticide is further distributed by mutual feeding behaviors. Because of its more efficient delivery system, TTR has better results in the laboratory and field conditions than bait systems.

TTR was developed by Dr. T. G. Myles at the University of Toronto, and was licensed by the University of Toronto Innovations Foundation to FMC Corporation.

D2.3 – Site Management

The following are measures to be taken during construction to reduce the probability of termite infestation in a building structure. These measures are meant to be used **IN ADDITION** to the other termite prevention and control methods discussed above and should not be used nor considered as standalone solutions.

1. Building sites should be cleared of stumps, roots or other woody material that remains beneath or adjacent to the building.
2. All stakes, forms and building debris should be removed from beneath and adjacent to buildings. Do not backfill over such debris.
3. The site should be well drained so that moisture is not retained under, or adjacent to, a building. Downspouts should carry water away from the building.
4. No wood (stair supports, posts or other wood) should project through concrete floors or foundations.
5. Foundations should be of concrete or masonry, and soil debris should be kept clear of wood resting on them. Make sure foundation wall is high

enough to allow sufficient top soil placement and still leave at least 6-8 inches (15-20 cm) of clearance between the bottom of siding or stucco and the ground.

6. Slabs, concrete floors and foundation joints should be sealed against moisture, and regularly inspected for cracks which should be immediately sealed.
7. In areas determined to be very heavily infested with termites, it is recommended to remove an 8 inch (20 cm) strip of EPS above the grade line to expose the concrete. Any termite shelter tubes will be clearly visible and the required treatment measures can be adopted.

D2.4 – Recommendations for Termite Prevention and Control

1. Wood or cellulose is the main food source for termites. Reducing or eliminating wood structural elements in a building structure, greatly enhances its durability against termite infestation. If wood cannot be eliminated, use treated wood or naturally resistant wood to termites.
2. Consider using more than one line of defense from the three different categories of termite control and prevention methods discussed above (Physical Barriers, Suppression and Site Management).
3. Always retain the services of licensed/professional Pest Control Operators (PCOs) to implement commercial termite control and prevention methods especially chemical treatment of soils, metal termite shields, termite baits and TTR.
4. Monitor the structure on a regular basis and inspect for any signs of termite infestation or damage. This should be performed by professional PCOs. Take remediation action when termites are discovered.

Appendix E – Utility Service Installations

E1.0 – ICF Wall Penetrations

The electrician, plumber, HVAC installer etc. should block out for service penetrations through the walls. This is done after the ICF forms have been stacked and before the concrete is poured. Blocking out for service penetrations is typically carried out by cutting a hole through the ICF forms and inserting a PVC pipe all the way through. The PVC pipe serves as a sleeve for subsequent installation of wiring, hose bibs, cables and other service utilities required for the structure. Foam adhesive can be used to seal the gaps between the PVC pipe and the Amvic ICF EPS panels.

Important Note!

All penetration sleeves should be installed at an angle pointing downward towards the exterior of the building. This is to ensure that if any water accumulates or is trapped in, it will be drained to the outside.

Sleeves should be sealed with a weather tight caulk or foam after all wiring has been installed.

E2.0 – Electrical Installation

E2.1 – Main Entrance Panel

The main electrical panel for a building is typically located internally in an independent room or enclosure. If the main electrical panel is to be installed flush with an exterior wall, build the equivalent of a door buck with the appropriate dimensions. The buck height should be enough to leave a gap of approximately 12-18 inches (30 – 45 cm) above the panel to allow easy access for the electrician to pull wire out of the top and swing it over to be embedded in the ICF EPS above. Wiring can then be carried to the upper floors and attic.

If power is entering from underneath the electrical panel, install sweeps through the foundation/SOG allowing it to enter within the opening formed by the buck.

Figure E1.1 – Main electrical panel installed flush with exterior wall

E2.2 – Electrical Wiring

Wiring is installed in Amvic ICF walls after the concrete is poured by cutting channels in the EPS panels in which the Romex wires are embedded. The most efficient way of cutting the channels is by using a chainsaw with a depth stop installed.

Figure E1.2 – Cutting a channel in the EPS panel using a chainsaw

The Romex wires stay embedded in the EPS panels by friction. In addition, use foam adhesive to glue the wires to the EPS on occasional spots in the same manner staples are used with wiring and conventional framing.

Use protective nail plates over the wiring in places where it could be hit by drywall screws.

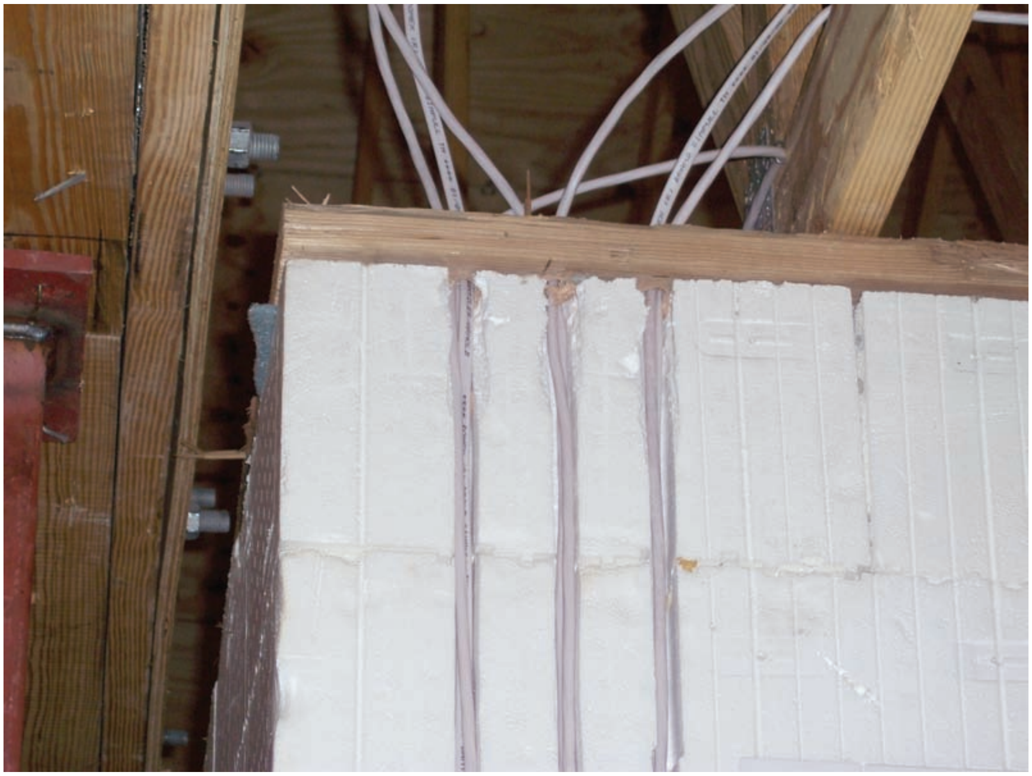


Figure E1.3 – Embedding Romex into the EPS panels

E2.3 – Conduit

Conduit is installed in Amvic ICF walls in the same manner as wiring by cutting a channel in the EPS after the walls are poured in which the conduit is embedded.

If the conduits are to be embedded in the concrete cavity, then it is installed prior to the concrete pour including the electrical boxes and sweeps to which the conduit will be attached.

E2.4 – Electric Outlet Boxes

Electric outlet boxes are installed in Amvic ICF after the concrete is poured by cutting out a recess in the EPS panel using a hot knife adjusted for the right depth. The EPS panels on the Amvic ICF are 2.5 inches (63.5 mm) thick, which is enough depth for most electrical boxes.

If electrical boxes of more than 2.5 inches (63.5 mm) depth are required, then installation should be carried out before the concrete is poured as follows:

1. Cut a foam plug in the EPS panel and push it back into the wall cavity. This will create a deeper void within which the electrical box will be installed.
2. Use foam adhesive to glue the foam plug in place. This will prevent the plug from moving during the concrete pour.
3. After the concrete is poured, break out the foam plug embedded in the concrete wall and install the electrical box in place.

E2.4.1 – Attaching the Electrical Box to the Wall

Electrical boxes are held in the ICF wall by:

1. Friction with the EPS foam
2. Foam adhesive
3. Using boxes with flanges on the front and screwing through the flanges into the polypropylene webs. For metal boxes with flanges, use concrete screws (Tapcon or equivalent) and drill through the concrete.

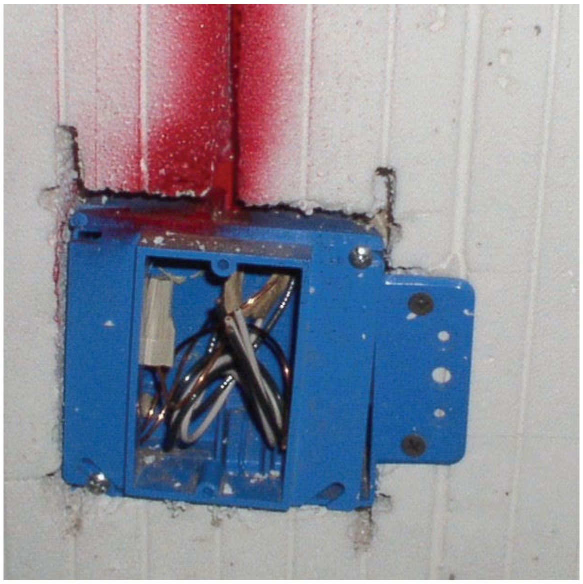


Figure E1.4 – Electric box with flange attached to the webs

Important Note!

DO NOT drill additional holes than what is provided in plastic electric boxes. This will void the UL/ULC rating.

E3.0 – Plumbing

Plumbing is installed in the same manner as conduit and wiring, by cutting channels in the EPS foam after the concrete pour and embedding the pipes. Foam adhesive is used to secure the pipes in place.

Figure E1.5 – Vent pipe embedded in the EPS foam

If brackets for fixtures are required, concrete screws can be used to secure the brackets to the concrete.

Larger diameter plumbing pipes e.g. 3 inch (76 mm) or larger vents can be installed by furring out the ICF wall to accommodate them or chases made of wood or metal in which the pipes are hidden and easily accessed for maintenance.

It is not recommended to place plumbing pipes in the concrete cavity of ICF walls because it creates a weak spot. If it is essential to run the pipes in the concrete cavity for architectural aesthetics, a local licensed/registered engineer should design and/or approve such a detail.