amvic

# Amvic ICF Installation Manual

**STRONGER EVERY DAY**

**INNOVATIVE INSULATION CONSTRUCTION SOLUTIONS FOR ENERGY EFFICIENT AND COMFORTABLE BUILDINGS**

8 NOVEMBER 2022

amvic building system

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## Preface

Amvic ICF are the best 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.

Phone: 1 (877) 470-9991 (toll free)

Email: technical@amvicsystem.com

## Amvic Website

The Amvic website is updated regularly with the most updated information including, product data sheets, construction details and installation manuals. This technical and installation manual is posted on the website, see **www.amvicsystem.com**

## Acknowledgment

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# PREFACE

## Disclaimer

This document is provided for informational purposes only. The information contained in this document represents the current view of Amvic Corporation on the issues discussed as of the date of publication. These opinions as expressed, should not be interpreted to be a commitment on the part of Amvic Corporation and cannot guarantee the accuracy of any information presented after the date of publication. The user assumes the entire risk as to the accuracy and use of this document.

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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## Amvic Insulated Concrete Forms (ICF)

Amvic insulated concrete forms (ICF) are hollow, lightweight forms manufactured using two 1.5 $lb/ft^3$ (24 $kg/m^3$) density, closed cell, expanded polystyrene (EPS) panels which are connected by 8 (R22) or 6 (R30) uniquely designed, high impact polypropylene webs. Amvic ICF R22 blocks use 2-1/2" (63mm) thick panels while 3-1/4" (82mm) panels are used for the Amvic ICF R30 blocks. During construction, the forms are stacked then filled with concrete making stable, durable and sustainable walls.

Amvic ICF combines the insulating effectiveness of EPS with the thermal mass and structural strength of reinforced concrete, in an air and vapor tight wall. ICF offers a "5 in 1" solution that provides structure, insulation, air and vapor barrier, sound attenuation and attachment for interior and exterior finishes in one easy step.

Amvic ICF provides a thermal resistance of 22 $hr.ft^2.F/Btu$ (3.87 $m^2K/W$) with the R22 blocks and 30 $hr.ft^2.F/Btu$ (5.28 $m^2K/W$) with the Amvic R30 blocks. A Fire Resistance Rating (FRR) of 3+ hours can be easily achieved along with an apparent Sound Transmission Class (ASTC) of 47+ depending on the wall assembly. The combination of the thermal mass, inherent air and vapor tightness and sound attenuation of an ICF wall creates for a very durable and comfortable space for the occupants to enjoy for many years.

*Figure 1 – Amvic ICF products*

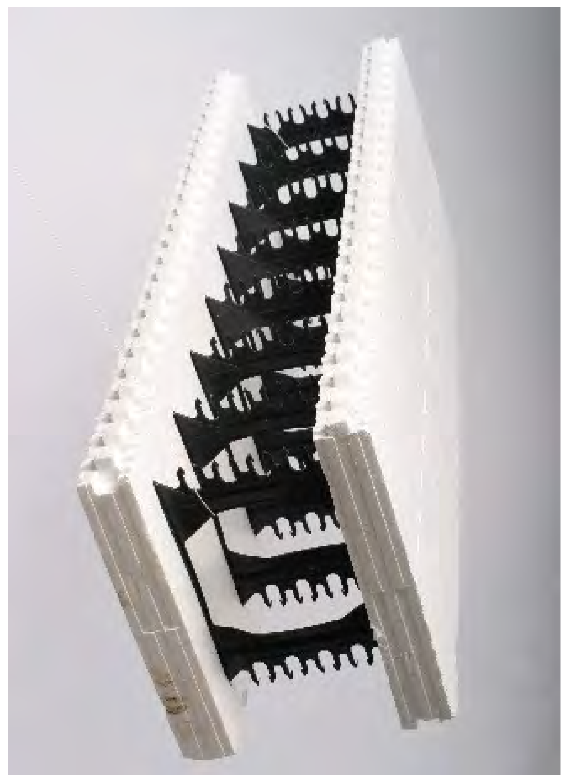


*Figure 2 – Typical Amvic reversible ICF straight block*

The webs used in Amvic ICF greatly reduce the need for rebar tie downs while placing rebar most effectively to ensure superior structural strength. The webs are manufactured using more raw material than competing products allowing for superior finishing capabilities and 198lbs (90kg) pull out strength for drywall screws. Webs are spaced 6" (152mm) on center for the Amvic R22 block or 8" (203mm) on center for the Amvic R30 resulting in greater rigidity, which keeps the wall straight and plumb during stacking and pouring of the concrete.

Amvic webs connect the EPS panels and terminate with a 1-1/2” (38mm) flange which is embedded 1/2” (13mm) beneath the outside surface of the panels. The flange has a height of 15” (381mm) in all blocks except the 10” (254mm) and 12” (305mm) block which has a flange height of 22” (559mm). When the blocks are stacked, the flanges form a continuous horizontal and vertical grid which is used to attach interior finishes like gypsum board (drywall) and exterior finishes like stucco, wood siding and brick veneer ties.

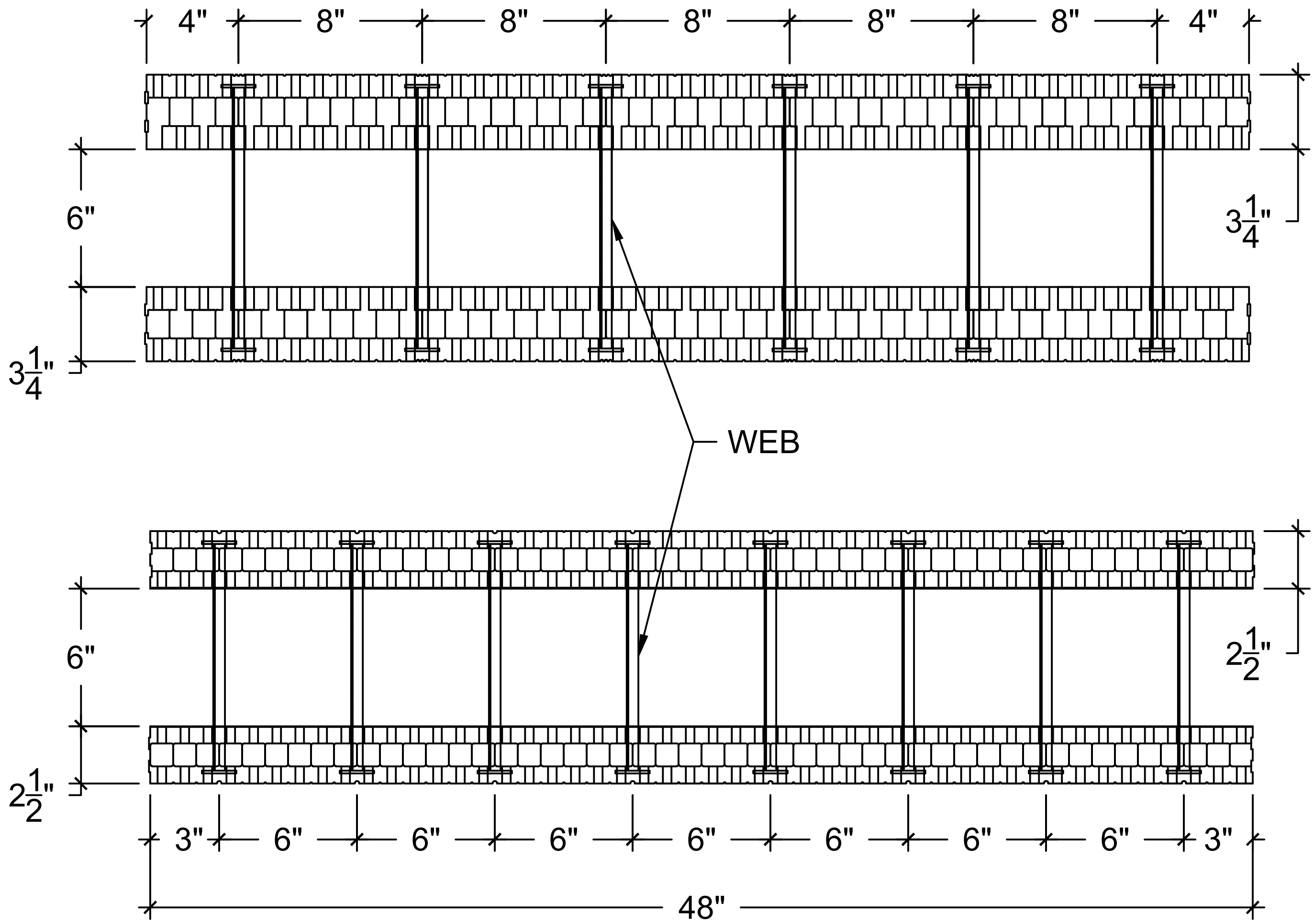



*Figure 3 – Typical Amvic straight ICF blocks (R30 6” block at the top and R22 6”, bottom)*

Amvic ICF blocks use the FormLock™ interlocking system developed by Amvic, which has considerably deeper grooves than competing products. The interlock exists on all long edges allowing the blocks to be fully reversible. They also secure the courses together, preventing any movement or leakage during the concrete pour. This unique feature allows Amvic ICF to be stacked quickly, easily and little 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.

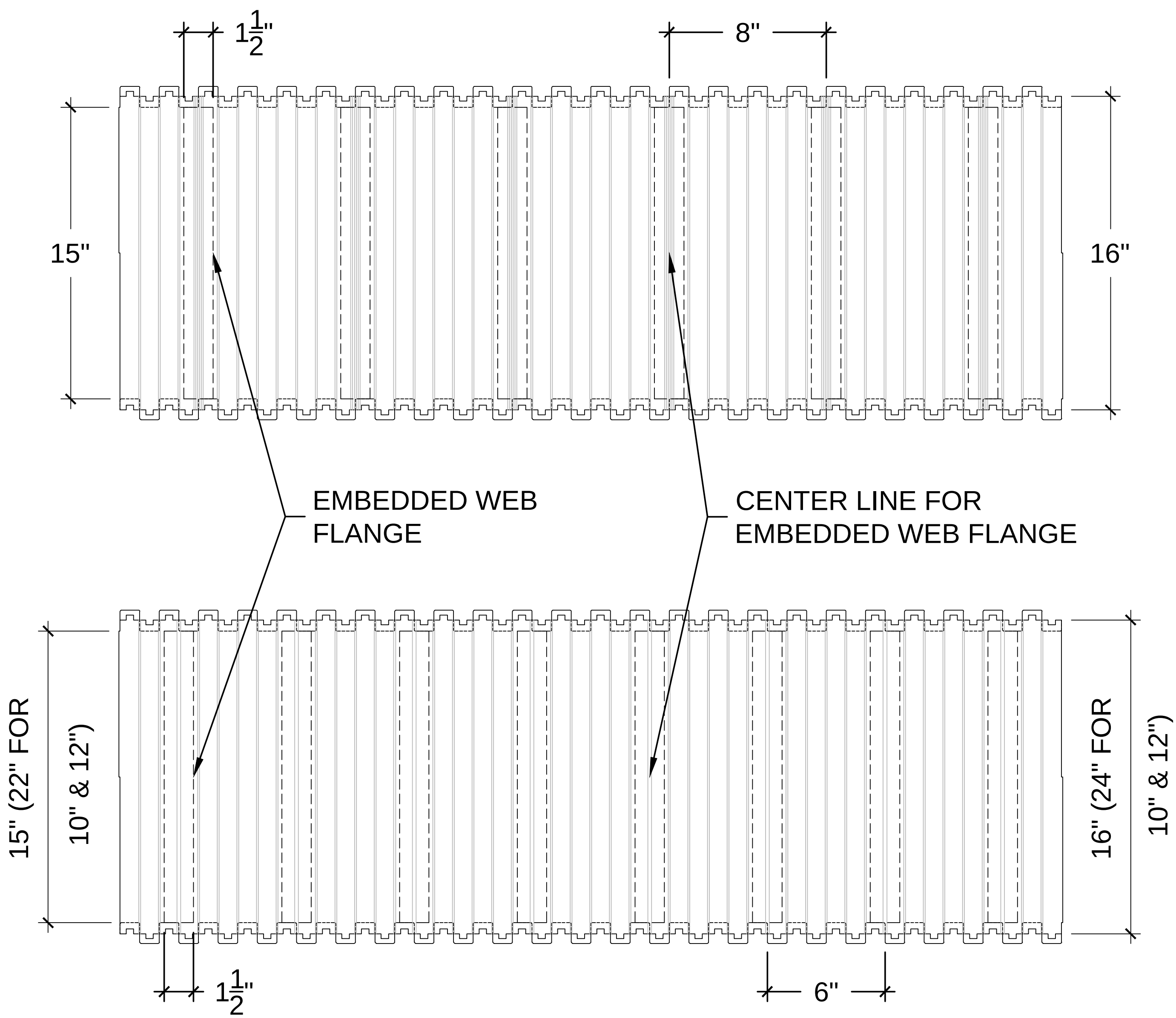



*Figure 4 – Side view of Amvic ICF straight block showing web flanges*

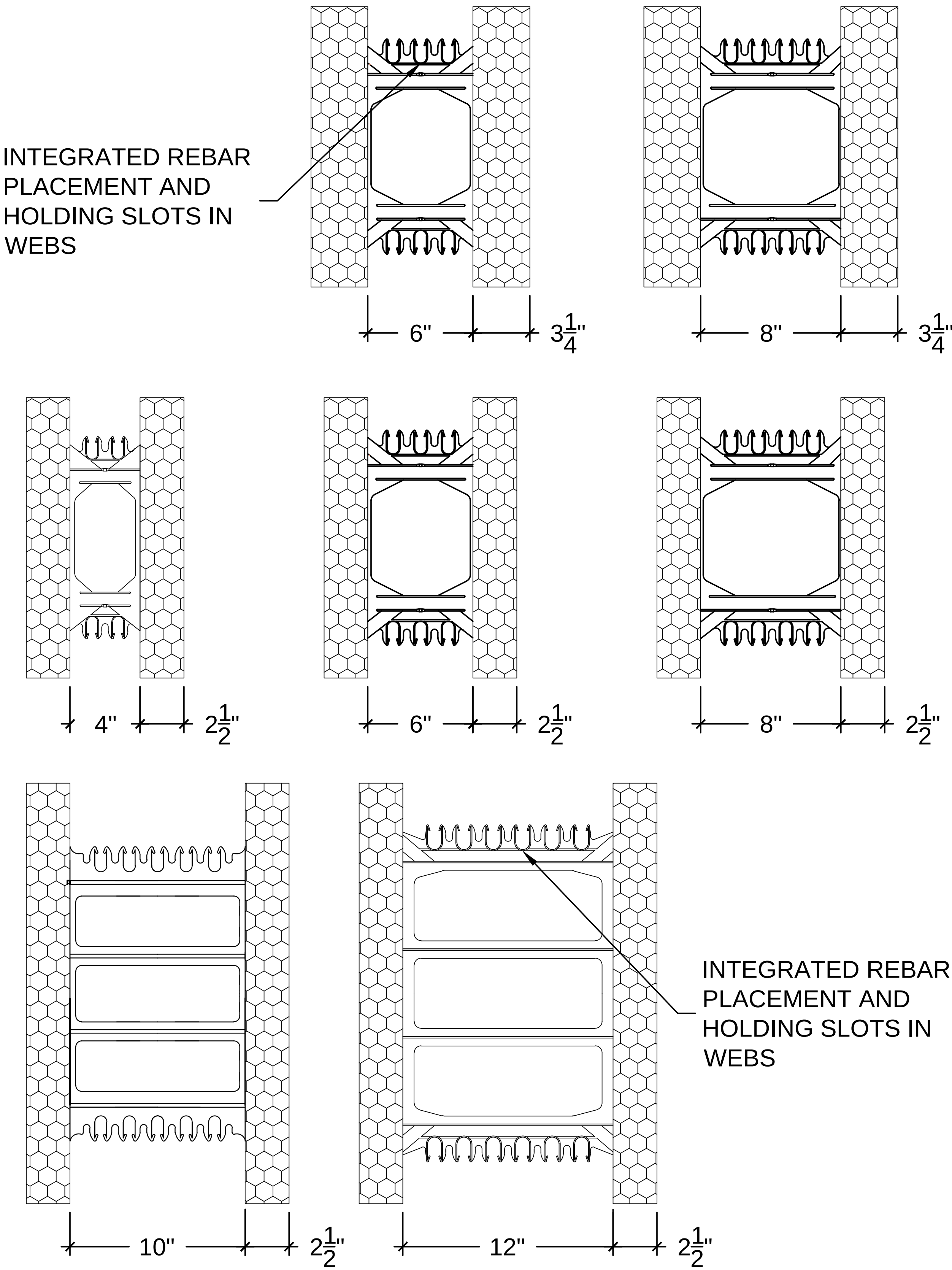



*Figure 5 – Cross section of Amvic ICF blocks*

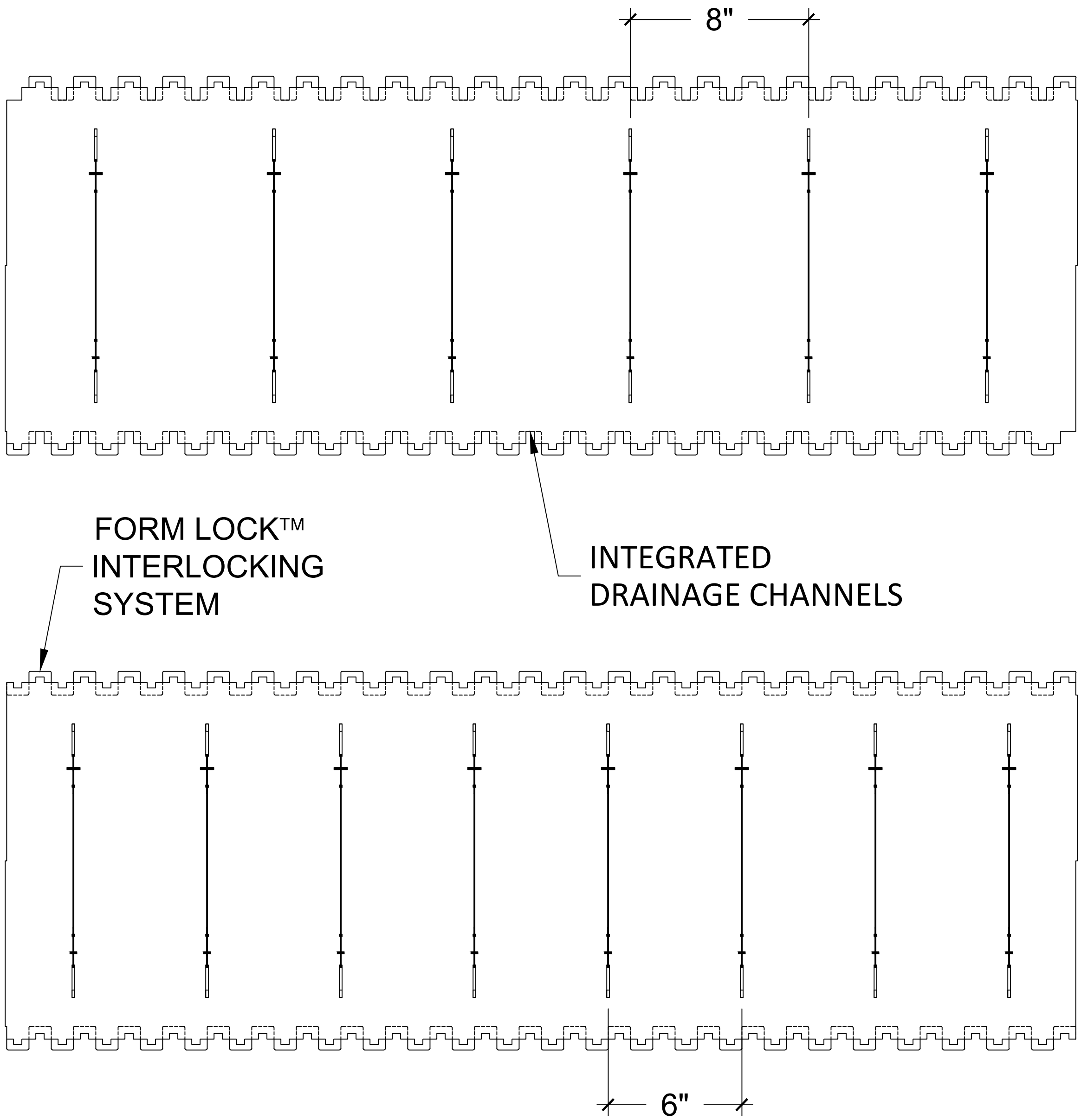



*Figure 6 – Interior view of ICF panel showing integrated drainage (R30 at the top, R22 bottom)*

Amvic ICF R22 is available in a variety of sizes allowing for concrete cores of 4” (102mm), 6” (152mm), 8” (203mm), 10” (254mm) and 12” (305mm). Straight, 90° corner, 45° corner, taper top, brick ledge, T-block and radius blocks are available in most core sizes. For Amvic ICF R30 straight, 90° corner, 45° corner, taper top and brick ledge blocks (only in 6” (152mm)) are available in 6” (152mm) and 8” (203mm) core sizes.

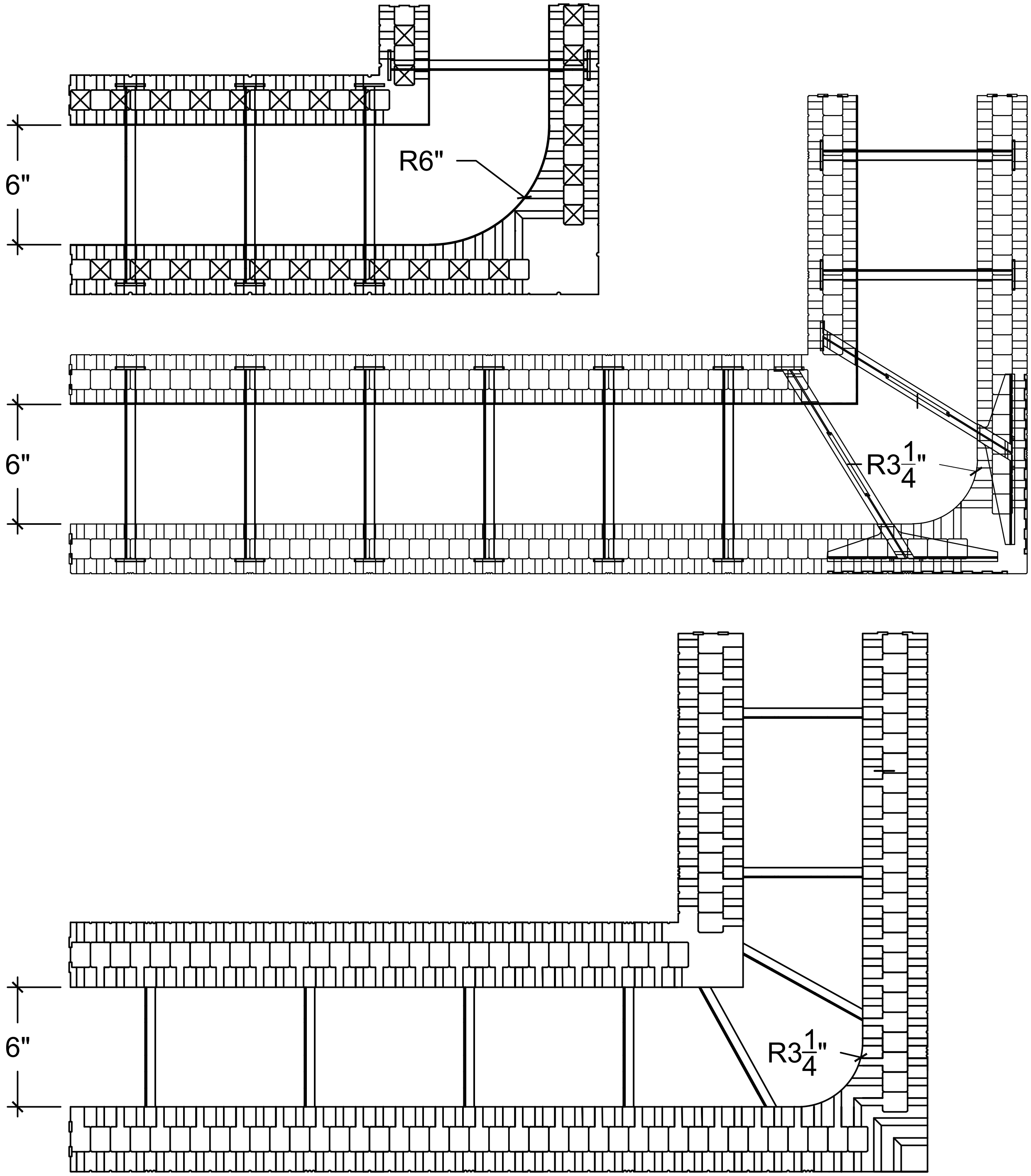



*Figure 7 – Typical Amvic ICF corners. Short R22 corner (above), long R22 corner (middle) and R30 corner (bottom)*

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.

## PRODUCTS AND AVAILABILITY

All Amvic ICF blocks and accessories are packaged in bundles to achieve maximum space utilization during shipping, refer to table below for details. Make sure to contact your local Amvic territory manager or distributor to discuss stock availability of blocks, tools and accessories.

| Amvic Code | Item Description | Bundle Size (L x W x H) in inches | Bundle Weight (Gross) In lbs | Blocks per Bundle | Number Bundles per 53ft Trailer |
|---|---|---|---|---|---|
| BLO0406 | R22 4” Straight | 55 x 48.5 x 49 | 125.5 | 18 | 814 |
| BLO0407 | R22 4” 90° Short Corner | 52.5 x 43 x 49 | 90.00 | 24 | 1280 |
| BLO0408 | R22 4” 45° Short Corner | 50 x 50 x 49 | 98.00 | 24 | 1179 |
| BLO0606 | R22 6” Straight | 55 x 48.5 x 49 | 110.0 | 15 | 678 |
| BLO0614L | R22 6” 90° Long Corner | 49 x 35 x 49 | 60.00 | 6 | 405 |
| BLO0608 | R22 6” 45° Short Corner | 51.5 x 28.5 x 49 | 55.50 | 12 | 770 |
| BLO0610 | R22 6” Brick Ledge | 49.5 x 48.5 x 49 | 76.75 | 9 | 455 |
| BLO0611 | R22 6” Double Taper Top | 55 x 48.5 x 49 | 107.5 | 15 | 678 |
| BLOT06S<br>BLOT06L | R22 6” Short T-Block<br>R22 6” Long T-Block | 45 x 31 x 49 | 46.00 | 6 | 389 |
| BLO0636 | R30 6” Straight | 50 x 48 x 49 | 87.00 | 12 | 590 |
| BLO0637 | R30 6” 90° Long Corner | 44 x 40 x 49 | 58.00 | 6 | 400 |
| BLO0638 | R30 6” 45° Long Corner | 53 x 35 x 49 | 55.50 | 6 | 374 |
| BLO0639 | R30 6” Brick Ledge | 55 x 48 x 49 | 90.00 | 9 | 426 |
| BLO0640 | R30 6” Double Taper Top | 50 x 48 x 49 | 84.00 | 12 | 590 |
| BLO0806 | R22 8” Straight | 53.25 x 48 x 49 | 89.00 | 12 | 570 |
| BLO0814L | R22 8” 90° Long Corner | 49 x 38 x 49.5 | 68.25 | 6 | 385 |
| BLO0808 | R22 8” 45° Short Corner | 60 x 31 x 49 | 57.50 | 12 | 796 |
| BLO0811 | R22 8” Brick Ledge | 54.5 x 48.5 x 49 | 78.75 | 9 | 407 |
| BLO0812 | R22 8” Double Taper Top | 53 x 48.5 x 49 | 84.00 | 12 | 570 |
| BLOT08S<br>BLOT08L | R22 8” Short T-Block<br>R22 8” Long T-Block | 49 x 33 x 49 | 78.75 | 6 | 442 |
| BLO0836 | R30 8” Straight | 60 x 49 x 49 | 88.00 | 12 | 519 |
| BLO0837 | R30 8” 90° Long Corner | 46 x 46 x 49 | 60.00 | 6 | 351 |
| BLO0838 | R30 8” 45° Long Corner | 53 x 35 x 49 | 55.50 | 6 | 354 |
| BLO0839 | R30 8” Double Taper Top | 60 x 49 x 49 | 80.00 | 12 | 519 |
| BLO0101 | R22 10” Straight | 45 x 48.5 x 48.5 | 56.00 | 6 | 319 |
| BLO0102 | R22 10” 90° Short Corner | 43.5 x 34 x 49 | 43.00 | 4 | 313 |
| BLO1201 | R22 12” Straight | 51 x 48.5 x 48.5 | 76.00 | 6 | 295 |
| BLO1202 | R22 12” 90° Short Corner | 39 x 38 x 49 | 44.00 | 4 | 301 |

## Tool Checklist For ICF 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
- □ Rebar tie tools (“Yankee” twist type preferred)
- □ Hammer
- □ Framing square
- □ 2’ (610mm) spirit level
- □ 6’ (183mm) spirit level
- □ Laser level, water level, or transit
- □ Plumb bob
- □ Mason’s line (Enough to circle entire structure)
- □ Chalk line
- □ Foam gun
- □ Rebar bender and cutter
- □ Scaffold planks
- □ Wall alignment & bracing system
- □ Steel stakes to anchor alignment braces (n/a if bracing off a slab)

## Tool Checklist For Concrete Pour

- □ Concrete pencil vibrator, 1” (25mm) maximum head size with 10-14’ (3-4.26m) shaft
- □ Rubber gloves
- □ Hard hats
- □ Concrete finishing tools
- □ Flat shovels for spill cleanup

*Note: Keep spare a concrete pencil vibrator head and shaft on hand.*

## Tool Checklist For Utilities Installation

- □ Hot knife (for electric box cutout)
- □ Electric chain saw (for cutting channels for electrical wiring and plumbing)
- □ Foam dispensing gun and foam

## Material Checklist

- □ Reinforcing steel as required and accessories, e.g. Amvic’s HV hooks, rebar ties, stirrups.
- □ Screws for alignment bracing attachment to ICF blocks (1-5/8” (41mm), 2-1/2” (64mm), #10 coarse thread)
- □ Concrete screws 1-1/2” (38mm) to 1-3/4” (44mm) to attach foot of alignment braces to concrete slab
- □ Material for rough openings (i.e. standard 2-by lumber or plywood for fabricating wood bucks, and nails or spikes to anchor the buck)
- □ Anchor bolts, nuts, and washers or Simpson Strong-tie® ICFVL ledger connector system
- □ PVC sleeves for mechanical and/or electrical fixtures
- □ OSB or plywood to use to bridge cut joints, or removed webs, block out for anchor bolts, etc.
- □ Low-expansion, polyurethane construction spray foam adhesive
- □ Waterproofing and drainage membrane

## Step 1

Plan the outline of the blocks and the location of door and window openings on a conventional footing or a slab that is level, straight and square. Rebar should extend upward at least 24” (610mm) from the footing into the cavity of the block or as per structural requirement.

*Figure 1 – Outline walls*

## Step 2

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

*Figure 2 – Place corner blocks first*

*Figure 3 – Install horizontal reinforcing steel and lap splicing*

### Step 3

Install the second course of blocks 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 – Install second course of blocks*

### Step 4

Install window and door frames (bucks) at each location where an opening is required; cut and fit the ICF 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 5 – Install 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 6 – Continue installing block courses*

## Step 6

Install alignment bracing along the entire interior (recommended) of the wall perimeter. This ensures that the walls are straight and plumb and allow 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 7 – Install alignment and bracing system around the interior of the perimeter wall*

## Step 7

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


*Figure 8 – Install vertical reinforcing bars after top course of blocks*

## Step 8

Pour the concrete into the stacked walls using a boom pump.  Do this in layers approximately 3-4' (0.9-1.2m) at a time, circling the structure until the top of the wall is reached. 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 9 – Pour concrete in lifts of 3-4' (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 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.

*Figure 11 - Once the concrete had time to cure, remove bracing if not needed for following stages of construction*

An Amvic ICF wall can be started from either a footing or a slab depending on the design and structural requirements. There are benefits and drawbacks to both methods ultimately depending on the specific site conditions.

## First course of block set on slab

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

## First course of block set on a footing

The primary advantage to this method is that the block itself provides slab edge insulation. The edge of a slab, where the floor is located, acts as thermal bridge. By insulating this area, heat movement is minimized providing energy cost savings. This method is also preferable when a radiant hydronic floor system will be used, or if the final floor finish will be stained and sealed concrete.

## Footing and walls for a raised floor

If the first floor will be a raised floor, then the wall must be started from a footing. In some cases, it might be beneficial to pour 2-3 courses of block initially, and then install their floor system. Once the floor system is complete, the rest of the ICF wall is erected normally.

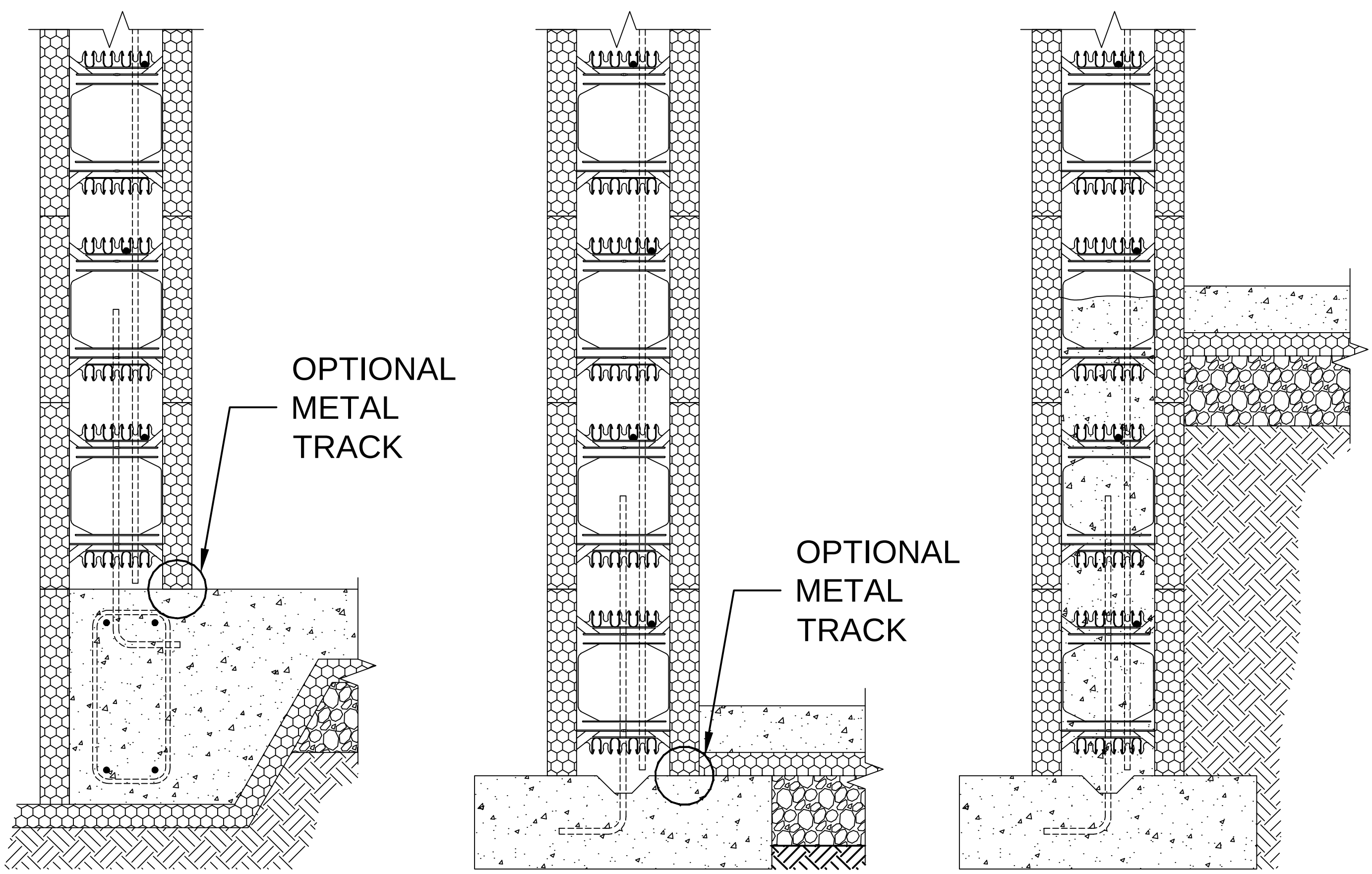



*Figure 1 – Typical ICF footing types*

## Level Foundation

After pouring the footings and/or slab on grade, the top finished surface should be level to within 1/4" (6.35mm). This is commonly a 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 the top surface is not within 1/4" (6.35mm) all the way around, the ICF blocks will need to be adjusted at a later time during installation. It is good practice to mark the variance of each corner of the footing or slab.

*Note: If the installation of the first story of Amvic ICF will take a few days to complete, it is recommended to protect the chalk line to avoid it being washed away by rain or wind gusts.*

*Note: It is possible to snap the chalk line at 1/2" (13mm) away from the face of the actual wall. This becomes beneficial when the wall placement needs to be adjusted by allowing the installer to see where the marked outline is located.*

*Figure 2 – Ensure the top surface of the footing or slab is level*

## Outlining the Project

Several outlining steps are necessary and should be marked on the foundation before beginning the actual installation process. This outlining process is essential in increasing jobsite efficiency and making the installation process flow smoothly with minimal complications.

## Outlining wall layout using chalk line

Check the building/project drawings carefully to determine the correct foundation wall layout and dimensions. Use a chalk line or string to mark the wall layout on the footings or slab. The outline can be marked on either face of the foundation wall. Most installers tend to mark the outside face simply because the building/project drawings will readily indicate this information.

Ensure all 90° corners are properly squared. This can usually be done by using conventional construction practices by measuring diagonals or 3-4-5 right angle triangle. A well-trained surveyor may be retained to carry out the task of establishing the correct angles on the jobsite including variable angles and special radius walls.

*Figure 3 – Snap a chalk line to mark the wall layout*

## Outlining wall layout using metal angle/metal track

An alternative to using chalk line is to use a light gauge metal angle or a metal track section to mark the wall layout. The angle should be fastened to the footings/slab with concrete screws or can be secured in place using foam adhesive. When installing the first course of Amvic ICF, the angle/metal track will serve as a guide for placement of the blocks, see images below. The major drawback of this method is the ability to make modifications at a later time, after a few courses have been erected. Since the metal angle/track are either adhered or mechanically fastened in place, it is difficult to move them even to make minor changes.

*Figure 4 – Securing a metal track to a concrete slab*

*Figure 5 – Metal track section acting as a guide for block placement*

## Outlining rough size windows and doors

From the drawings, measure and mark where the center of each door and window will be located on the footing/slab as well as the overall width (including buck thickness if applicable). The heights of the rough opening are also calculated from the drawings for each opening (include buck thickness if applicable). It is important to know which type of bucking and window detailing configuration the designer has specified since it will affect the size of the rough opening.

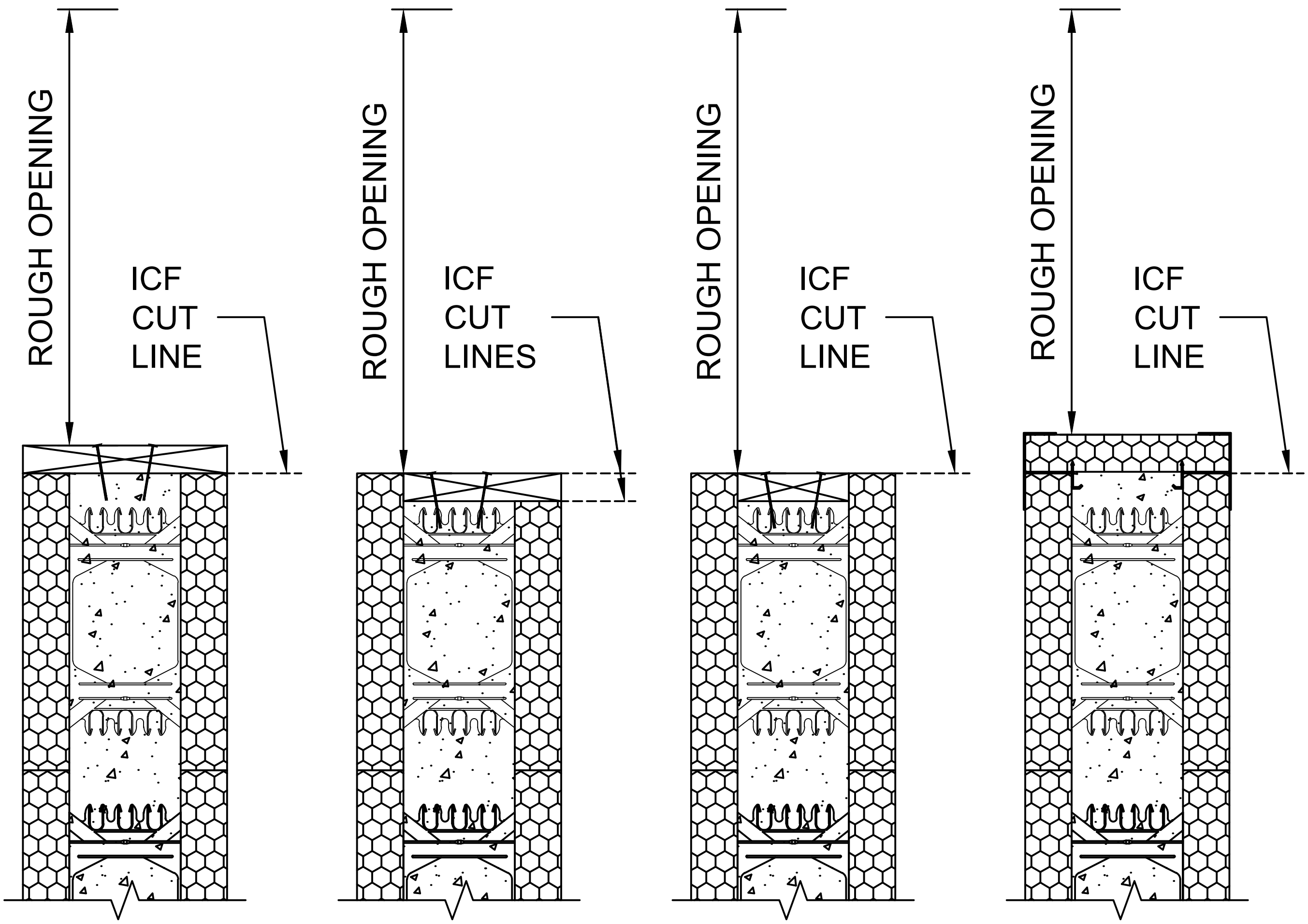



*Figure 6 – Rough opening size depends on the type of bucking system used*

## Dowel Placement

When pouring footings or concrete slab, place reinforcing dowels as per engineer and/or local building code requirements. For most walls, the dimension of the wall does not perfectly divide into an even number of blocks. In order to keep the webs vertically aligned it is best to use a standing seam, see Part 9.12. Dowel placement should be started at the corners and worked towards the center/cut joint. If the dowel comes up directly at a web location, the bar can be bent in a slight S-curve to allow it to clear the web. See Part 5.1 for specific dowel placement and spacing for all Amvic ICF block sizes

Table 1 - Vertical coursing chart for Amvic R22 & R30 4" (102mm), 6" (152mm) & 8" (203mm) blocks

| No. of Courses | Total Height | | | Plus 2" (51mm) Height Adjuscter | | | Plus 3" (51mm) Height Adjuscter | | | Plus 4" (51mm) Height Adjuscter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (in) | (ft) | (mm) | (in) | (ft) | (mm) | (in) | (ft) | (mm) | (in) | (ft) | (mm) |
| 1 | 16 | 1' 4" | 406 | 18 | 1' 6" | 457 | 19 | 1' 7" | 483 | 20 | 1' 8" | 508 |
| 2 | 32 | 2' 8" | 813 | 34 | 2' 10" | 864 | 35 | 2' 11" | 889 | 36 | 3' 0" | 914 |
| 3 | 48 | 4' 0" | 1219 | 50 | 4' 2" | 1270 | 51 | 4' 3" | 1295 | 52 | 4' 4" | 1321 |
| 4 | 64 | 5' 4" | 1626 | 66 | 5' 6" | 1676 | 67 | 5' 7" | 1702 | 68 | 5' 8" | 1727 |
| 5 | 80 | 6' 8" | 2032 | 82 | 6' 10" | 2083 | 83 | 6' 11" | 2108 | 84 | 7' 0" | 2134 |
| 6 | 96 | 8' 0" | 2438 | 98 | 8' 2" | 2489 | 99 | 8' 3" | 2515 | 100 | 8' 4" | 2540 |
| 7 | 112 | 9' 4" | 2845 | 114 | 9' 6" | 2896 | 115 | 9' 7" | 2921 | 116 | 9' 8" | 2946 |
| 8 | 128 | 10' 8" | 3251 | 130 | 10' 10" | 3302 | 131 | 10' 11" | 3327 | 132 | 11' 0" | 3353 |
| 9 | 144 | 12' 0" | 3658 | 146 | 12' 2" | 3708 | 147 | 12' 3" | 3734 | 148 | 12' 4" | 3759 |
| 10 | 160 | 13' 4" | 4064 | 162 | 13' 6" | 4115 | 163 | 13' 7" | 4140 | 164 | 13' 8" | 4166 |
| 11 | 176 | 14' 8" | 4470 | 178 | 14' 10" | 4521 | 179 | 14' 11" | 4547 | 180 | 15' 0" | 4572 |
| 12 | 192 | 16' 0" | 4877 | 194 | 16' 2" | 4928 | 195 | 16' 3" | 4953 | 196 | 16' 4" | 4978 |
| 13 | 208 | 17' 4" | 5283 | 210 | 17' 6" | 5334 | 211 | 17' 7" | 5359 | 212 | 17' 8" | 5385 |
| 14 | 224 | 18' 8" | 5690 | 226 | 18' 10" | 5740 | 227 | 18' 11" | 5766 | 228 | 19' 0" | 5791 |
| 15 | 240 | 20' 0" | 6096 | 242 | 20' 2" | 6147 | 243 | 20' 3" | 6172 | 244 | 20' 4" | 6198 |
| 16 | 256 | 21' 4" | 6502 | 258 | 21' 6" | 6553 | 259 | 21' 7" | 6579 | 260 | 21' 8" | 6604 |
| 17 | 272 | 22' 8" | 6909 | 274 | 22' 10" | 6960 | 275 | 22' 11" | 6985 | 276 | 23' 0" | 7010 |
| 18 | 288 | 24' 0" | 7315 | 290 | 24' 2" | 7366 | 291 | 24' 3" | 7391 | 292 | 24' 4" | 7417 |
| 19 | 304 | 25' 4" | 7722 | 306 | 25' 6" | 7772 | 307 | 25' 7" | 7798 | 308 | 25' 8" | 7823 |
| 20 | 320 | 26' 8" | 8128 | 322 | 26' 10" | 8179 | 323 | 26' 11" | 8204 | 324 | 27' 0" | 8230 |

Table 2 - Vertical coursing chart for Amvic R22 10" (254mm) and 12" (305mm) blocks

| No. of Courses | Total Height | | | Plus 2" (51mm) Height Adjuscter | | | Plus 3" (51mm) Height Adjuscter | | | Plus 4" (51mm) Height Adjuscter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (in) | (ft) | (mm) | (in) | (ft) | (mm) | (in) | (ft) | (mm) | (in) | (ft) | (mm) |
| 1 | 24 | 2' 0" | 610 | 26 | 2' 2" | 660 | 27 | 2' 3" | 686 | 28 | 2' 4" | 711 |
| 2 | 48 | 4' 0" | 1219 | 50 | 4' 2" | 1270 | 51 | 4' 3" | 1295 | 52 | 4' 4" | 1321 |
| 3 | 72 | 6' 0" | 1829 | 74 | 6' 2" | 1880 | 75 | 6' 3" | 1905 | 76 | 6' 4" | 1930 |
| 4 | 96 | 8' 0" | 2438 | 98 | 8' 2" | 2489 | 99 | 8' 3" | 2515 | 100 | 8' 4" | 2540 |
| 5 | 120 | 10' 0" | 3048 | 122 | 10' 2" | 3099 | 123 | 10' 3" | 3124 | 124 | 10' 4" | 3150 |
| 6 | 144 | 12' 0" | 3658 | 146 | 12' 2" | 3708 | 147 | 12' 3" | 3734 | 148 | 12' 4" | 3759 |
| 7 | 168 | 14' 0" | 4267 | 170 | 14' 2" | 4318 | 171 | 14' 3" | 4343 | 172 | 14' 4" | 4369 |
| 8 | 192 | 16' 0" | 4877 | 194 | 16' 2" | 4928 | 195 | 16' 3" | 4953 | 196 | 16' 4" | 4978 |
| 9 | 216 | 18' 0" | 5486 | 218 | 18' 2" | 5537 | 219 | 18' 3" | 5563 | 220 | 18' 4" | 5588 |
| 10 | 240 | 20' 0" | 6096 | 242 | 20' 2" | 6147 | 243 | 20' 3" | 6172 | 244 | 20' 4" | 6198 |
| 11 | 264 | 22' 0" | 6706 | 266 | 22' 2" | 6756 | 267 | 22' 3" | 6782 | 268 | 22' 4" | 6807 |
| 12 | 288 | 24' 0" | 7315 | 290 | 24' 2" | 7366 | 291 | 24' 3" | 7391 | 292 | 24' 4" | 7417 |
| 13 | 312 | 26' 0" | 7925 | 314 | 26' 2" | 7976 | 315 | 26' 3" | 8001 | 316 | 26' 4" | 8026 |
| 14 | 336 | 28' 0" | 8534 | 338 | 28' 2" | 8585 | 339 | 28' 3" | 8611 | 340 | 28' 4" | 8636 |
| 15 | 360 | 30' 0" | 9144 | 362 | 30' 2" | 9195 | 363 | 30' 3" | 9220 | 364 | 30' 4" | 9246 |
| 16 | 384 | 32' 0" | 9754 | 386 | 32' 2" | 9804 | 387 | 32' 3" | 9830 | 388 | 32' 4" | 9855 |
| 17 | 408 | 34' 0" | 10363 | 410 | 34' 2" | 10414 | 411 | 34' 3" | 10439 | 412 | 34' 4" | 10465 |
| 18 | 432 | 36' 0" | 10973 | 434 | 36' 2" | 11024 | 435 | 36' 3" | 11049 | 436 | 36' 4" | 11074 |
| 19 | 456 | 38' 0" | 11582 | 458 | 38' 2" | 11633 | 459 | 38' 3" | 11659 | 460 | 38' 4" | 11684 |
| 20 | 480 | 40' 0" | 12192 | 482 | 40' 2" | 12243 | 483 | 40' 3" | 12268 | 484 | 40' 4" | 12294 |

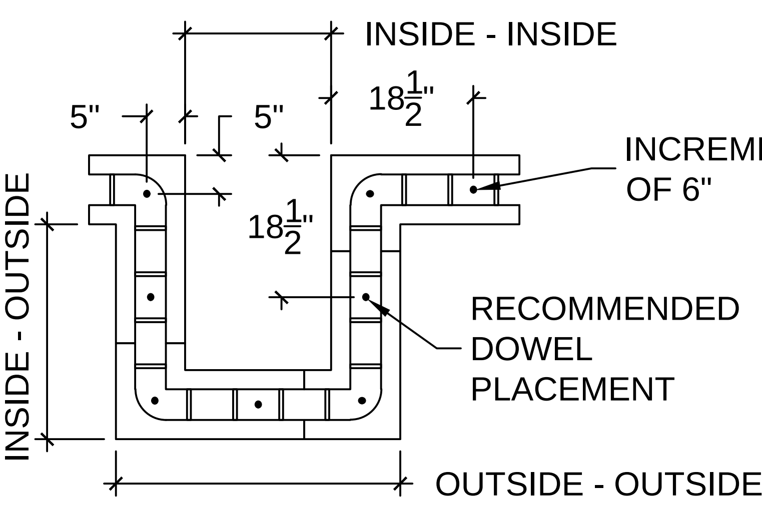
Table 3 - Horizontal coursing chart for Amvic R22 4" (102mm) short 90° corner blocks

| Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] | Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] |
|---|---|---|---|---|---|
| 1' 4" (406)[1] | 2' 1" (635)[1] | 0' 7" (178)[1] | 13' 4" (4064)[1] | 14' 1" (4293)[1] | 12' 7" (3835)[1] |
| 1' 10" (559)[2] | 2' 7" (787)[2] | 1' 1" (330)[2] | 13' 10" (4216)[2] | 14' 7" (4445)[2] | 13' 1" (3988)[2] |
| **2' 4" (711)** | **3' 1" (940)** | **1' 7" (483)** | **14' 4" (4369)** | **15' 1" (4597)** | **13' 7" (4140)** |
| 2' 10" (864) | 3' 7" (1092) | 2' 1" (635) | 14' 10" (4521) | 15' 7" (4750) | 14' 1" (4293) |
| 3' 4" (1016) | 4' 1" (1245) | 2' 7" (787) | 15' 4" (4674) | 16' 1" (4902) | 14' 7" (4445) |
| 3' 10" (1168) | 4' 7" (1397) | 3' 1" (940) | 15' 10" (4826) | 16' 7" (5055) | 15' 1" (4597) |
| 4' 4" (1321) | 5' 1" (1549) | 3' 7" (1092) | 16' 4" (4978) | 17' 1" (5207) | 15' 7" (4750) |
| 4' 10" (1473) | 5' 7" (1702) | 4' 1" (1245) | 16' 10" (5131) | 17' 7" (5359) | 16' 1" (4902) |
| 5' 4" (1626) | 6' 1" (1854) | 4' 7" (1397) | 17' 4" (5283) | 18' 1" (5512) | 16' 7" (5055) |
| 5' 10" (1778) | 6' 7" (2007) | 5' 1" (1549) | 17' 10" (5436) | 18' 7" (5664) | 17' 1" (5207) |
| **6' 4" (1930)** | **7' 1" (2159)** | **5' 7" (1702)** | **18' 4" (5588)** | **19' 1" (5817)** | **17' 7" (5359)** |
| 6' 10" (2083) | 7' 7" (2311) | 6' 1" (1854) | 18' 10" (5740) | 19' 7" (5969) | 18' 1" (5512) |
| 7' 4" (2235) | 8' 1" (2464) | 6' 7" (2007) | 19' 4" (5893) | 20' 1" (6121) | 18' 7" (5664) |
| 7' 10" (2388) | 8' 7" (2616) | 7' 1" (2159) | 19' 10" (6045) | 20' 7" (6274) | 19' 1" (5817) |
| 8' 4" (2540) | 9' 1" (2769) | 7' 7" (2311) | 20' 4" (6198) | 21' 1" (6426) | 19' 7" (5969) |
| 8' 10" (2692) | 9' 7" (2921) | 8' 1" (2464) | 20' 10" (6350) | 21' 7" (6579) | 20' 1" (6121) |
| 9' 4" (2845) | 10' 1" (3073) | 8' 7" (2616) | 21' 4" (6502) | 22' 1" (6731) | 20' 7" (6274) |
| 9' 10" (2997) | 10' 7" (3226) | 9' 1" (2769) | 21' 10" (6655) | 22' 7" (6883) | 21' 1" (6426) |
| **10' 4" (3150)** | **11' 1" (3378)** | **9' 7" (2921)** | **22' 4" (6807)** | **23' 1" (7036)** | **21' 7" (6579)** |
| 10' 10" (3302) | 11' 7" (3531) | 10' 1" (3073) | 22' 10" (6960) | 23' 7" (7188) | 22' 1" (6731) |
| 11' 4" (3454) | 12' 1" (3683) | 10' 7" (3226) | 23' 4" (7112) | 24' 1" (7341) | 22' 7" (6883) |
| 11' 10" (3607) | 12' 7" (3835) | 11' 1" (3378) | 23' 10" (7264) | 24' 7" (7493) | 23' 1" (7036) |
| 12' 4" (3759) | 13' 1" (3988) | 11' 7" (3531) | 24' 4" (7417) | 25' 1" (7645) | 23' 7" (7188) |
| 12' 10" (3912) | 13' 7" (4140) | 12' 1" (3683) | 24' 10" (7569) | 25' 7" (7798) | 24' 1" (7341) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*



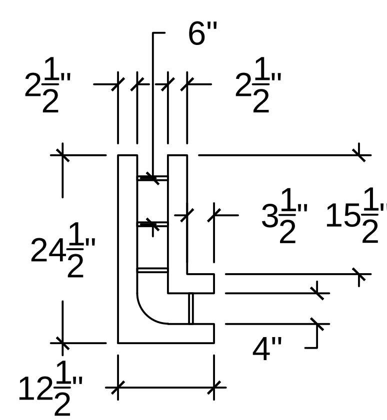



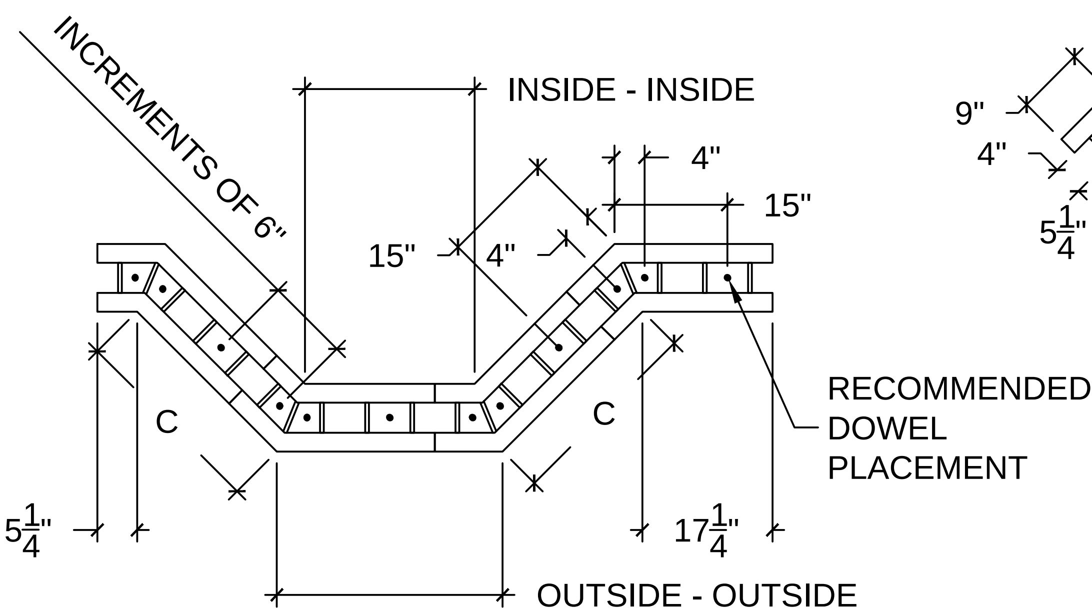
Table 4 - Horizontal coursing chart for Amvic R22 4" (102mm) 45° corner blocks

| Diagonal Dimension C [ft - in (mm)] | Outside - Outside Dimension A [ft - in (mm)] | Inside - Inside Dimension B [ft - in (mm)] |
|---|---|---|
| 1' 2-1/4" (362) [(1)] | 1' 6" (457) [(1)] | 0' 10-9/16" (268) [(1)] |
| 1' 8-1/4" (514) [(2)] | 2' 0" (610) [(2)] | 1' 4-9/16" (421) [(2)] |
| **2' 2-1/4" (667)** | **2' 6" (762)** | **1' 10-9/16" (573)** |
| 2' 8-1/4" (819) | 3' 0" (914) | 2' 4-9/16" (725) |
| 3' 2-1/4" (972) | 3' 6" (1067) | 2' 10-9/16" (878) |
| 3' 8-1/4" (1124) | 4' 0" (1219) | 3' 4-9/16" (1030) |
| 4' 2-1/4" (1276) | 4' 6" (1372) | 3' 10-9/16" (1183) |
| 4' 8-1/4" (1429) | 5' 0" (1524) | 4' 4-9/16" (1335) |
| 5' 2-1/4" (1581) | 5' 6" (1676) | 4' 10-9/16" (1487) |
| 5' 8-1/4" (1734) | 6' 0" (1829) | 5' 4-9/16" (1640) |
| **6' 2-1/4" (1886)** | **6' 6" (1981)** | **5' 10-9/16" (1792)** |
| 6' 8-1/4" (2038) | 7' 0" (2134) | 6' 4-9/16" (1945) |
| 7' 2-1/4" (2191) | 7' 6" (2286) | 6' 10-9/16" (2097) |
| 7' 8-1/4" (2343) | 8' 0" (2438) | 7' 4-9/16" (2249) |
| 8' 2-1/4" (2496) | 8' 6" (2591) | 7' 10-9/16" (2402) |
| 8' 8-1/4" (2648) | 9' 0" (2743) | 8' 4-9/16" (2554) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*



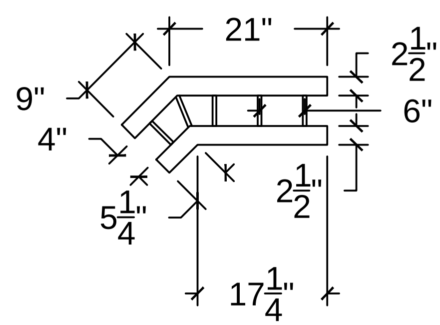



Table 6 - Horizontal coursing chart for Amvic R22 6" (152mm) long 90° corner blocks

| Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] | Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] |
|---|---|---|---|---|---|
| 2' 1" (635)(1) | 3' 0" (914)(1) | 1' 2" (356)(1) | 14' 1" (4293)(1) | 15' 0" (4572)(1) | 13' 2" (4013)(1) |
| 2' 7" (787)(2) | 3' 6" (1067)(2) | 1' 8" (508)(2) | 14' 7" (4445)(2) | 15' 6" (4724)(2) | 13' 8" (4166)(2) |
| 3' 1" (940) | 4' 0" (1219) | 2' 2" (660) | 15' 1" (4597) | 16' 0" (4877) | 14' 2" (4318) |
| 3' 7" (1092) | 4' 6" (1372) | 2' 8" (813) | 15' 7" (4750) | 16' 6" (5029) | 14' 8" (4470) |
| 4' 1" (1245) | 5' 0" (1524) | 3' 2" (965) | 16' 1" (4902) | 17' 0" (5182) | 15' 2" (4623) |
| 4' 7" (1397) | 5' 6" (1676) | 3' 8" (1118) | 16' 7" (5055) | 17' 6" (5334) | 15' 8" (4775) |
| **5' 1" (1549)** | **6' 0" (1829)** | **4' 2" (1270)** | **17' 1" (5207)** | **18' 0" (5486)** | **16' 2" (4928)** |
| 5' 7" (1702) | 6' 6" (1981) | 4' 8" (1422) | 17' 7" (5359) | 18' 6" (5639) | 16' 8" (5080) |
| 6' 1" (1854) | 7' 0" (2134) | 5' 2" (1575) | 18' 1" (5512) | 19' 0" (5791) | 17' 2" (5232) |
| 6' 7" (2007) | 7' 6" (2286) | 5' 8" (1727) | 18' 7" (5664) | 19' 6" (5944) | 17' 8" (5385) |
| 7' 1" (2159) | 8' 0" (2438) | 6' 2" (1880) | 19' 1" (5817) | 20' 0" (6096) | 18' 2" (5537) |
| 7' 7" (2311) | 8' 6" (2591) | 6' 8" (2032) | 19' 7" (5969) | 20' 6" (6248) | 18' 8" (5690) |
| 8' 1" (2464) | 9' 0" (2743) | 7' 2" (2184) | 20' 1" (6121) | 21' 0" (6401) | 19' 2" (5842) |
| 8' 7" (2616) | 9' 6" (2896) | 7' 8" (2337) | 20' 7" (6274) | 21' 6" (6553) | 19' 8" (5994) |
| **9' 1" (2769)** | **10' 0" (3048)** | **8' 2" (2489)** | **21' 1" (6426)** | **22' 0" (6706)** | **20' 2" (6147)** |
| 9' 7" (2921) | 10' 6" (3200) | 8' 8" (2642) | 21' 7" (6579) | 22' 6" (6858) | 20' 8" (6299) |
| 10' 1" (3073) | 11' 0" (3353) | 9' 2" (2794) | 22' 1" (6731) | 23' 0" (7010) | 21' 2" (6452) |
| 10' 7" (3226) | 11' 6" (3505) | 9' 8" (2946) | 22' 7" (6883) | 23' 6" (7163) | 21' 8" (6604) |
| 11' 1" (3378) | 12' 0" (3658) | 10' 2" (3099) | 23' 1" (7036) | 24' 0" (7315) | 22' 2" (6756) |
| 11' 7" (3531) | 12' 6" (3810) | 10' 8" (3251) | 23' 7" (7188) | 24' 6" (7468) | 22' 8" (6909) |
| 12' 1" (3683) | 13' 0" (3962) | 11' 2" (3404) | 24' 1" (7341) | 25' 0" (7620) | 23' 2" (7061) |
| 12' 7" (3835) | 13' 6" (4115) | 11' 8" (3556) | 24' 7" (7493) | 25' 6" (7772) | 23' 8" (7214) |
| **13' 1" (3988)** | **14' 0" (4267)** | **12' 2" (3708)** | **25' 1" (7645)** | **26' 0" (7925)** | **24' 2" (7366)** |
| 13' 7" (4140) | 14' 6" (4420) | 12' 8" (3861) | 25' 7" (7798) | 26' 6" (8077) | 24' 8" (7518) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*

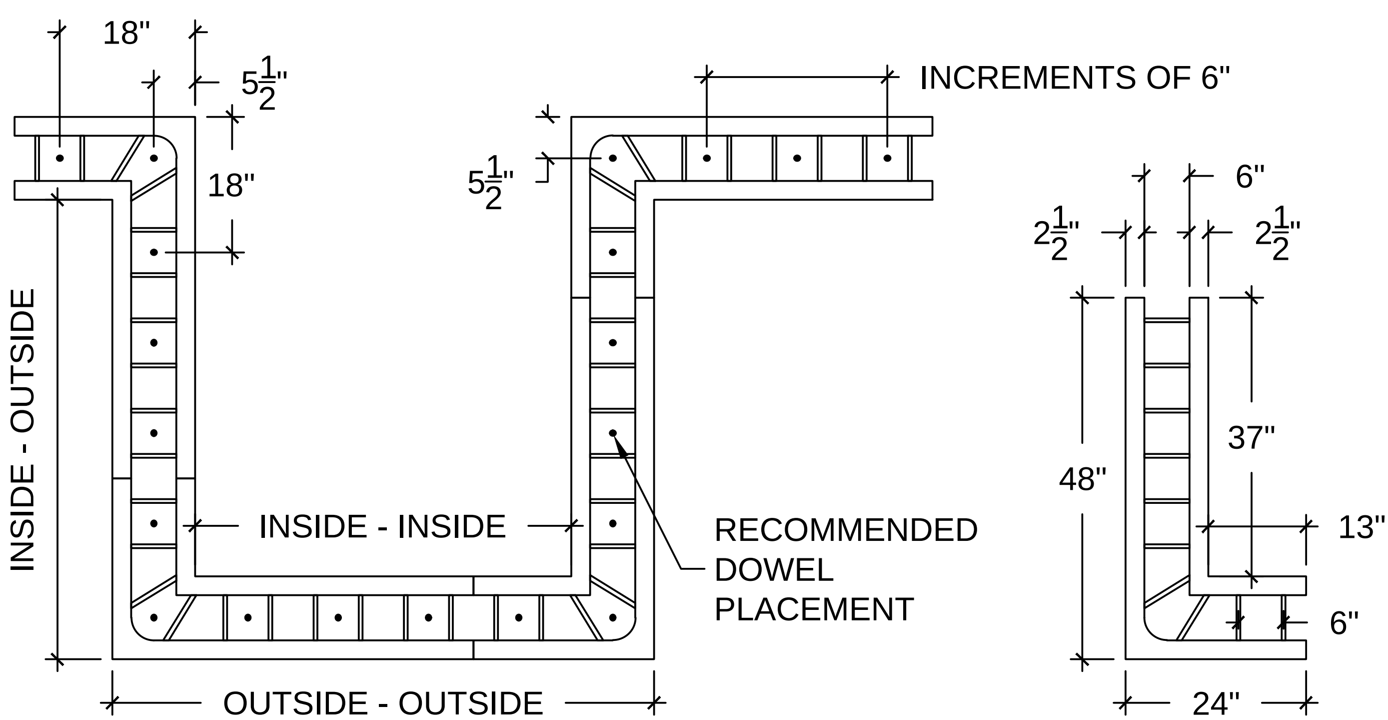


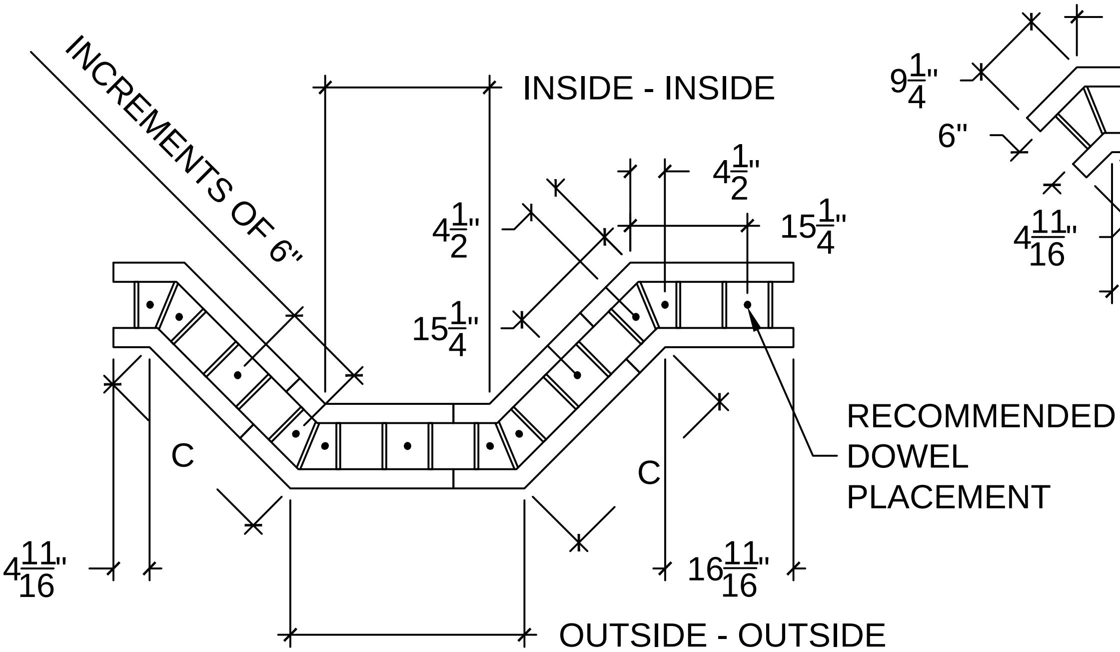
Table 7 - Horizontal coursing chart for Amvic R22 6" (152mm) 45° corner blocks

| Diagonal Dimension C [ft - in (mm)] | Outside - Outside Dimension A [ft - in (mm)] | Inside - Inside Dimension B [ft - in (mm)] |
|---|---|---|
| 1' 1-15/16" (354) (1) | 1' 6-1/2" (470) (1) | 0' 9-3/8" (238) (1) |
| 1' 7-15/16" (506) (2) | 2' 1/2" (622) (2) | 1' 3-3/8" (391) (2) |
| **2' 1-15/16" (659)** | **2' 6-1/2" (775)** | **1' 9-3/8" (543)** |
| 2' 7-15/16" (811) | 3' 1/2" (927) | 2' 3-3/8" (695) |
| 3' 1-15/16" (964) | 3' 6-1/2" (1080) | 2' 9-3/8" (848) |
| 3' 7-15/16" (1116) | 4' 1/2" (1232) | 3' 3-3/8" (1000) |
| 4' 1-15/16" (1268) | 4' 6-1/2" (1384) | 3' 9-3/8" (1153) |
| 4' 7-15/16" (1421) | 5' 1/2" (1537) | 4' 3-3/8" (1305) |
| 5' 1-15/16" (1573) | 5' 6-1/2" (1689) | 4' 9-3/8" (1457) |
| 5' 7-15/16" (1726) | 6' 1/2" (1842) | 5' 3-3/8" (1610) |
| **6' 1-15/16" (1878)** | **6' 6-1/2" (1994)** | **5' 9-3/8" (1762)** |
| 6' 7-15/16" (2030) | 7' 1/2" (2146) | 6' 3-3/8" (1915) |
| 7' 1-15/16" (2183) | 7' 6-1/2" (2299) | 6' 9-3/8" (2067) |
| 7' 7-15/16" (2335) | 8' 1/2" (2451) | 7' 3-3/8" (2219) |
| 8' 1-15/16" (2488) | 8' 6-1/2" (2604) | 7' 9-3/8" (2372) |
| 8' 7-15/16" (2640) | 9' 1/2" (2756) | 8' 3-3/8" (2524) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*



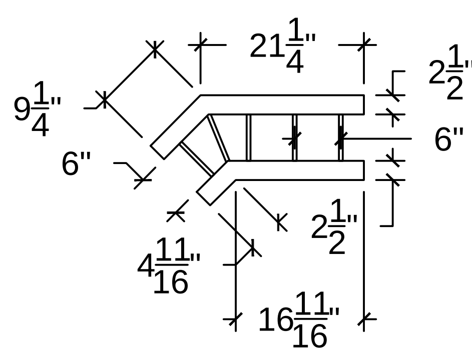



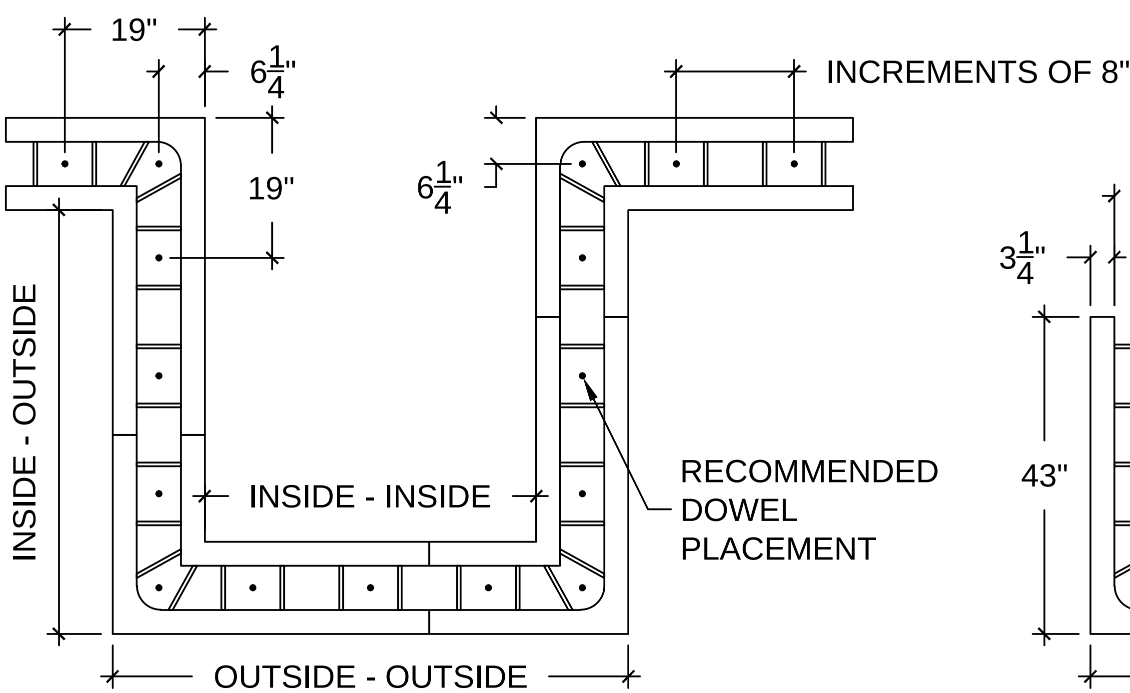
Table 8 - Horizontal coursing chart for Amvic R30 6" (152mm) long 90° corner blocks

| Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] | Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] |
|---|---|---|---|---|---|
| 2' 1-1/2" (648) [1] | 3' 2" (965) [1] | 1' 1" (330) [1] | 18' 1-1/2" (5525) [1] | 19' 2" (5842) [1] | 17' 1" (5207) [1] |
| 2' 9-1/2" (851) [2] | 3' 10" (1168) [2] | 1' 9" (533) [2] | 18' 9-1/2" (5728) [2] | 19' 10" (6045) [2] | 17' 9" (5410) [2] |
| 3' 5-1/2" (1054) | 4' 6" (1372) | 2' 5" (737) | 19' 5-1/2" (5931) | 20' 6" (6248) | 18' 5" (5613) |
| 4' 1-1/2" (1257) | 5' 2" (1575) | 3' 1" (940) | 20' 1-1/2" (6134) | 21' 2" (6452) | 19' 1" (5817) |
| **4' 9-1/2" (1461)** | **5' 10" (1778)** | **3' 9" (1143)** | **20' 9-1/2" (6337)** | **21' 10" (6655)** | **19' 9" (6020)** |
| 5' 5-1/2" (1664) | 6' 6" (1981) | 4' 5" (1346) | 21' 5-1/2" (6541) | 22' 6" (6858) | 20' 5" (6223) |
| 6' 1-1/2" (1867) | 7' 2" (2184) | 5' 1" (1549) | 22' 1-1/2" (6744) | 23' 2" (7061) | 21' 1" (6426) |
| 6' 9-1/2" (2070) | 7' 10" (2388) | 5' 9" (1753) | 22' 9-1/2" (6947) | 23' 10" (7264) | 21' 9" (6629) |
| 7' 5-1/2" (2273) | 8' 6" (2591) | 6' 5" (1956) | 23' 5-1/2" (7150) | 24' 6" (7468) | 22' 5" (6833) |
| 8' 1-1/2" (2477) | 9' 2" (2794) | 7' 1" (2159) | 24' 1-1/2" (7353) | 25' 2" (7671) | 23' 1" (7036) |
| **8' 9-1/2" (2680)** | **9' 10" (2997)** | **7' 9" (2362)** | **24' 9-1/2" (7557)** | **25' 10" (7874)** | **23' 9" (7239)** |
| 9' 5-1/2" (2883) | 10' 6" (3200) | 8' 5" (2565) | 25' 5-1/2" (7760) | 26' 6" (8077) | 24' 5" (7442) |
| 10' 1-1/2" (3086) | 11' 2" (3404) | 9' 1" (2769) | 26' 1-1/2" (7963) | 27' 2" (8280) | 25' 1" (7645) |
| 10' 9-1/2" (3289) | 11' 10" (3607) | 9' 9" (2972) | 26' 9-1/2" (8166) | 27' 10" (8484) | 25' 9" (7849) |
| 11' 5-1/2" (3493) | 12' 6" (3810) | 10' 5" (3175) | 27' 5-1/2" (8369) | 28' 6" (8687) | 26' 5" (8052) |
| 12' 1-1/2" (3696) | 13' 2" (4013) | 11' 1" (3378) | 28' 1-1/2" (8573) | 29' 2" (8890) | 27' 1" (8255) |
| **12' 9-1/2" (3899)** | **13' 10" (4216)** | **11' 9" (3581)** | **28' 9-1/2" (8776)** | **29' 10" (9093)** | **27' 9" (8458)** |
| 13' 5-1/2" (4102) | 14' 6" (4420) | 12' 5" (3785) | 29' 5-1/2" (8979) | 30' 6" (9296) | 28' 5" (8661) |
| 14' 1-1/2" (4305) | 15' 2" (4623) | 13' 1" (3988) | 30' 1-1/2" (9182) | 31' 2" (9500) | 29' 1" (8865) |
| 14' 9-1/2" (4509) | 15' 10" (4826) | 13' 9" (4191) | 30' 9-1/2" (9385) | 31' 10" (9703) | 29' 9" (9068) |
| 15' 5-1/2" (4712) | 16' 6" (5029) | 14' 5" (4394) | 31' 5-1/2" (9589) | 32' 6" (9906) | 30' 5" (9271) |
| 16' 1-1/2" (4915) | 17' 2" (5232) | 15' 1" (4597) | 32' 1-1/2" (9792) | 33' 2" (10109) | 31' 1" (9474) |
| **16' 9-1/2" (5118)** | **17' 10" (5436)** | **15' 9" (4801)** | **32' 9-1/2" (9995)** | **33' 10" (10312)** | **31' 9" (9677)** |
| 17' 5-1/2" (5321) | 18' 6" (5639) | 16' 5" (5004) | 33' 5-1/2" (10198) | 34' 6" (10516) | 32' 5" (9881) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*



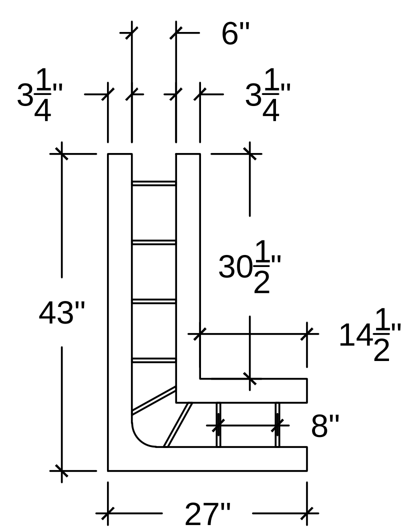



Table 9 - Horizontal coursing chart for Amvic R30 6" (152mm) 45° corner blocks

| Diagonal Dimension C [ft - in (mm)] | Outside - Outside Dimension A [ft - in (mm)] | Inside - Inside Dimension B [ft - in (mm)] |
|---|---|---|
| 1' 6-13/16" (478) (1) | 2' 0" (610) (1) | 1' 1-5/8" (346) (1) |
| 2' 2-13/16" (681) (2) | 2' 8" (813) (2) | 1' 9-5/8" (549) (2) |
| 2' 10-13/16" (884) | 3' 4" (1016) | 2' 5-5/8" (752) |
| 3' 6-13/16" (1087) | 4' 0" (1219) | 3' 1-5/8" (956) |
| **4' 2-13/16" (1291)** | **4' 8" (1422)** | **3' 9-5/8" (1159)** |
| 4' 10-13/16" (1494) | 5' 4" (1626) | 4' 5-5/8" (1362) |
| 5' 6-13/16" (1697) | 6' 0" (1829) | 5' 1-5/8" (1565) |
| 6' 2-13/16" (1900) | 6' 8" (2032) | 5' 9-5/8" (1768) |
| 6' 10-13/16" (2103) | 7' 4" (2235) | 6' 5-5/8" (1972) |
| 7' 6-13/16" (2307) | 8' 0" (2438) | 7' 1-5/8" (2175) |
| **8' 2-13/16" (2510)** | **8' 8" (2642)** | **7' 9-5/8" (2378)** |
| 8' 10-13/16" (2713) | 9' 4" (2845) | 8' 5-5/8" (2581) |
| 9' 6-13/16" (2916) | 10' 0" (3048) | 9' 1-5/8" (2784) |
| 10' 2-13/16" (3119) | 10' 8" (3251) | 9' 9-5/8" (2988) |
| 10' 10-13/16" (3323) | 11' 4" (3454) | 10' 5-5/8" (3191) |
| 11' 6-13/16" (3526) | 12' 0" (3658) | 11' 1-5/8" (3394) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*

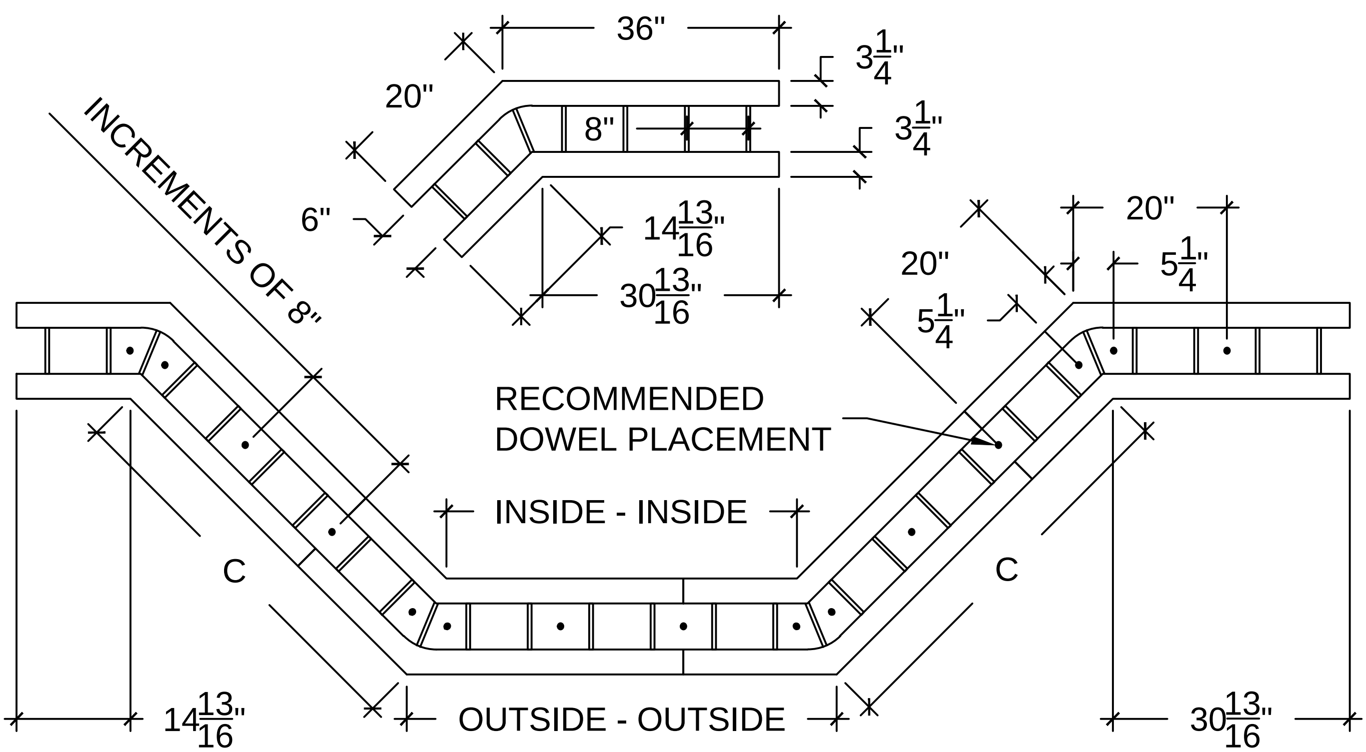


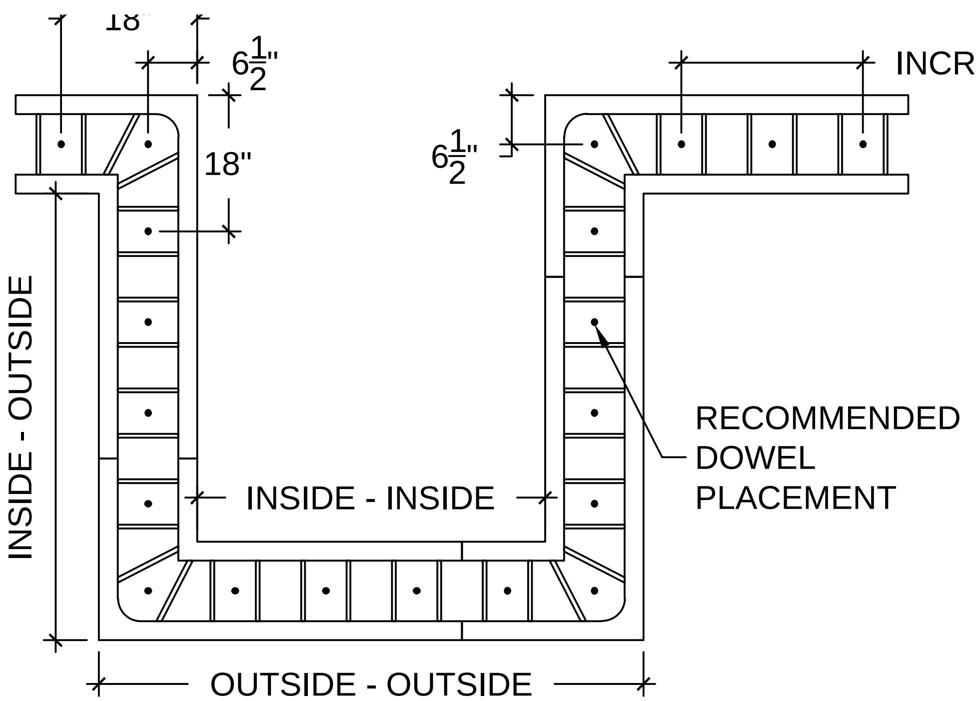
Table 11 - Horizontal coursing chart for Amvic R22 8" (203mm) long 90° corner blocks

| **Inside - Outside** [ft - in (mm)] | **Outside - Outside** [ft - in (mm)] | **Inside - Inside** [ft - in (mm)] | **Inside - Outside** [ft - in (mm)] | **Outside - Outside** [ft - in (mm)] | **Inside - Inside** [ft - in (mm)] |
|---|---|---|---|---|---|
| 1' 11" (584) (1) | 3' 0" (914) (1) | 0' 10" (254) (1) | 13' 11" (4242) (1) | 15' 0" (4572) (1) | 12' 10" (3912) (1) |
| 2' 5" (737) (2) | 3' 6" (1067) (2) | 1' 4" (406) (2) | 14' 5" (4394) (2) | 15' 6" (4724) (2) | 13' 4" (4064) (2) |
| 2' 11" (889) | 4' 0" (1219) | 1' 10" (559) | 14' 11" (4547) | 16' 0" (4877) | 13' 10" (4216) |
| 3' 5" (1041) | 4' 6" (1372) | 2' 4" (711) | 15' 5" (4699) | 16' 6" (5029) | 14' 4" (4369) |
| 3' 11" (1194) | 5' 0" (1524) | 2' 10" (864) | 15' 11" (4851) | 17' 0" (5182) | 14' 10" (4521) |
| 4' 5" (1346) | 5' 6" (1676) | 3' 4" (1016) | 16' 5" (5004) | 17' 6" (5334) | 15' 4" (4674) |
| **4' 11" (1499)** | **6' 0" (1829)** | **3' 10" (1168)** | **16' 11" (5156)** | **18' 0" (5486)** | **15' 10" (4826)** |
| 5' 5" (1651) | 6' 6" (1981) | 4' 4" (1321) | 17' 5" (5309) | 18' 6" (5639) | 16' 4" (4978) |
| 5' 11" (1803) | 7' 0" (2134) | 4' 10" (1473) | 17' 11" (5461) | 19' 0" (5791) | 16' 10" (5131) |
| 6' 5" (1956) | 7' 6" (2286) | 5' 4" (1626) | 18' 5" (5613) | 19' 6" (5944) | 17' 4" (5283) |
| 6' 11" (2108) | 8' 0" (2438) | 5' 10" (1778) | 18' 11" (5766) | 20' 0" (6096) | 17' 10" (5436) |
| 7' 5" (2261) | 8' 6" (2591) | 6' 4" (1930) | 19' 5" (5918) | 20' 6" (6248) | 18' 4" (5588) |
| 7' 11" (2413) | 9' 0" (2743) | 6' 10" (2083) | 19' 11" (6071) | 21' 0" (6401) | 18' 10" (5740) |
| 8' 5" (2565) | 9' 6" (2896) | 7' 4" (2235) | 20' 5" (6223) | 21' 6" (6553) | 19' 4" (5893) |
| **8' 11" (2718)** | **10' 0" (3048)** | **7' 10" (2388)** | **20' 11" (6375)** | **22' 0" (6706)** | **19' 10" (6045)** |
| 9' 5" (2870) | 10' 6" (3200) | 8' 4" (2540) | 21' 5" (6528) | 22' 6" (6858) | 20' 4" (6198) |
| 9' 11" (3023) | 11' 0" (3353) | 8' 10" (2692) | 21' 11" (6680) | 23' 0" (7010) | 20' 10" (6350) |
| 10' 5" (3175) | 11' 6" (3505) | 9' 4" (2845) | 22' 5" (6833) | 23' 6" (7163) | 21' 4" (6502) |
| 10' 11" (3327) | 12' 0" (3658) | 9' 10" (2997) | 22' 11" (6985) | 24' 0" (7315) | 21' 10" (6655) |
| 11' 5" (3480) | 12' 6" (3810) | 10' 4" (3150) | 23' 5" (7137) | 24' 6" (7468) | 22' 4" (6807) |
| 11' 11" (3632) | 13' 0" (3962) | 10' 10" (3302) | 23' 11" (7290) | 25' 0" (7620) | 22' 10" (6960) |
| 12' 5" (3785) | 13' 6" (4115) | 11' 4" (3454) | 24' 5" (7442) | 25' 6" (7772) | 23' 4" (7112) |
| **12' 11" (3937)** | **14' 0" (4267)** | **11' 10" (3607)** | **24' 11" (7595)** | **26' 0" (7925)** | **23' 10" (7264)** |
| 13' 5" (4089) | 14' 6" (4420) | 12' 4" (3759) | 25' 5" (7747) | 26' 6" (8077) | 24' 4" (7417) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*



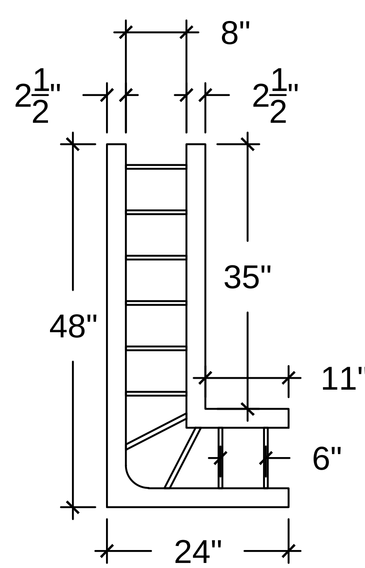



Table 12 - Horizontal coursing chart for Amvic R22 8" (203mm) short 45° corner blocks

| Diagonal Dimension C [ft - in (mm)] | Outside - Outside Dimension A [ft - in (mm)] | Inside - Inside Dimension B [ft - in (mm)] |
|---|---|---|
| 1' 2-5/8" (371)[1] | 1' 8" (508)[1] | 0' 9-1/4" (235)[1] |
| 1' 8-5/8" (524)[2] | 2' 2" (660)[2] | 1' 3-1/4" (387)[2] |
| **2' 2-5/8" (676)** | **2' 8" (813)** | **1' 9-1/4" (540)** |
| 2' 8-5/8" (829) | 3' 2" (965) | 2' 3-1/4" (692) |
| 3' 2-5/8" (981) | 3' 8" (1118) | 2' 9-1/4" (845) |
| 3' 8-5/8" (1133) | 4' 2" (1270) | 3' 3-1/4" (997) |
| 4' 2-5/8" (1286) | 4' 8" (1422) | 3' 9-1/4" (1149) |
| 4' 8-5/8" (1438) | 5' 2" (1575) | 4' 3-1/4" (1302) |
| 5' 2-5/8" (1591) | 5' 8" (1727) | 4' 9-1/4" (1454) |
| 5' 8-5/8" (1743) | 6' 2" (1880) | 5' 3-1/4" (1607) |
| **6' 2-5/8" (1895)** | **6' 8" (2032)** | **5' 9-1/4" (1759)** |
| 6' 8-5/8" (2048) | 7' 2" (2184) | 6' 3-1/4" (1911) |
| 7' 2-5/8" (2200) | 7' 8" (2337) | 6' 9-1/4" (2064) |
| 7' 8-5/8" (2353) | 8' 2" (2489) | 7' 3-1/4" (2216) |
| 8' 2-5/8" (2505) | 8' 8" (2642) | 7' 9-1/4" (2369) |
| 8' 8-5/8" (2657) | 9' 2" (2794) | 8' 3-1/4" (2521) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*

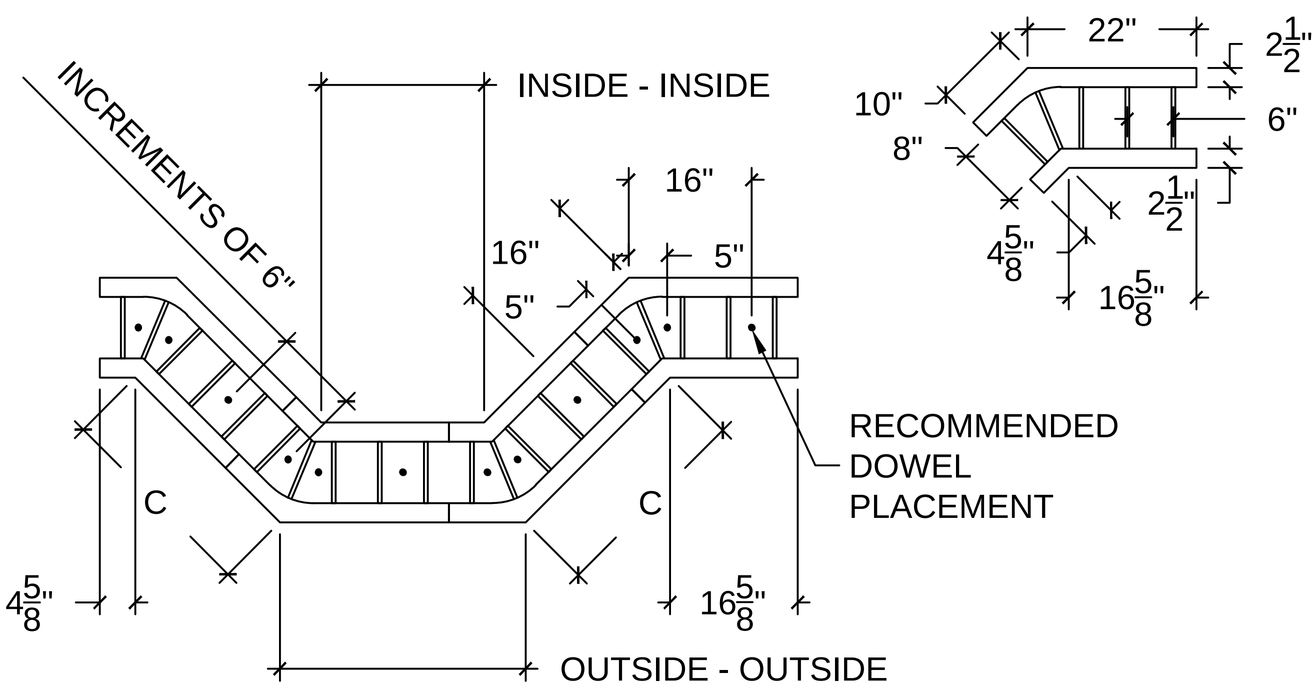


Table 13 - Horizontal coursing chart for Amvic R30 8" (203mm) long 90° corner blocks

| Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] | Inside - Outside [ft - in (mm)] | Outside - Outside [ft - in (mm)] | Inside - Inside [ft - in (mm)] |
|---|---|---|---|---|---|
| 2' 3-1/2" (699)[1] | 3' 6" (1067)[1] | 1' 1" (330)[1] | 18' 3-1/2" (5575)[1] | 19' 6" (5944)[1] | 17' 1" (5207)[1] |
| 2' 11-1/2" (902)[2] | 4' 2" (1270)[2] | 1' 9" (533)[2] | 18' 11-1/2" (5779)[2] | 20' 2" (6147)[2] | 17' 9" (5410)[2] |
| 3' 7-1/2" (1105) | 4' 10" (1473) | 2' 5" (737) | 19' 7-1/2" (5982) | 20' 10" (6350) | 18' 5" (5613) |
| 4' 3-1/2" (1308) | 5' 6" (1676) | 3' 1" (940) | 20' 3-1/2" (6185) | 21' 6" (6553) | 19' 1" (5817) |
| **4' 11-1/2" (1511)** | **6' 2" (1880)** | **3' 9" (1143)** | **20' 11-1/2" (6388)** | **22' 2" (6756)** | **19' 9" (6020)** |
| 5' 7-1/2" (1715) | 6' 10" (2083) | 4' 5" (1346) | 21' 7-1/2" (6591) | 22' 10" (6960) | 20' 5" (6223) |
| 6' 3-1/2" (1918) | 7' 6" (2286) | 5' 1" (1549) | 22' 3-1/2" (6795) | 23' 6" (7163) | 21' 1" (6426) |
| 6' 11-1/2" (2121) | 8' 2" (2489) | 5' 9" (1753) | 22' 11-1/2" (6998) | 24' 2" (7366) | 21' 9" (6629) |
| 7' 7-1/2" (2324) | 8' 10" (2692) | 6' 5" (1956) | 23' 7-1/2" (7201) | 24' 10" (7569) | 22' 5" (6833) |
| 8' 3-1/2" (2527) | 9' 6" (2896) | 7' 1" (2159) | 24' 3-1/2" (7404) | 25' 6" (7772) | 23' 1" (7036) |
| **8' 11-1/2" (2731)** | **10' 2" (3099)** | **7' 9" (2362)** | **24' 11-1/2" (7607)** | **26' 2" (7976)** | **23' 9" (7239)** |
| 9' 7-1/2" (2934) | 10' 10" (3302) | 8' 5" (2565) | 25' 7-1/2" (7811) | 26' 10" (8179) | 24' 5" (7442) |
| 10' 3-1/2" (3137) | 11' 6" (3505) | 9' 1" (2769) | 26' 3-1/2" (8014) | 27' 6" (8382) | 25' 1" (7645) |
| 10' 11-1/2" (3340) | 12' 2" (3708) | 9' 9" (2972) | 26' 11-1/2" (8217) | 28' 2" (8585) | 25' 9" (7849) |
| 11' 7-1/2" (3543) | 12' 10" (3912) | 10' 5" (3175) | 27' 7-1/2" (8420) | 28' 10" (8788) | 26' 5" (8052) |
| 12' 3-1/2" (3747) | 13' 6" (4115) | 11' 1" (3378) | 28' 3-1/2" (8623) | 29' 6" (8992) | 27' 1" (8255) |
| **12' 11-1/2" (3950)** | **14' 2" (4318)** | **11' 9" (3581)** | **28' 11-1/2" (8827)** | **30' 2" (9195)** | **27' 9" (8458)** |
| 13' 7-1/2" (4153) | 14' 10" (4521) | 12' 5" (3785) | 29' 7-1/2" (9030) | 30' 10" (9398) | 28' 5" (8661) |
| 14' 3-1/2" (4356) | 15' 6" (4724) | 13' 1" (3988) | 30' 3-1/2" (9233) | 31' 6" (9601) | 29' 1" (8865) |
| 14' 11-1/2" (4559) | 16' 2" (4928) | 13' 9" (4191) | 30' 11-1/2" (9436) | 32' 2" (9804) | 29' 9" (9068) |
| 15' 7-1/2" (4763) | 16' 10" (5131) | 14' 5" (4394) | 31' 7-1/2" (9639) | 32' 10" (10008) | 30' 5" (9271) |
| 16' 3-1/2" (4966) | 17' 6" (5334) | 15' 1" (4597) | 32' 3-1/2" (9843) | 33' 6" (10211) | 31' 1" (9474) |
| **16' 11-1/2" (5169)** | **18' 2" (5537)** | **15' 9" (4801)** | **32' 11-1/2" (10046)** | **34' 2" (10414)** | **31' 9" (9677)** |
| 17' 7-1/2" (5372) | 18' 10" (5740) | 16' 5" (5004) | 33' 7-1/2" (10249) | 34' 10" (10617) | 32' 5" (9881) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*

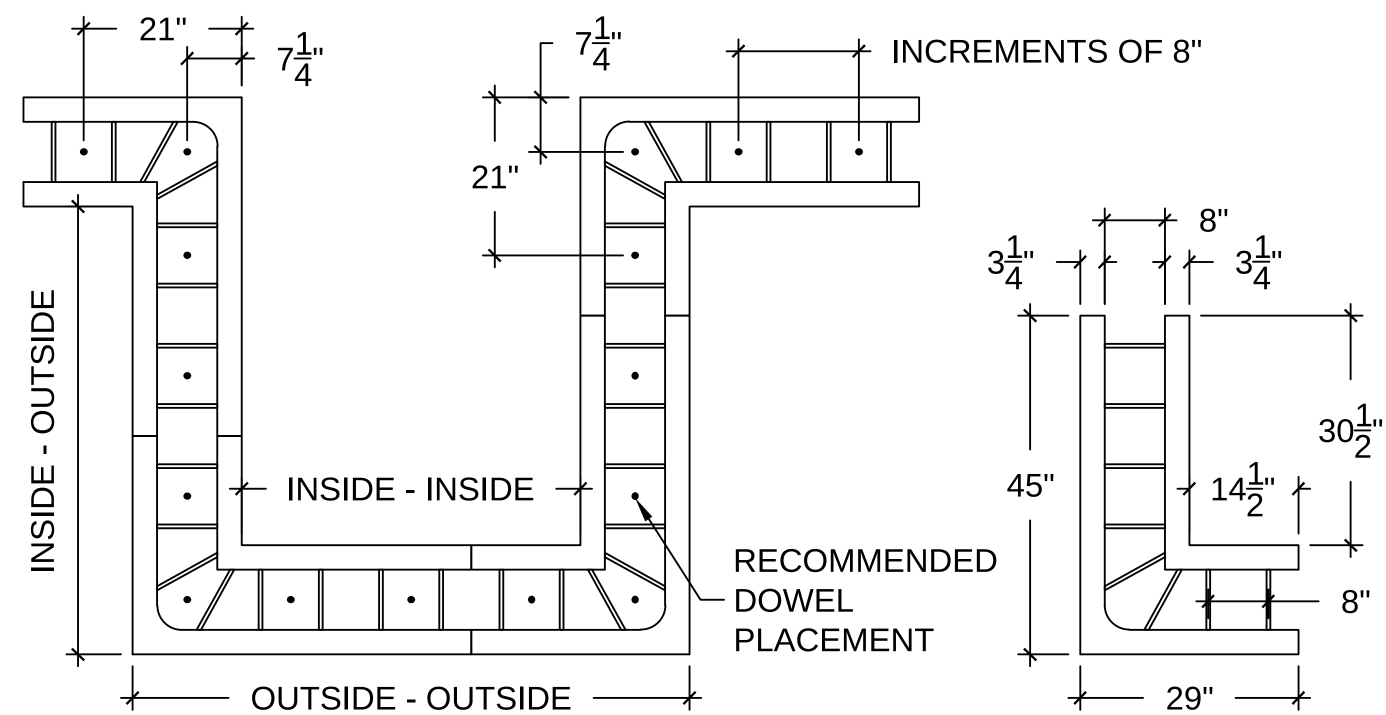


Table 14 - Horizontal coursing chart for Amvic R30 8" (203mm) 45° corner blocks

| Diagonal Dimension C [ft - in (mm)] | Outside - Outside Dimension A [ft - in (mm)] | Inside - Inside Dimension B [ft - in (mm)] |
|---|---|---|
| 1' 6" (457)(1) | 2' 0" (610)(1) | 1' 0" (305)(1) |
| 2' 2" (660)(2) | 2' 8" (813)(2) | 1' 8" (508)(2) |
| 2' 10" (864) | 3' 4" (1016) | 2' 4" (711) |
| 3' 6" (1067) | 4' 0" (1219) | 3' 0" (914) |
| **4' 2" (1270)** | **4' 8" (1422)** | **3' 8" (1118)** |
| 4' 10" (1473) | 5' 4" (1626) | 4' 4" (1321) |
| 5' 6" (1676) | 6' 0" (1829) | 5' 0" (1524) |
| 6' 2" (1880) | 6' 8" (2032) | 5' 8" (1727) |
| 6' 10" (2083) | 7' 4" (2235) | 6' 4" (1930) |
| 7' 6" (2286) | 8' 0" (2438) | 7' 0" (2134) |
| **8' 2" (2489)** | **8' 8" (2642)** | **7' 8" (2337)** |
| 8' 10" (2692) | 9' 4" (2845) | 8' 4" (2540) |
| 9' 6" (2896) | 10' 0" (3048) | 9' 0" (2743) |
| 10' 2" (3099) | 10' 8" (3251) | 9' 8" (2946) |
| 10' 10" (3302) | 11' 4" (3454) | 10' 4" (3150) |
| 11' 6" (3505) | 12' 0" (3658) | 11' 0" (3353) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*

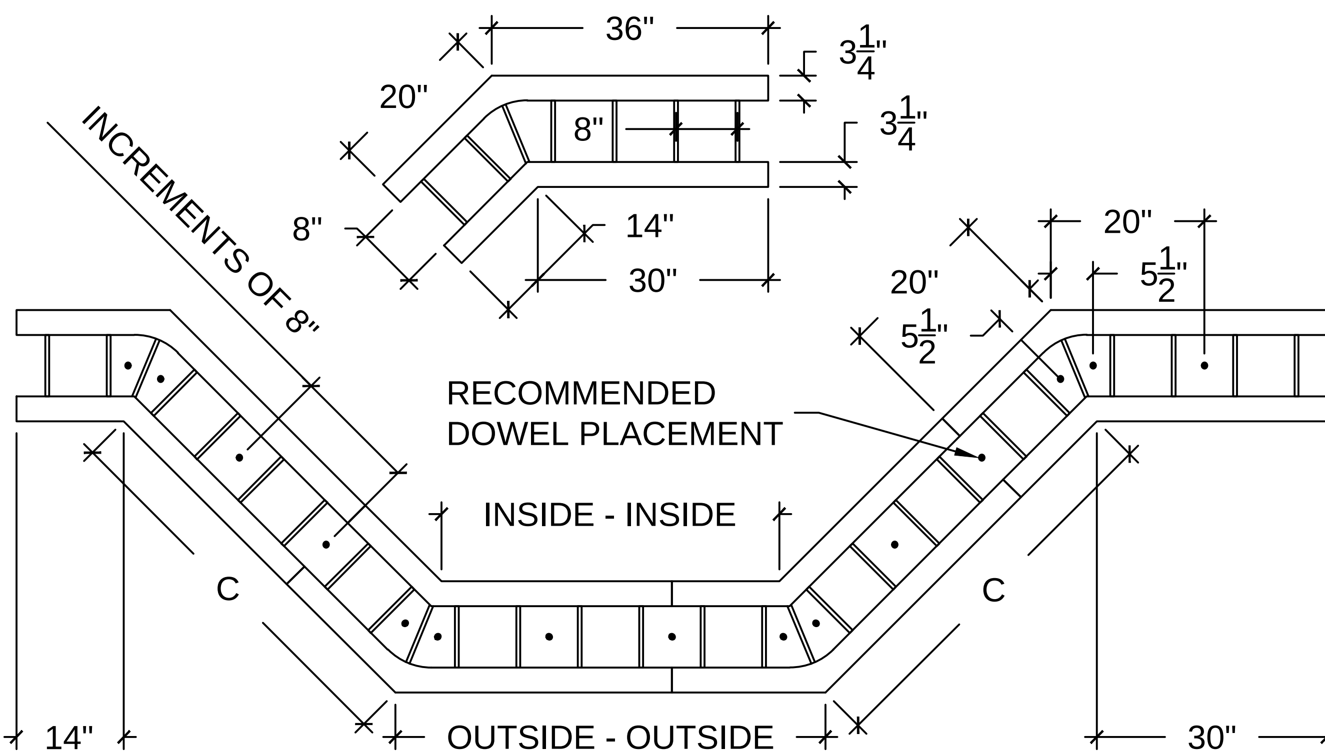


Table 15 - Horizontal coursing chart for Amvic R22 10" (254mm) short 90° corner blocks

| **Inside - Outside** [ft - in (mm)] | **Outside - Outside** [ft - in (mm)] | **Inside - Inside** [ft - in (mm)] | **Inside - Outside** [ft - in (mm)] | **Outside - Outside** [ft - in (mm)] | **Inside - Inside** [ft - in (mm)] |
|---|---|---|---|---|---|
| 1' 10" (559)[1] | 3' 1" (940)[1] | 0' 7" (178)[1] | 13' 10" (4216)[1] | 15' 1" (4597)[1] | 12' 7" (3835)[1] |
| 2' 4" (711)[2] | 3' 7" (1092)[2] | 1' 1" (330)[2] | 14' 4" (4369)[2] | 15' 7" (4750)[2] | 13' 1" (3988)[2] |
| 2' 10" (864) | 4' 1" (1245) | 1' 7" (483) | 14' 10" (4521) | 16' 1" (4902) | 13' 7" (4140) |
| 3' 4" (1016) | 4' 7" (1397) | 2' 1" (635) | 15' 4" (4674) | 16' 7" (5055) | 14' 1" (4293) |
| **3' 10" (1168)** | **5' 1" (1549)** | **2' 7" (787)** | **15' 10" (4826)** | **17' 1" (5207)** | **14' 7" (4445)** |
| 4' 4" (1321) | 5' 7" (1702) | 3' 1" (940) | 16' 4" (4978) | 17' 7" (5359) | 15' 1" (4597) |
| 4' 10" (1473) | 6' 1" (1854) | 3' 7" (1092) | 16' 10" (5131) | 18' 1" (5512) | 15' 7" (4750) |
| 5' 4" (1626) | 6' 7" (2007) | 4' 1" (1245) | 17' 4" (5283) | 18' 7" (5664) | 16' 1" (4902) |
| 5' 10" (1778) | 7' 1" (2159) | 4' 7" (1397) | 17' 10" (5436) | 19' 1" (5817) | 16' 7" (5055) |
| 6' 4" (1930) | 7' 7" (2311) | 5' 1" (1549) | 18' 4" (5588) | 19' 7" (5969) | 17' 1" (5207) |
| 6' 10" (2083) | 8' 1" (2464) | 5' 7" (1702) | 18' 10" (5740) | 20' 1" (6121) | 17' 7" (5359) |
| 7' 4" (2235) | 8' 7" (2616) | 6' 1" (1854) | 19' 4" (5893) | 20' 7" (6274) | 18' 1" (5512) |
| **7' 10" (2388)** | **9' 1" (2769)** | **6' 7" (2007)** | **19' 10" (6045)** | **21' 1" (6426)** | **18' 7" (5664)** |
| 8' 4" (2540) | 9' 7" (2921) | 7' 1" (2159) | 20' 4" (6198) | 21' 7" (6579) | 19' 1" (5817) |
| 8' 10" (2692) | 10' 1" (3073) | 7' 7" (2311) | 20' 10" (6350) | 22' 1" (6731) | 19' 7" (5969) |
| 9' 4" (2845) | 10' 7" (3226) | 8' 1" (2464) | 21' 4" (6502) | 22' 7" (6883) | 20' 1" (6121) |
| 9' 10" (2997) | 11' 1" (3378) | 8' 7" (2616) | 21' 10" (6655) | 23' 1" (7036) | 20' 7" (6274) |
| 10' 4" (3150) | 11' 7" (3531) | 9' 1" (2769) | 22' 4" (6807) | 23' 7" (7188) | 21' 1" (6426) |
| 10' 10" (3302) | 12' 1" (3683) | 9' 7" (2921) | 22' 10" (6960) | 24' 1" (7341) | 21' 7" (6579) |
| 11' 4" (3454) | 12' 7" (3835) | 10' 1" (3073) | 23' 4" (7112) | 24' 7" (7493) | 22' 1" (6731) |
| **11' 10" (3607)** | **13' 1" (3988)** | **10' 7" (3226)** | **23' 10" (7264)** | **25' 1" (7645)** | **22' 7" (6883)** |
| 12' 4" (3759) | 13' 7" (4140) | 11' 1" (3378) | 24' 4" (7417) | 25' 7" (7798) | 23' 1" (7036) |
| 12' 10" (3912) | 14' 1" (4293) | 11' 7" (3531) | 24' 10" (7569) | 26' 1" (7950) | 23' 7" (7188) |
| 13' 4" (4064) | 14' 7" (4445) | 12' 1" (3683) | 25' 4" (7722) | 26' 7" (8103) | 24' 1" (7341) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*

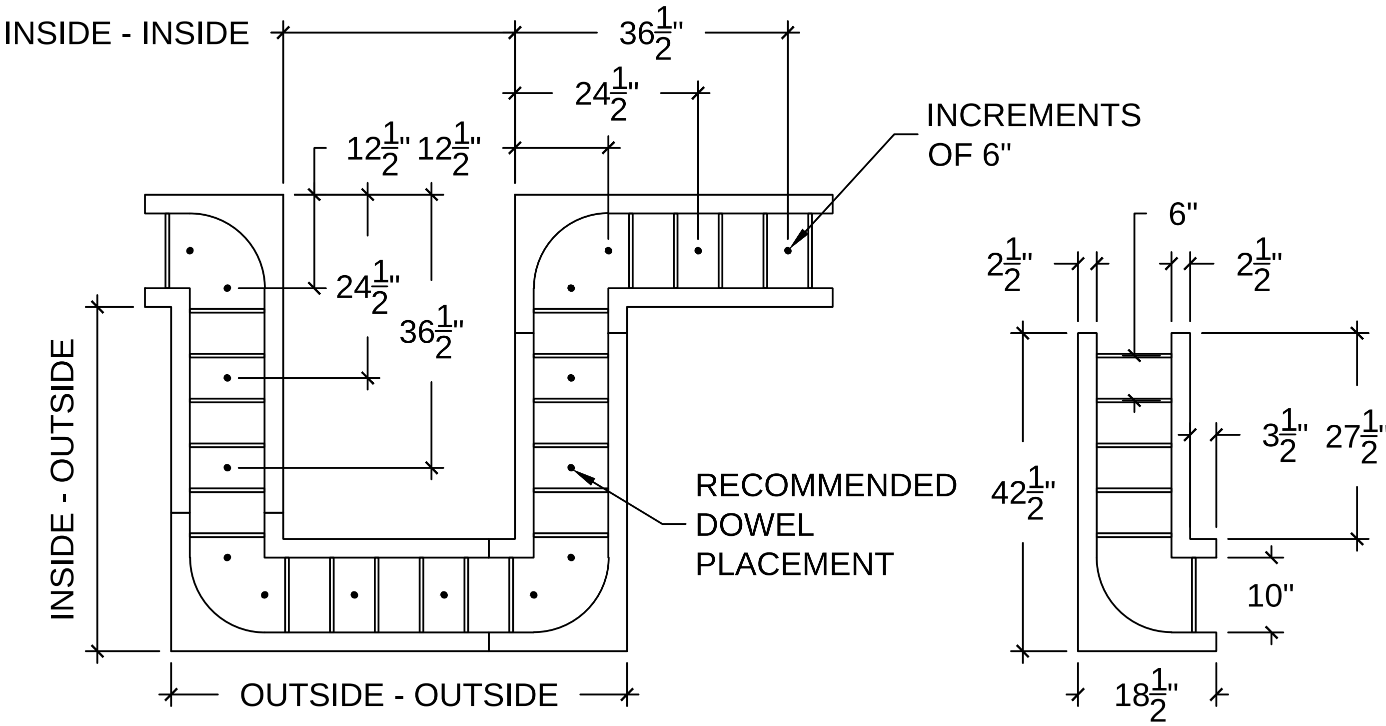


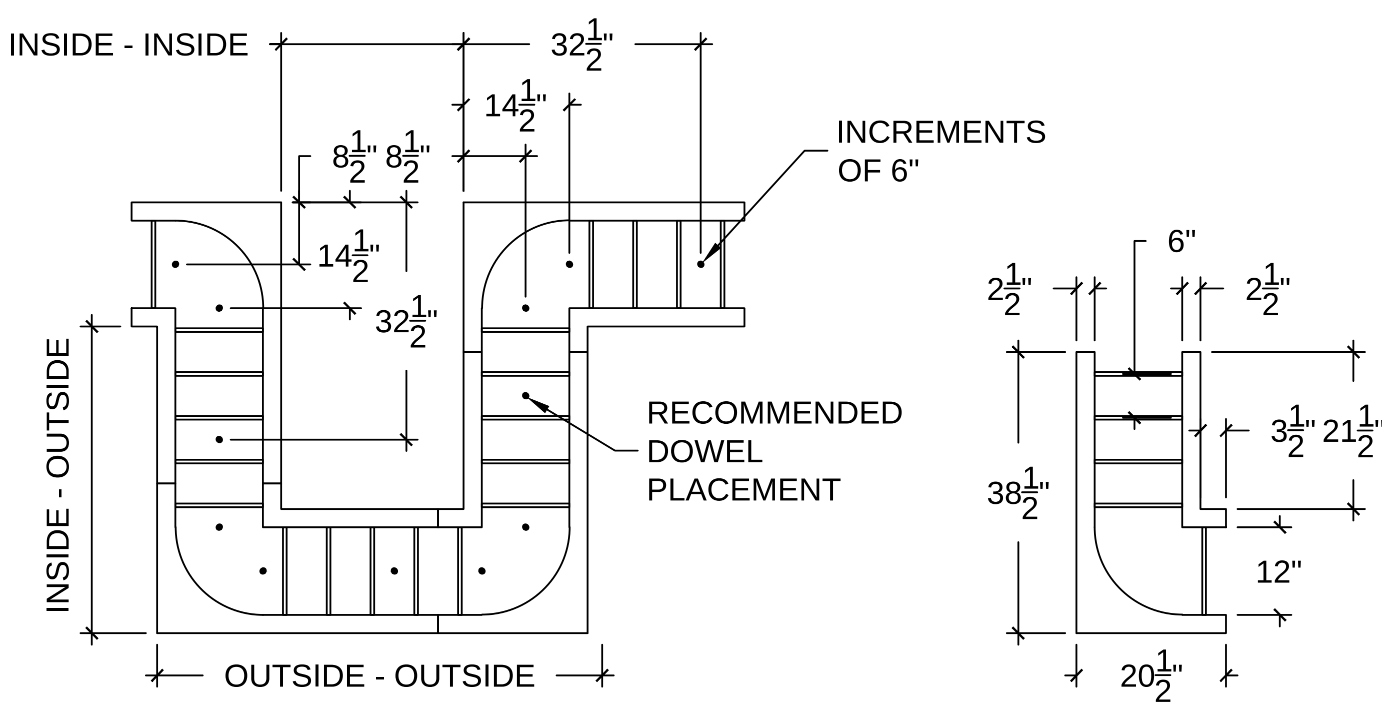
Table 16 - Horizontal coursing chart for Amvic R22 12" (305mm) short 90° corner blocks

| **Inside - Outside** [ft - in (mm)] | **Outside - Outside** [ft - in (mm)] | **Inside - Inside** [ft - in (mm)] | **Inside - Outside** [ft - in (mm)] | **Outside - Outside** [ft - in (mm)] | **Inside - Inside** [ft - in (mm)] |
|---|---|---|---|---|---|
| 2' 0" (610)[1] | 3' 5" (1041)[1] | 0' 7" (178)[1] | 14' 0" (4267)[1] | 15' 5" (4699)[1] | 12' 7" (3835)[1] |
| 2' 6" (762)[2] | 3' 11" (1194)[2] | 1' 1" (330)[2] | 14' 6" (4420)[2] | 15' 11" (4851)[2] | 13' 1" (3988)[2] |
| 3' 0" (914) | 4' 5" (1346) | 1' 7" (483) | 15' 0" (4572) | 16' 5" (5004) | 13' 7" (4140) |
| **3' 6" (1067)** | **4' 11" (1499)** | **2' 1" (635)** | **15' 6" (4724)** | **16' 11" (5156)** | **14' 1" (4293)** |
| 4' 0" (1219) | 5' 5" (1651) | 2' 7" (787) | 16' 0" (4877) | 17' 5" (5309) | 14' 7" (4445) |
| 4' 6" (1372) | 5' 11" (1803) | 3' 1" (940) | 16' 6" (5029) | 17' 11" (5461) | 15' 1" (4597) |
| 5' 0" (1524) | 6' 5" (1956) | 3' 7" (1092) | 17' 0" (5182) | 18' 5" (5613) | 15' 7" (4750) |
| 5' 6" (1676) | 6' 11" (2108) | 4' 1" (1245) | 17' 6" (5334) | 18' 11" (5766) | 16' 1" (4902) |
| 6' 0" (1829) | 7' 5" (2261) | 4' 7" (1397) | 18' 0" (5486) | 19' 5" (5918) | 16' 7" (5055) |
| 6' 6" (1981) | 7' 11" (2413) | 5' 1" (1549) | 18' 6" (5639) | 19' 11" (6071) | 17' 1" (5207) |
| 7' 0" (2134) | 8' 5" (2565) | 5' 7" (1702) | 19' 0" (5791) | 20' 5" (6223) | 17' 7" (5359) |
| **7' 6" (2286)** | **8' 11" (2718)** | **6' 1" (1854)** | **19' 6" (5944)** | **20' 11" (6375)** | **18' 1" (5512)** |
| 8' 0" (2438) | 9' 5" (2870) | 6' 7" (2007) | 20' 0" (6096) | 21' 5" (6528) | 18' 7" (5664) |
| 8' 6" (2591) | 9' 11" (3023) | 7' 1" (2159) | 20' 6" (6248) | 21' 11" (6680) | 19' 1" (5817) |
| 9' 0" (2743) | 10' 5" (3175) | 7' 7" (2311) | 21' 0" (6401) | 22' 5" (6833) | 19' 7" (5969) |
| 9' 6" (2896) | 10' 11" (3327) | 8' 1" (2464) | 21' 6" (6553) | 22' 11" (6985) | 20' 1" (6121) |
| 10' 0" (3048) | 11' 5" (3480) | 8' 7" (2616) | 22' 0" (6706) | 23' 5" (7137) | 20' 7" (6274) |
| 10' 6" (3200) | 11' 11" (3632) | 9' 1" (2769) | 22' 6" (6858) | 23' 11" (7290) | 21' 1" (6426) |
| 11' 0" (3353) | 12' 5" (3785) | 9' 7" (2921) | 23' 0" (7010) | 24' 5" (7442) | 21' 7" (6579) |
| **11' 6" (3505)** | **12' 11" (3937)** | **10' 1" (3073)** | **23' 6" (7163)** | **24' 11" (7595)** | **22' 1" (6731)** |
| 12' 0" (3658) | 13' 5" (4089) | 10' 7" (3226) | 24' 0" (7315) | 25' 5" (7747) | 22' 7" (6883) |
| 12' 6" (3810) | 13' 11" (4242) | 11' 1" (3378) | 24' 6" (7468) | 25' 11" (7899) | 23' 1" (7036) |
| 13' 0" (3962) | 14' 5" (4394) | 11' 7" (3531) | 25' 0" (7620) | 26' 5" (8052) | 23' 7" (7188) |
| 13' 6" (4115) | 14' 11" (4547) | 12' 1" (3683) | 25' 6" (7772) | 26' 11" (8204) | 24' 1" (7341) |

*(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) Bold dimensions indicate the use of full size Amvic blocks with no cutting required*



Building any structure using Amvic ICF requires the installer to have a good knowledge about the fundamentals of steel reinforcement. This part of the manual will discuss the basics of reinforcing steel requirements for Amvic ICF walls. 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. Rebar should extend upward at least 24” (610mm) from the footing into the cavity of the block or as per engineering requirement.

## Plan Requirements

For any given project, the following information should be indicated on the drawings.;

1. Separate cross sections of all walls using Amvic ICF. Each cross section should show the type of Amvic ICF block used (i.e. core size) clearly marked and readily visible to the building official and installer.
2. Each cross section should show the wall heights involved for every floor.
3. Vertical and horizontal reinforcing bar sizes, spacing and grade of steel should be clearly marked for every story in each wall cross section or in a separate note on other sheets.
4. The placement of reinforcing steel bars 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 (covered in later part of this section).

## The Purpose of Reinforcement in concrete

Reinforced concrete structures such as Amvic ICF walls are composed of primarily two different materials;

- Concrete
- Steel

Plain concrete is a strong material in compression. A plain concrete cube or cylinder under typical compressive testing will take a relatively large amount of force before it breaks or cracks (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.

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 has 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.

## Horizontal Reinforcement

Amvic’s polypropylene ICF webs are specifically designed to accommodate and secure the horizontal reinforcing bars in place practically eliminating the need to tie them. Typically, the first course of horizontal reinforcement is placed in the notches closer to the EPS panel (i.e. on the tension side of the wall for below grade). The second course of horizontal reinforcement should be placed in the notch towards the center of the concrete wall. The third course will be placed in the same position as the first course. The fourth course will be 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.

## Vertical Reinforcement

Vertical reinforcement is placed after the Amvic ICF wall has been stacked and completely erected. In case of a multi-story wall, the vertical reinforcement is placed after the erection of each individual storey. As mentioned above, 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 requirements.

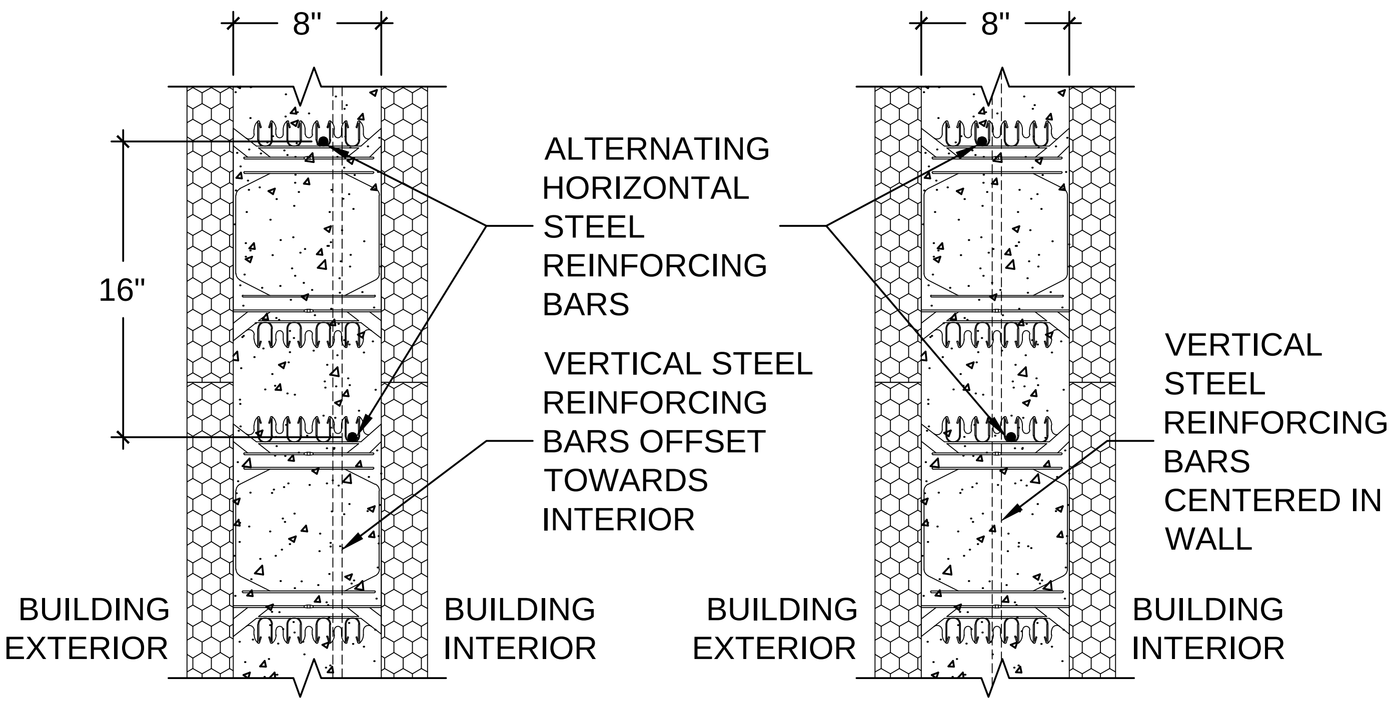



*Figure 1 – Typical reinforcing steel placement below (left) and above (right) grade*

## Wall Openings Reinforcement

Almost all 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 commonly known as lintels especially in load bearing walls can be subjected to significant bending moment and shear forces depending on several factors.

## Splicing Reinforcement

Steel reinforcement typically comes in 20 feet (6 meters) 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 codes and/or requirements of the structural design.

## Types of Lap Splice

For the purpose and scope of this manual only one type of splicing known as lap splicing is discussed. Lap splicing is typically lapping reinforcing steel over each other over a certain length. The length of the splice is calculated according to the local building codes or by a structural engineer and is specified as part of the design package.

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.
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 6" (152mm).

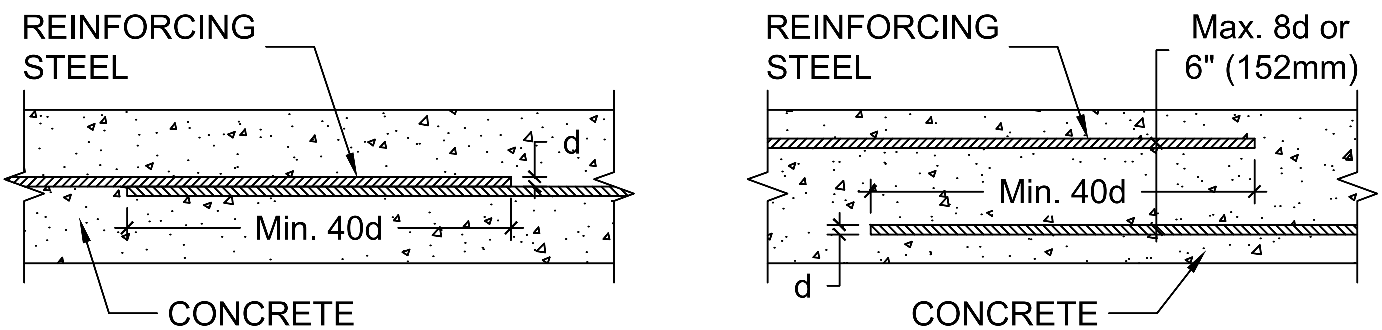



*Figure 2 – Contact lap splices (left) and non-contact lap splices (right)*

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

| Example: Canadian Rebar Sizes | Example: US Rebar Sizes |
|---|---|
| When splicing a 10M reinforcing steel bar which has a diameter of 11.3mm, the minimum lapped splice length is;<br>40 x 11.3 mm = 452 mm | When splicing a #5 reinforcing steel bar which has a diameter of 0.625" the minimum lapped splice length is;<br>40 x 0.625" = 25" |

## Lapped Splices for Multiple Concrete Pours

When a project has more than one story 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 story. The length of the extension should be equal to the required splice length specified by the structural engineer or a minimum length of 40d (where d = diameter of smaller steel bar being spliced).

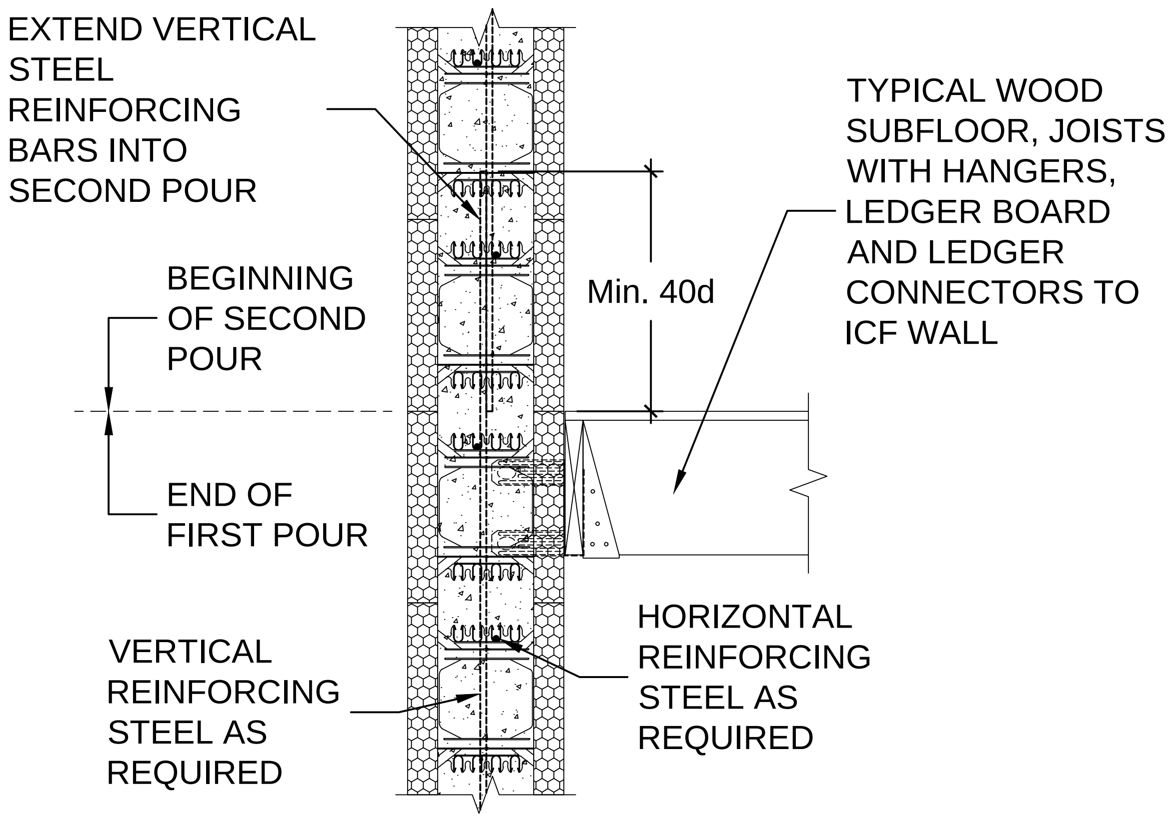



*Figure 3 – Vertical lap splice*

## Option 2

In some situations, it might be more beneficial to use a dowel as a splice due to ease of installation or site conditions. Cut the vertical reinforcement steel bars for the lower story 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 bars 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.

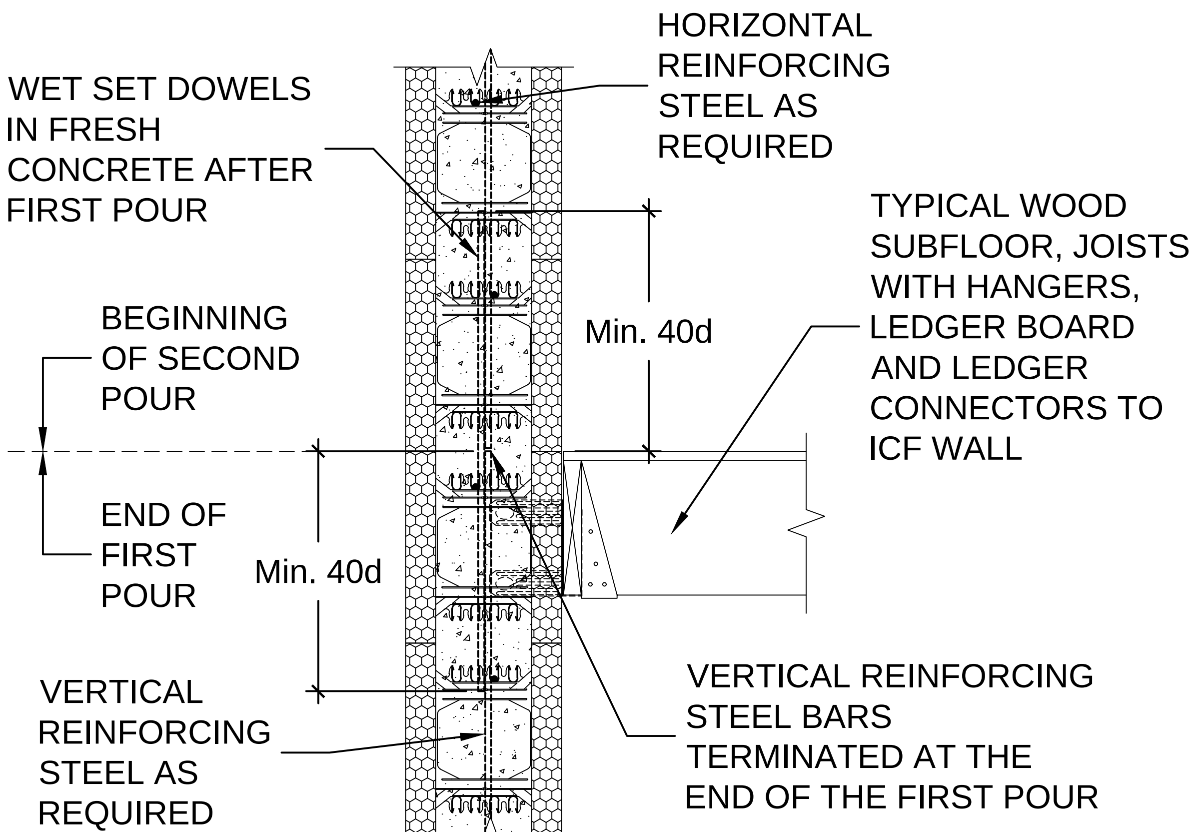



*Figure 4 – Vertical lap splice using a dowel*

## Designing Reinforcing Steel for Walls

Determining the reinforcing steel schedule whether vertical or horizontal is purely a structural engineering task which depends on many factors. It is beyond the scope of this technical manual and the intended user to indulge into principles of reinforced concrete design. However, some tools are available for the residential construction industry to help professionals understand reinforcing steel design for ICF construction.

| Canada | |
|---|---|
| Amvic's Canadian Design Guide (Part 6.1) and ICF CCMC report 13043-R contain reinforcing steel tables for below grade and up to two stories of above grade applications in residential projects. The report also contains some lintel tables for wall openings both in metric and imperial units.<br><br>There are applicability limits mentioned in the report which must be adhered to. **If the particular project at hand falls outside of these limits, then a local licensed/registered engineer should be retained.** | Code Requirements<br><br>A. Design of reinforced concrete shall be in accordance with CSA A23.3.<br><br>B. Reinforcing steel placement shall conform to CSA A23.1, CSA A23.4 and/or the local building code having jurisdiction.<br><br>C. Reinforcing steel bars shall conform to clause 7 of CSA A23.1 AND CSA G30.18.<br><br>D. Minimum Steel Yield Strength shall not be less than 300 MPa (40 ksi). |

| 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.<br><br>The book contains reinforcing steel schedules for below grade and up to 2 stories above grade applications. The book also contains a lot of lintel tables for wall openings in different applications. As expected, there are limitations to using the book which must be adhered in order to use it.<br><br>**For applications that fall outside the scope of the "Prescriptive Method" a local licensed/registered engineer should be retained.**<br><br>PCA (Portland Cement Association) has prepared another tool targeted at engineers to assist them in the design of ICF walls namely "Structural Design of Insulating Concrete Form Walls in Residential Construction". 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". | Code Requirements<br><br>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..<br><br>B. Reinforcing steel bars shall conform to one of the following specifications;<br><br>a. ASTM A615 – Specifications for Deformed and Plain Billet-Steel Bars<br><br>b. ASTM A706 – Specifications for Low-Alloy Steel Deformed and Plain Bars<br><br>c. ASTM A996 – Specifications for Rail-Steel and Axle Steel Deformed Bars<br><br>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). |

## Steel Reinforcing Bars and Jobsite Safety

Unguarded protruding steel rebar are hazardous and can result in serious internal injuries or death due to impalement from falling or stumbling. The following measures should greatly reduce the hazards of exposed reinforcing steel;

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

*Figure 5 - Plastic mushroom caps on protruding steel bars*

Window and door bucks are an integral part of the ICF construction process. Some contractors build their own bucks using two-by lumber, while others prefer using a vinyl buck. Experienced ICF installers use a variety of methods for forming and installing bucks. This section explains the main principles and most common methods of buck construction and installation. This section should only be used as a guideline.

*Note: It is advisable to follow window manufacturers guidelines for rough opening sizes to ensure proper dimensions are achieved with taking into consideration the buck configuration. It is important to verify with the window manufacturer that the specified rough opening is the size of the buck and not the size of the actual window.*

*Note: Most windows in ICF construction should be placed on the solid area of the opening and not directly on top of the of the EPS panels. This will provide proper support and eliminate potential issues of sagging and movement over time.*


*Figure 1 – Constructing your window/door bucks*

## Wood Bucks - Choosing the Lumber

Historically, full dimension pressure treated two-by 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 surfaces. 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 gypsum board (drywall) installation problems.


Figure 2 – Typical full width wood buck made of pressure treated lumber


Figure 3 – Regular wood lumber with waterproofing membrane


Figure 4 – Typical full width window buck bottom construction


Figure 5 – Opening at bottom of full width window buck for pouring concrete

## Wood Bucks - Connecting Wood Bucks to Concrete

The simplest way to connect wood bucks to the concrete wall is to drive galvanized 16d (3.5”/89mm) nails through the bucks after the block is installed, 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” (305mm) at opposing angles (for example 20-30 degrees from perpendicular), to prevent movement of the buck once the concrete has set.

Figure 6 – Installing nails into the buck for attachment to concrete

## Wood Bucks - Constructing Wood Bucks with R22 ICF

When constructing a wood buck for Amvic R22 6” (152mm) block, use 2”x10” (38mm x 254mm) stock lumber for the top and sides of the buck since the thickness of the concrete and one panel is 8.5” (216mm). The lumber must be trimmed down to 8.5” (216mm) wide to ensure a proper fit.

This may be done using a table saw. The bottom of the buck should be constructed using a single pressure treated (or with membrane) 2x4’ (38mm x 89mm) on the interior. This leaves an opening at the bottom of the window which will be used to pour concrete and insert the concrete vibrator. Additional horizontal and vertical supports are needed inside and around the buck which are removed after the concrete consolidation.

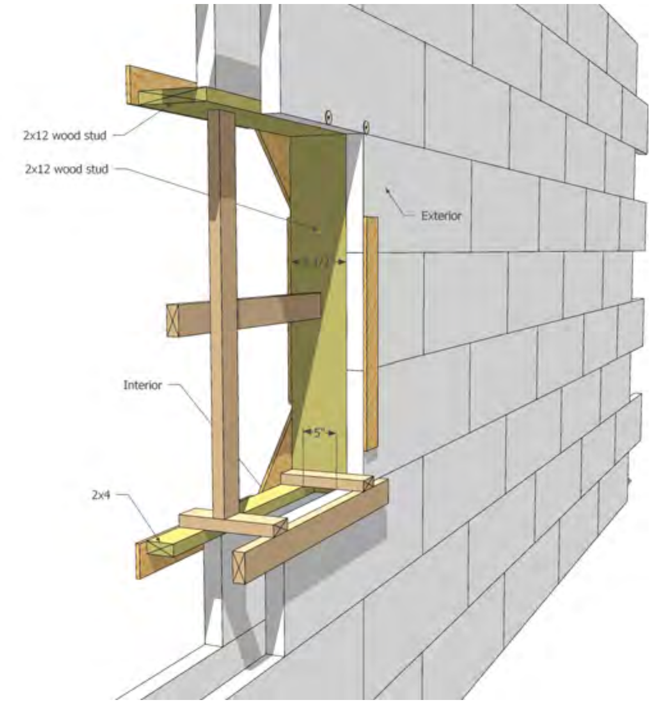



*Figure 7 – Typical wood buck for 6” (152mm) Amvic R22 ICF*

## Wood Bucks – Constructing Wood Bucks with R30 ICF

When constructing a wood buck for Amvic R30 6” (152mm) block, use 2”x10” (38mm x 254mm) stock lumber for the top and sides of the buck since the thickness of the concrete and one panel is 9.25” (235mm). In this case the lumber does not need to be trimmed and can be used as is.

The bottom of the buck should be constructed using a single pressure treated (or with membrane) 2x4’ (38mm x 89mm) on the interior. This leaves an opening at the bottom of the window which will be used to pour concrete and insert the concrete vibrator. Additional horizontal and vertical supports are needed inside and around the buck which are removed after the concrete consolidation.

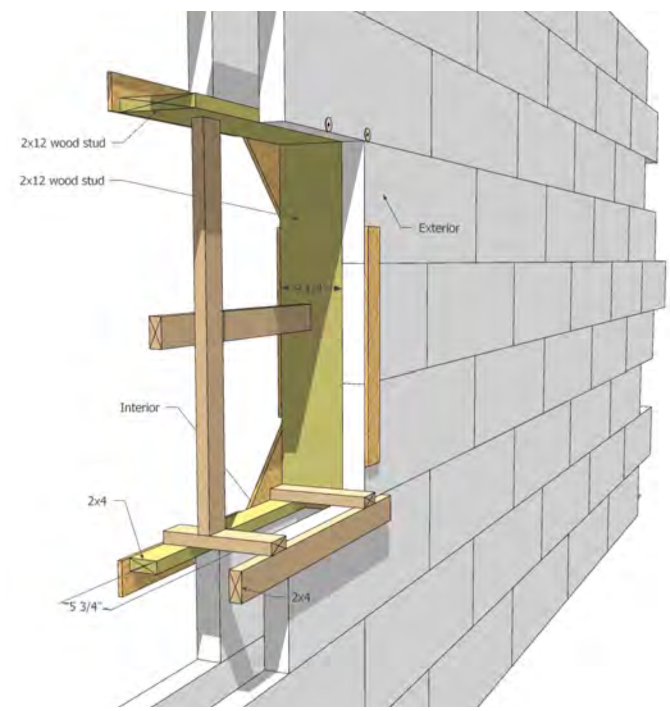



*Figure 8 - Typical wood buck for 6” (152mm) Amvic R30 ICF*

This part covers the installation process in detail for a typical Amvic ICF project.

## Section 8.1 - Mobilization: Materials & Tool Positioning

Once the walls, windows and door openings are laid out, 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;

- Before any installation begins it is preferable to move as much of the block as possible within the perimeter of the wall layout and stack it if necessary. This will minimize workers movement during the construction process.
    a. 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.
- Place rebar and all tools and equipment within the perimeter of the wall layout including the bracing system, bender/cutter, table saws, scaffolding and planks as well as any other equipment that may be needed.
    a. Place all materials and tools at least six feet away from the inside wall to provide space for bracing and alignment equipment.
- 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.

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 two-by lumber through the forms then carry them to the desired location. A greater number of bundles may require using a forklift. An average person can easily carry a few separate blocks during construction.

*Figure 1 – Placing Amvic ICF within the perimeter of the wall layout*

*Figure 2 – Moving ICF bundles by hand*

*Figure 3 – Using forklift to move bundles*

It is highly advisable to order pre-cut and bent rebar from the steel supplier. For 90° corners and Z-shaped rebar, cut and bent rebar to the correct splice length greatly improves site efficiency allowing them to be placed as soon as are delivered to the site.

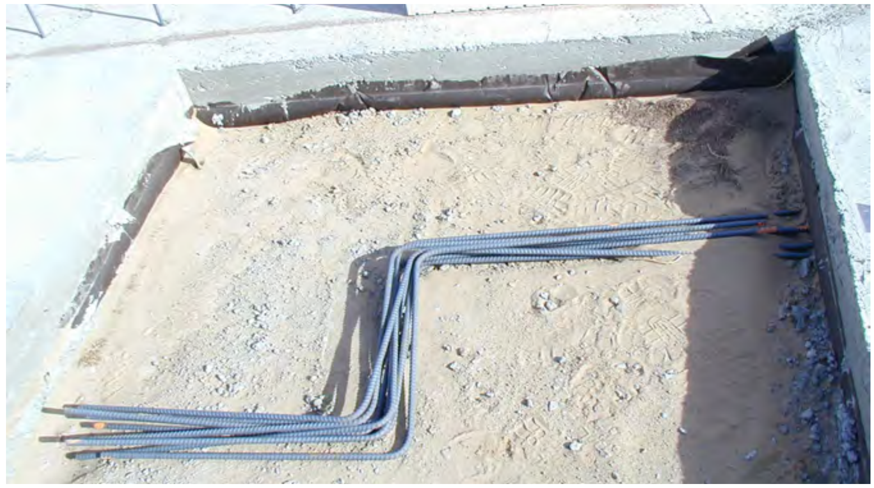


*Figure 4 – Using pre-cut & bent reinforcing steel will increase efficiency*

## Section 8.2 - Course Planning: Determining Wall Heights and Number of Courses per Floor

Prior to laying block, determine the exact wall height required for the project. Amvic ICF is manufactured to 16" (406mm) high with the only exception being the 10" (254mm) and 12" (305mm) blocks which are 24" high (610 mm). If the floor heights are not divisible by 16" (406mm) or 24" (610mm), the two most common practices are the following:

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/slab and will not affect the interlocking of subsequent courses. If using this method, make sure to preserve the polypropylene webs which connect the two EPS panels.
    a. A table saw is recommended for rip cuts since cutting the webs by hand can be tedious and time consuming.
2) Use an Amvic ICF height adjuster. These are available in 2", 3" and 4" heights (51mm, 76mm and 102mm) and can be placed below the first course or above the last course. Placing the height adjuster above the top course is recommended.

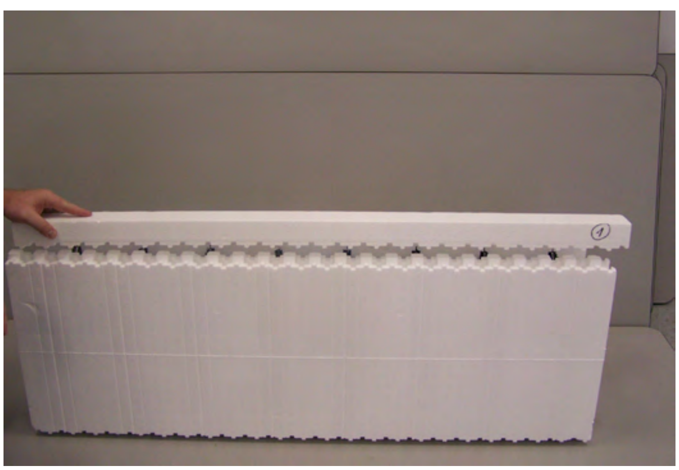


*Figure 5 – Amvic ICF height adjuster*

*Figure 6 – Using a circular saw to horizontally rip cut ICF*

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

## Section 8.3 - 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/slab. Install a temporary kicker, stacked outside to hold each safely in place.
    a. 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 waste.
2) If the first course of blocks is not rip-cut, it is recommended to shave off the nubs on the interlock from the bottom of the blocks to provide a flat surface that can be glued to the footing/slab.
    a. Use the same setting on your table saw when ripping all blocks for the first course to ensure a consistent height and plumb corners.
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.
    a. Test different placements of the corner blocks to minimize block wastage.
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/slab 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.
5) Cut the final block in each wall section to size. Ideally the cut will be made at a 2” (51mm) increment line (centered 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 joint (interlock between two courses do not line up) will be created. The key point here is to keep this offset joint at the same location when stacking the subsequent courses of block.
    a. Offset joints require additional bracing to withstand pressure during the concrete pour.

*Figure 7 – Placing Door Bucks*

*Figure 8 – Placing corner block first*

*Figure 9 – Placing straight blocks*

*Figure 10 – Cutting the final block for a wall section*

*Figure 11 – Fitting the cut block in place*

6) Connect blocks in the first two courses together using zip ties (plastic ties). One zip tie per end joint is generally sufficient. Place zip ties towards either edge (next to the EPS inside face). Tightening the zip ties 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 12 – Using zip ties to tie the first course of blocks together*

7) Install the horizontal reinforcing steel as per engineering or local building code requirements (See Canadian and US Design Guides).

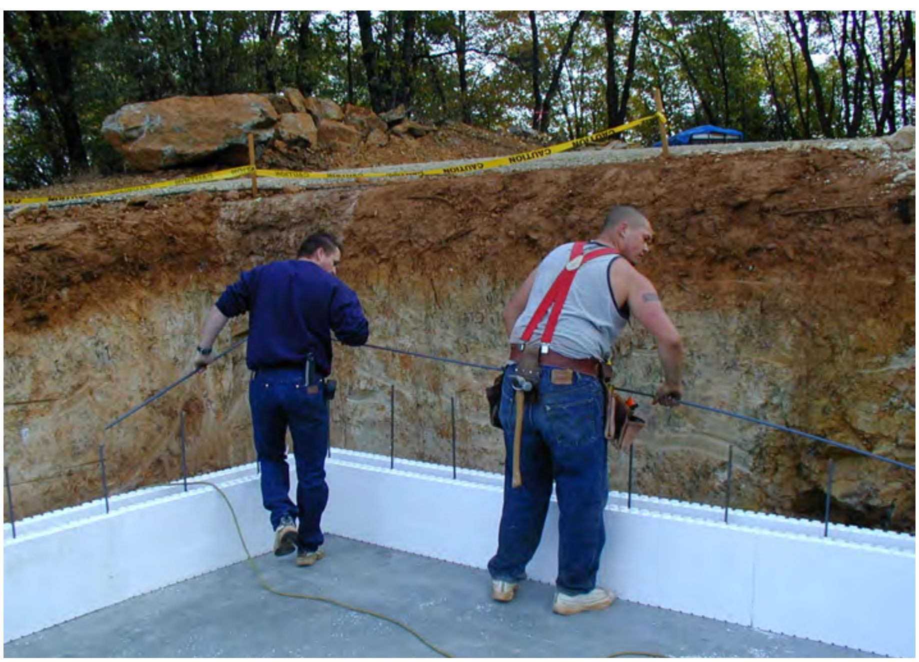


*Figure 13 – Installing horizontal rebar*

## Section 8.4 - Placing the Second Course of Block

*Figure 14 – Second course placement*

1) Stacking with the corner blocks first. Every corner block has a short leg and a long leg. Make sure that the corner block is reversed at 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 running bond pattern between the two courses.
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 the offset joint remains roughly in the same place.
    a. It is very important to keep the offset 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.
4) Press down firmly on the blocks to ensure a secure connection with the course below.
5) Install horizontal rebar as per engineering or local building code requirements.

*Figure 15 – Reversing 45° corner blocks for bay window*

*Figure 16 – Placing the offset joint in approximately same place as first course*

## Section 8.5 - Checking for Level

Once the second course has been laid, setup a laser level and place a square of plywood or OSB over each corner block to check for level. If the wall is more than 1/4 of an inch (6mm) out, then the wall will either need to be pushed up (using shims) at the low spots or trimmed at the high spots. A good method to trim block at high spots is to slide a hand saw underneath the blocks (at the desired location) and cut off the desired amount. Use foam cuttings as shims to level the wall at the vertical joints. Once the walls have been leveled to be within ¼" (6mm), the first course of block is ready to be secured to the footings/slab.

*Figure 17 – Checking for level after second course placement*

*Figure 18 – Shimming the first course with foam cuttings*


*Figure 19 – Trimming the first course of block with a hand saw*

## Section 8.6 - Securing First Course to Foundation/Slab

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/slab. Insert the nose of the foam gun into one of the notches every 6–12 inches (152-305mm) 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.

*Figure 20 – Using foam adhesive to secure the first course of block to the foundation/slab*

If the form interlock on the bottom of the first course was not cut prior to the installation, it is recommended to have a continuous bead of foam adhesive to secure the first course to the footings/slab and to prevent the cement paste in the concrete from leaking away. Securing the first course of block to the foundation is an ideal task to do just before a break.

*Figure 21 – Gluing an unshaven first course to the footing/slab*

## Section 8.7 - Placing Third & Subsequent Courses of Block

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

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 joints 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 (for R22) or triple grooves (for R30) on the outside face of the EPS panels).
    a. Webs will not line up where your offset joints occur.
4) Place horizontal steel reinforcement as required by engineering or local building code.

### Section 8.7.1 - Cutting block around door bucks

If the installer has chosen to delay door buck installation until after the first two courses of block are in place, it must be done at this point. Cut the blocks and secure the door bucks in place, remember to leave ¼" (6mm) gap between the forms and the buck to allow for adjustment before pouring the concrete.

*Figure 22 - Stacking courses around door bucks*

### Section 8.7.2 - Elevated doorways

For doors on second floor 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 practice to install a pressure treated 2x4" (38x89mm) or 2x6" (38x140mm) sill into the block that will be poured in place to provide an attachment point for the door threshold.

*Figure 23 – Installing Door bucks on the second floor*

## Section 8.7.3 - Cutting Forms around Window Bucks

The window and/or door bucks should already be assembled and ready for installation. The bottoms of window bucks are usually placed in the 3rd or 4th course of blocks and must be perfectly level. If not, then trim or shim as required. When cutting the block, leave a ¼" (6mm) gap between the block and the buck to allow for adjustment after all the courses have been stacked and before concrete is poured.


*Figure 24 – Building courses around window bucks*

## Section 8.7.4 - Reinforcing Steel around wall openings

Install reinforcing steel around the window/doors as blocks are stacked. Wall openings are required to have minimum shrinkage and crack control steel bars on both sides of the sill (area below window opening). For wall openings greater than 2' (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 (See Canadian and US Design Guides).

*Figure 25 – Installing reinforcing steel bars for wall opening header or lintel*

## Section 8.7.5 - 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 interlocking to be misaligned should there be another ICF wall floor above. The following steps are recommended for each top course;

1) Tie each block to the next using zip ties on the webs ensuring they are pulled snugly together. Do not place ties in the centre of the webs, to avoid flexing and cut off the ends of the ties.
2) Use a horizontal wailer around the top at the corners of the structure. A2x4" (38x89mm) lumber is ideal. Install an Amvic ICF screw into every other web on each block to minimize stretching.
3) For long and narrow wall sections, install a wailer on both sides of the block wall and fasten them to each other. This prevents the course from flexing outwards.
4) If another course of block will be installed above this temporary top course, protect the top interlock of the block.
    a. An ideal protective covering for the R22 block is a 2-1/2" (64mm) metal stud starter track. It is exactly the right dimension to fit over the EPS foam panel on each side. Alternatively, 4" (102mm) wide plastic tape can be used.
    b. For the R30 block which has wider EPS panels, a 4" (102mm) wide plastic tape can be used.

*Figure 26 – Protecting the interlock on a top course*

### Section 8.7.6 - Installing vertical rebar

The vertical reinforcing steel bars are installed after the top course of block for each floor has been placed. The steel bars are inserted from the top of the wall through the weave created by the alternating horizontal bars which are already installed. If top course of block will NOT have another floor of ICF installed over it, the vertical reinforcement steel bars need to be cut 2” (51mm) short as to ensure there is 2 inches (51mm) of concrete cover above them. If there will be another ICF wall story above, then refer to Part 6 of this manual for splicing details and placement. Review site safety plans and OSHA compliance regulations for protruding steel bars on the jobsite to protect workers from this hazard.

*Figure 27 – Installing vertical rebar*

### Section 8.8 - 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 gusts 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 scaffolding must meet the safety requirements of OSHA (Occupational Safety and Health Administration).
- In Canada scaffolding must meet the fall protection and scaffolding regulations of OHSA (Occupational Health and Safety Act).

### Section 8.8.1 - General application

The following rules of thumb generally apply to bracing and alignment systems to be used with Amvic ICF. Amvic recommends using Plumbwall’s ICF bracing system, but it is compatible with virtually all bracing system types, check with your local Amvic distributor to ensure that it is appropriate for your use.

- Bracing is typically installed by the 3rd or 4th course of block.
- Bracing in most cases is installed only on the inside of the wall structure, maximizing construction efficiency since this is where all the labor work occurs.
- Bracing is able to push the wall outward very well but is limited in its pulling capability. While generally bracing is placed only one side, if there is a wall section that cannot be plumb any other way, bracing on both sides can be installed in order to align the wall properly.

*Figure 29 – Bracing on the inside of the wall*

Most bracing systems include a scaffold platform upon which scaffolding planks are placed for workers to work from along with provision for installing a handrail. Scaffold planks and handrails are typically not included with the bracing system and are provided separately.


*Figure 30 –Platform and scaffold planks*

Bracing is usually attached either with a “hat bracket” that wraps the strongback or through slotted screw holes in the brace. It is recommended to use Amvic’s 2” (51mm) ICF screws to secure the strongback to the ICF webs. For a strongback with slotted screw holes, install the screws near the top of the slot. Over tightening the screw may result in the block settling or compressing which can misalign a wall, however, this is unlikely with Amvic ICF which compresses very little. If the first course of ICF blocks is firmly attached to the footing/slab using glue, start the bracing installation from the second course. Attach the strongback at every course and twice for the top course.

*Figure 31 – A hat bracket wrapped around a vertical strong-back and screwed to webs on both sides*

## Section 8.8.2 - Spacing for the alignment and bracing system

Depending on the system used and the governing local codes, there are minimum spacing requirements for the bracing which holds scaffolding. The following are common requirements for location of bracing and typical spacing. Install one brace within 2' (610mm) of the corner and the other 3' (914mm) to allow the platform supports to miss each other.

*Figure 32 – Bracing corners on the inside*

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

*Figure 33 – Bracing both sides of wall openings*

Install braces along all the wall segments at a maximum of 6’ (1.8m) apart.

On walls that end without an adjoining corner (stub walls), install braces on all three sides of the stub. On T-walls, install at least two kicker braces on the outside of the T (the top). This is due to walls tending to bulge at T-joints due to the pressure from the concrete in the leg of the T. If in doubt, add another brace.

*Figure 34 – Bracing every 6’ (1.8m)*

## Section 8.9 - Preparing Bucks for the Concrete Pour

At this stage, the windows and door bucks need to be checked for any final adjustments to be ready for the concrete pour. The following steps are recommended;

1) Ensure that window and door bucks are square and plumb, adjust as required.
2) 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 35 – Filling gaps between bucks and forms with foam adhesive*

3) At each buck, in at least the four corners on each side, install a cleat that screws to the buck and overlaps 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 36 – Installing cleats around wall openings*

4) If already not done so, install both horizontal and vertical braces in all doors and windows bucks. There should be a cross brace at least every 2' (610mm). Lintels over 8' (2.4m) may require additional shoring.

*Figure 37 – Bracing wall opening vertically and horizontally*

## Section 8.10 – Required Additional Bracing

Additional bracing may be required to reinforce areas where the factory edge has been compromised due to cutting of the block (e.g. stack joint). This bracing generally comes in the form of OSB and dimensional lumber should be used to connect at least two intact webs (or web and a buck) to reinforce said area.

This added reinforcement is extremely important. 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 are locked together both above and below by connecting of the interlocking nubs. Additional cleats or bracing is required for any but not limited to the following situations:

- Where an internal web has been cut out (to fit around rebar or other obstructions). It is important to mark the block face at the time of the web cutting in order to be able to later locate it with ease and reinforce the area as needed.
- 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 is repeated exactly in the same place for above courses to follow.


*Figure 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 there has been a cut in the last block in a wall section so that it fits the required wall dimension. The "running bond" pattern on an offset joint is less than 12" (305mm) which is the recommended overlap of the interlock.
- Where the edge of the block joins a window or door buck if using wooden bucks.

*Figure 39 – Additional bracing when vertical joints are less than 6in (152mm) apart*

*Figure 40 - Cleat installation around a door opening using OSB*

## Section 8.11 – Utility Penetrations

Penetrations for utilities must be installed after the full wall height has been stacked and before the concrete has been poured. Generally all wiring and plumbing is ran inside the walls by cutting channels and imbedding in the EPS foam (after the concrete is placed). Wiring for external fixtures is normally run through the wall only at the point where the external fixture will be placed. Penetrations are required for the following;

- 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 (when the furnace is in the garage and the ducts run beneath a raised floor)
- 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 for tight seal.

*Figure 41 – Using PVC pipe for penetration block-outs*

## Section 8.12 – Suspended Floor Installations

Floor systems are most commonly suspended from rim joists or ledger boards that are mechanically attached to the concrete with anchor bolts or with a proprietary tie. The Simpson Strong-Tie™ ICFVL ledger is highly recommended, as it simplifies the installation and can be used with both wood and steel floor joists. Other methods can also be used and will be either addressed in Part 9 of this manual or can be found on Amvic's website in the form of technical bulletins or construction details.

## Section 8.12.1 – Ledger boards Installed with Anchor Bolts

Anchor bolt sizing, spacing and pattern of installation, must be specified by a structural engineer as it is an essential element of the structural design. The "Prescriptive Method" has some engineering tables for using anchor bolts to connect wood floor joist to ICF walls.

Installation:

1) Cut 8x8" (203x203mm) 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" (13 mm) OSB, there needs to be approximately 3-1/4" (83 mm) of thread.

*Figure 42 – Cutting square OSB boards for anchor bolt installation*

3) Cut out a 4" (102mm) 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° allowing the concrete to readily fill the cavity and be flush with the outside face of the EPS.

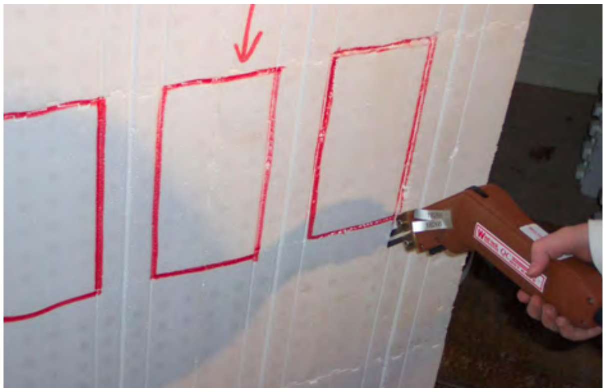


*Figure 43 – Cutting openings in EPS between webs*

*Figure 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. Drywall screws work well.

*Figure 45 – Installing the OSB with anchor bolts onto the EPS openings and securing with drywall screws*

5) Allow at least 3 days after the pour before tensioning the anchor bolts.

*Figure 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 to the ledger board.

*Figure 47 – Installing ledger board with proper nuts and washers*

## Section 8.12.2 - Simpson Strong-Tie™ ICFVL Ledger Connector System Overview

The Simpson Strong-Tie™ ICFVL connector is the preferred method for attaching a ledger, primarily because it lowers cost of construction of the floor. The labor time to install an ICFVL 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 ICFVL permit the concrete to flow around it, anchoring the ICFVL securely to the concrete. The exposed flange provides a structural surface for mounting either a wood or a steel ledger. In addition, the available ICFVL-W and ICFVL-CW provide easy mounting for both two-by lumber and LVL respectively. Steel ledger is easily attached using four drill-point screws. The system comes in three parts (see Simpson Strong-Tie™ website for more detailed information).

1) Base plate designated as ICFVL. It comes in 14 gauge (0.068" (1.73mm)) thickness, galvanized steel.
2) Ledger connector designated as ICFVL-W or ICFVL-CW made of 16 gauge (0.054" (1.37mm) thickness, galvanized steel.
3) Eight (per base plate) ICF-D3.25 screw (for wood only).

*Figure 48 – ICFVL base plate*

*Figure 49 – ICFVL-CW ledger connector*

## Section 8.12.3 - Installing Simpson Strong-Tie™ ICFVL Ledger Connector System

1) Once the exact location of the hangers has been planned and marked, press the legs of the ICFVL base plate into the foam to mark their exact size and orientation.
2) Make two saw cuts in the block and insert the legs of the ICFVL piece into the block.

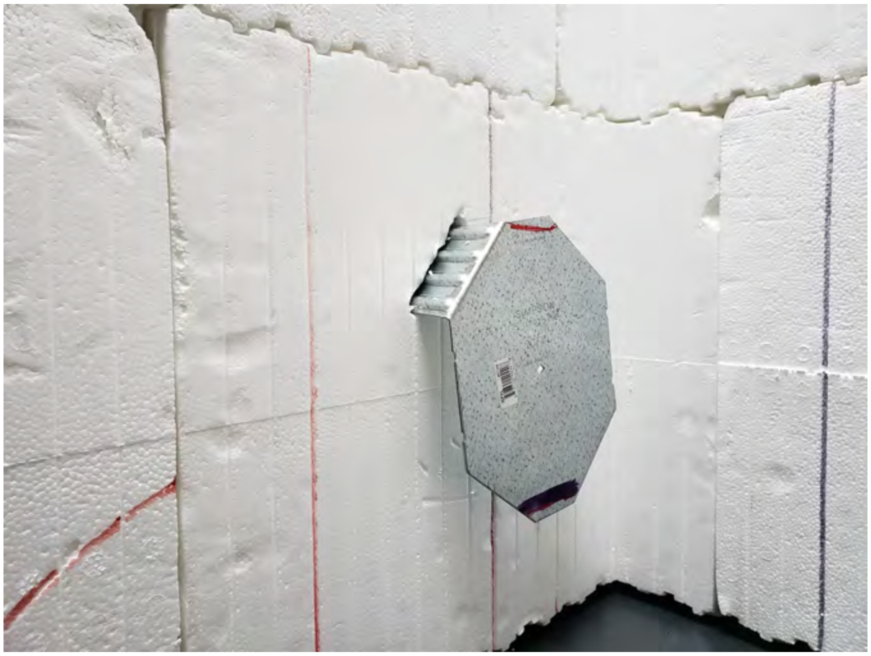


*Figure 50 – Inserting the ICFVL long legs through the EPS and into the concrete*

3) Fix it in place either with a foam adhesive or a single screw through the small hole in the center of the ICFVL plate into a web (the ICFVL base plate would need to be centered with the web).
4) 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 51 – Securing the ledger board in place temporarily*

5) Install the ICFVL-W or ICFVL-CW connector piece around the ledger.
6) Using a drill, install the self-tapping screws through the holes in the ICFVL-W/ICFVL-CW, through the ledger connector and into the flange of the ICFVL base plate.


*Figure 52 – Laminated Veneer Lumber ledger attached using ICFVL-CW*

7) Attach the floor joists to the ledger board using standard top mount floor hangers.

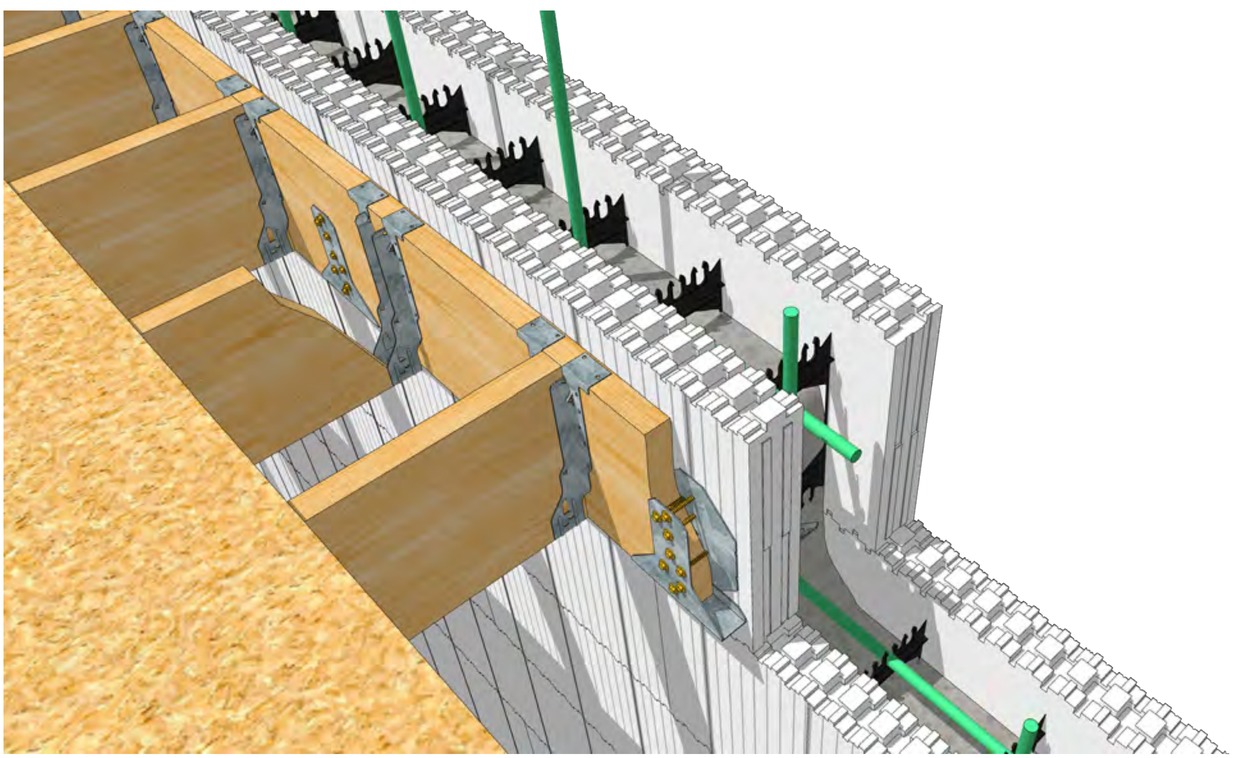


*Figure 53 – Attaching floor joists to the ledger board with the Simpson-Tie™ (ICFVL-W with dimensional lumber shown)*

Additional technical and engineering information on the ICFVL system can be found at **www.strongtie.com**

## Section 8.13 – Beam Pocket and 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 structural design. A beam pocket made inside the wall can 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 the beam will bear, cut out an opening from the inside and outside EPS panels. Make sure that the cut-out pieces are aligned in elevation and are larger than the actual beam size by about 1/2” (13 mm) all around. This will facilitate placing the beam in place.
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 again be aligned with the opposite wall and larger than the actual beam size by 1/2” (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.
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 54 – Cut beam opening through both EPS panels*

*Figure 55 – Block opening voids with scrap foam or wood*

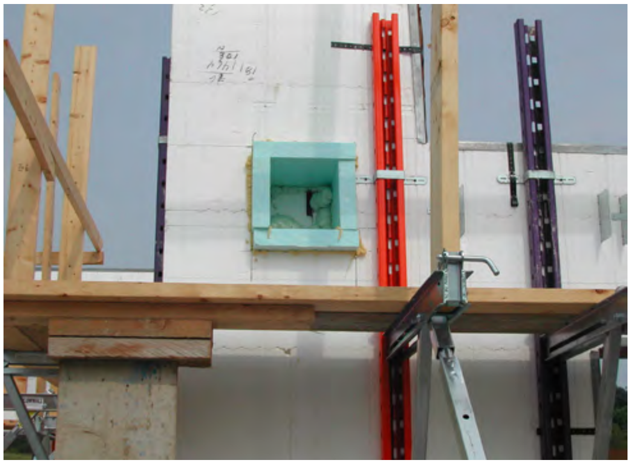


*Figure 56 – Opening should be blocked deep enough to provide required bearing*

*Figure 57 – Once the concrete is cured sufficiently, void fill is removed, and beam is installed*

*Figure 58 – Maneuvering wood beam in place to bear on beam pocket*

## Section 8.14 - Final Adjustments Prior to Pouring of the Concrete

Check corners for plumb. Use bracing and add additional bracing if 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" (38x89mm) 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 wall to the string line.

Many builders prefer to lean the center of each wall inward (toward the bracing) by 1/4" (6mm) 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.

This part explains some of the more advanced installation techniques and special floor systems that can be used with Amvic ICF. The most common special installations are included below, however if the project has any site specific situation that are not covered by this manual, please contact us for assistance.

## Section 9.1 - 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.

### Section 9.1.1 – Short corners using 90° corner blocks with a stack joint

A short corner can be constructed using at least two (2) 90° corner blocks. Refer to Part 5 for coursing and minimum corner dimensions using this method. Recommended steps are given below;

- Install the first course so that the short legs on both blocks are adjoining each other as illustrated in Figure 1 below.
- Install second and consecutive courses of corner blocks in the same manner without alternating forms. This will create a stack joint.
- Ensure stack joint is adequately braced on both sides of forms and at every course.
- Failure to brace a stack joint adequately may lead to a blowout during the concrete pour. Make sure to use additional bracing if necessary.

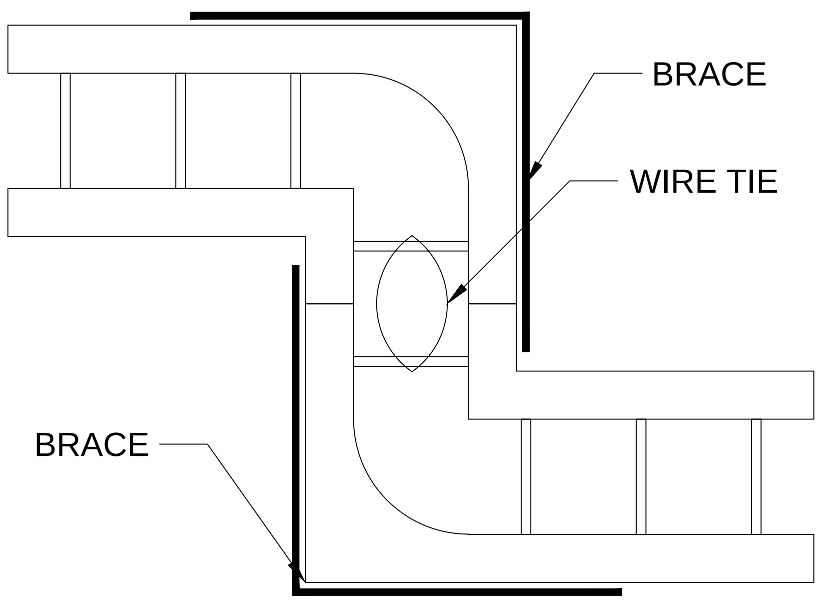



*Figure 1 – Short corner made of 90° forms with a stack joint*

### Section 9.1.2 – Short corners using 90° corner blocks with a running bond pattern

This method also involves at least two (2) 90° corner blocks. Refer to Part 5 for coursing and minimum corner dimensions using this method. The recommended steps are given below;

- Install the first course so that the long leg of one corner block and the short leg from the second block are adjoining each other as illustrated in Figure 2 below.
- Install second and consecutive courses by alternating the forms to create a running bond pattern. Refer to Figure 3 below.

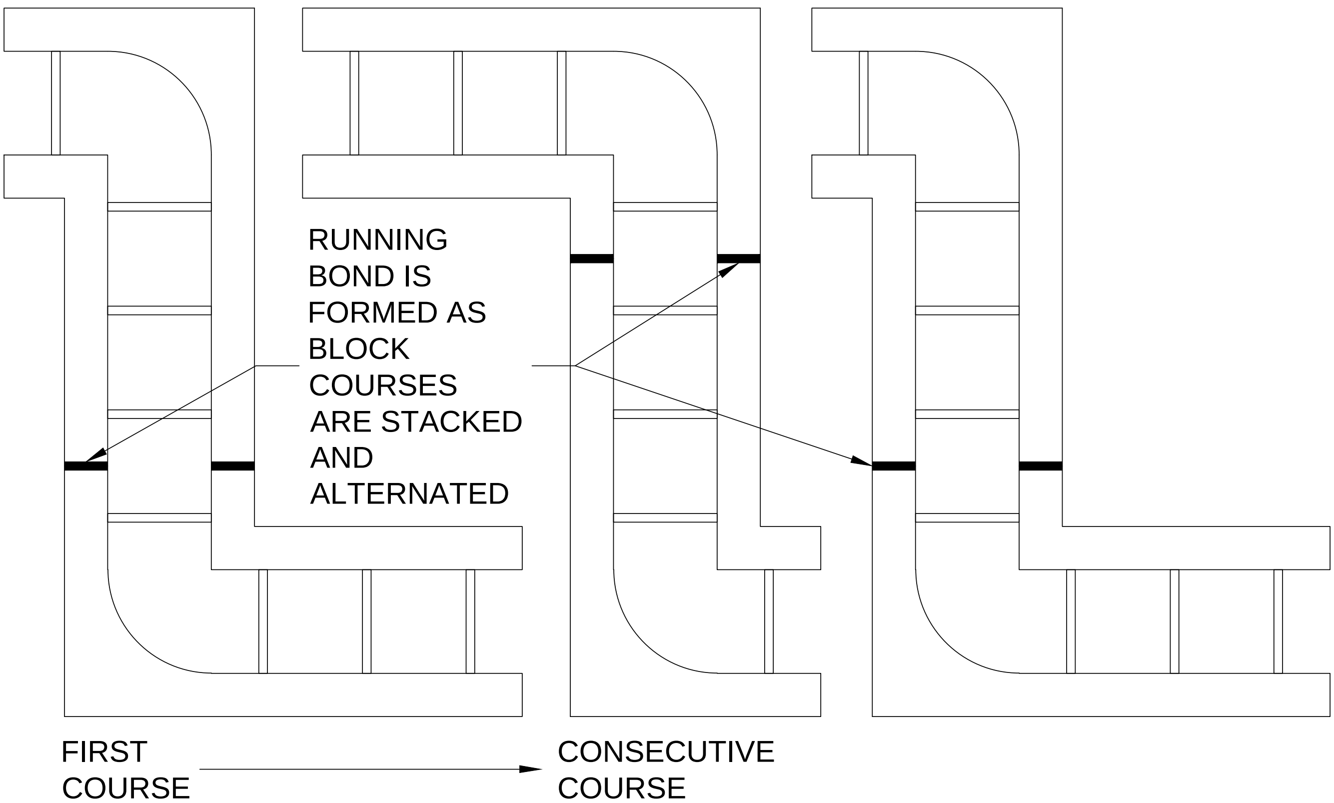



*Figure 2 – Plan view of two short corners made using 90° forms to create a running bond pattern*


*Figure 3 – Short corner made of 90° forms with a running bond pattern*

## Section 9.1.3 – Short corners made of straight Amvic ICF

Corners shorter than the minimum allowed by our 90° blocks can be achieved by using straight Amvic ICF blocks. The recommended steps are given below;

1. Start with two straight ICF blocks.
2. Cut off 6.5, 8.5, 10.5, 12.5 or 114.5” (165, 216, 267, 318 or 368 mm) depending on the block core size being used for Amvic R22 blocks.
3. Cut off 9.25 or 11.25 inches (235 or 286 mm) depending on the block core size being used for Amvic R30 blocks.

*Figure 4 – Cutting foam from the end of the straight block on one EPS panel*

4. Set the forms in place and glue the cut off pieces to fill the ends of the forms thereby creating a 90° corner.

*Figure 5 – Setting the two cut forms into position*

*Figure 6 – Using cut off pieces to close the open ends and create a corner*

5. Construct two 90° wood forms made of 2x10” (38x235mm) lumber and place them on each of the formed EPS corners.

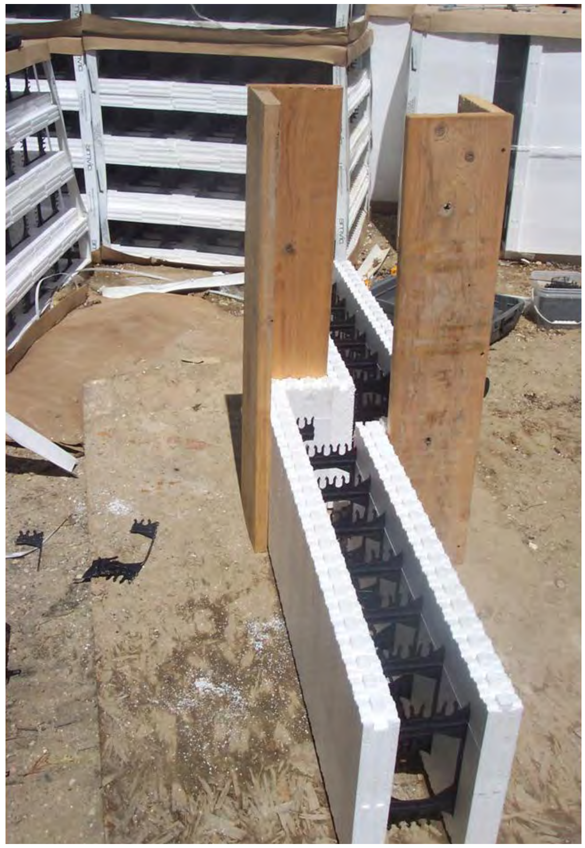


*Figure 7 – Using 2x10" (38x235mm) wood forms to support the formed corner*

6. Drill a 1/2" (13 mm) hole through the wood forms and the EPS panels starting about 12" (305 mm) from footing or slab. Insert a 3/8" (10mm) threaded rod through holes in the wood forms. Use plate washers and nuts on both sides to hold the rod securely.

*Figure 8 – Inserting the threaded rod through the drilled holes*

*Figure 9 – Threaded rod inserted through both wood forms*

7. Continue to cut and stack the blocks to the desired wall height. Place the threaded bolts approximately 16" (406mm) 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.

## Section 9.2 - 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. Radius forms can also be constructed by the contractor on site using straight Amvic ICF.

### Installing Radius Forms:

1. On the footings/slab, 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.
3. After laying the first course, install the horizontal rebar as per engineering requirements and/or local building codes.
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, refer to Figures 13, 14 and tables below for information on radius dimensions and cutting blocks.

*Figure 10 – Pre-cut Amvic radius blocks. Tongue and groove cut on the inside and slit cut on the outside*

*Figure 12 – Several courses of radius blocks installed*

*Figure 11 – Bending and securing the radius form into place*

## Section 9.2.1 Minimum Radii for Amvic ICF

Amvic ICF blocks are available in a wide variety of configurations including pre-cut radius blocks. These blocks are designed to provide the desired curvature while maintaining proper fit between courses for easy and smooth installation. The blocks are tongue and groove cut on the inner wythe and slit cut on the outer wythe according to the needed radius of the wall. Although almost any curve is possible, there is a minimum outside radius requirement depending on the core size and type of form.

Amvic R22 ICF 4” (102mm) – Minimum outside radius is 42” (1067mm)

- Amvic R22 ICF 6” (152mm) – Minimum outside radius is 46” (1168mm)
- Amvic R22 ICF 8” (203mm) – Minimum outside radius is 48” (1219mm)
- Amvic R22 ICF 10” (254mm) – Minimum outside radius is 50” (1270mm)
- Amvic R22 ICF 12” (305mm) – Minimum outside radius is 52” (1321mm)
- Amvic R30 ICF 6” (152mm) – Minimum outside radius is 48” (1219mm)
- Amvic R30 ICF 8” (203mm) – Minimum outside radius is 50” (1270mm)

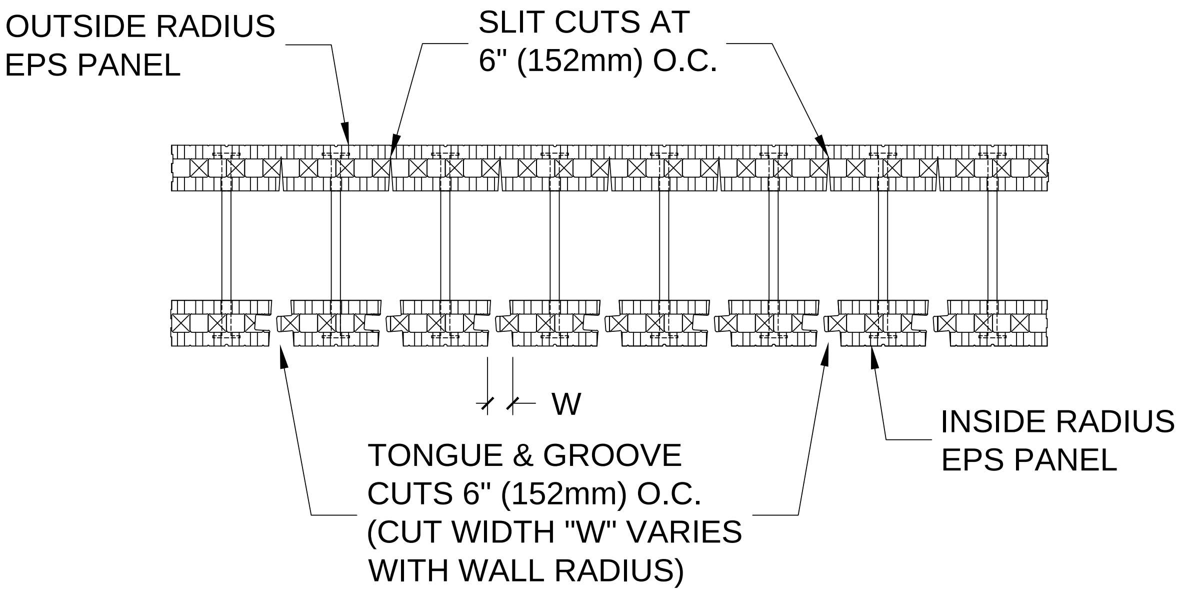



*Figure 13 – Radius wall tongue & groove and slit cut details*

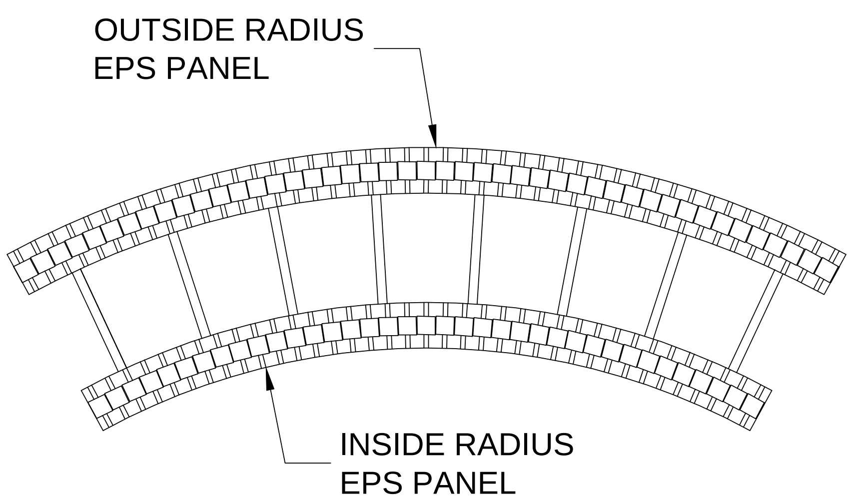



*Figure 14 – Radius wall bent to shape*

| Outside Wall Radius | Tongue and Groove Cut Width “W” Spaced at 6” (152mm) o.c. 4” (102mm) ICF Core Width | 6” (152mm) ICF Core Width | 8” (203mm) ICF Core Width | 10” (254mm) ICF Core Width | 12” (305mm) ICF Core Width |
|---|---|---|---|---|---|
| 3.0’ (0.9m) | 1.714” (43.5mm) | 2.095” (53.2mm) | | | |
| 3.5’ (1.1m) | 1.469” (37.3mm) | 1.796” (45.6mm) | 2.122” (53.9mm) | | |
| 4.0’ (1.2m) | 1.286” (32.7mm) | 1.571” (39.9mm) | 1.857” (47.2mm) | 2.143” (54.4mm) | |
| 4.5’ (1.4m) | 1.143” (29.0mm) | 1.397” (35.5mm) | 1.651” (41.9mm) | 1.905” (48.4mm) | 2.159” (54.8mm) |
| 5.0’ (1.5m) | 1.029” (26.1mm) | 1.257” (31.9mm) | 1.486” (37.7mm) | 1.714” (43.5mm) | 1.942” (49.3mm) |
| 6.0’ (1.8m) | 0.857” (21.8mm) | 1.048” (26.6mm) | 1.238” (31.4mm) | 1.429” (36.3mm) | 1.620” (41.1mm) |
| 7.0’ (2.1m) | 0.735” (18.7mm) | 0.898” (22.8mm) | 1.061” (26.9mm) | 1.224” (31.1mm) | 1.387” (32.2mm) |
| 8.0’ (2.4m) | 0.643” (16.3mm) | 0.786” (20.0mm) | 0.929” (23.6mm) | 1.071” (27.2mm) | 1.213” (30.8mm) |
| 9.0’ (2.7m) | 0.571” (14.5mm) | 0.698” (17.7mm) | 0.825” (21.0mm) | 0.952” (24.2mm) | 1.079” (27.4mm) |
| 10’ (3.0m) | 0.514” (13.1mm) | 0.629” (16.0mm) | 0.743” (18.9mm) | 0.857” (21.8mm) | 0.971” (24.7mm) |
| 12’ (3.6m) | 0.429” (10.9mm) | 0.524” (13.3mm) | 0.619” (15.7mm) | 0.714” (18.1mm) | 0.809” (20.5mm) |
| 14’ (4.3m) | 0.367” (9.3mm) | 0.449” (11.4mm) | 0.531” (13.5mm) | 0.612” (15.4mm) | 0.693” (17.6mm) |
| 16’ (4.9m) | 0.321” (8.1mm) | 0.393” (10.0mm) | 0.464” (11.8mm) | 0.536” (13.6mm) | 0.608” (15.4mm) |
| 18’ (5.5m) | 0.286” (7.3mm) | 0.349” (8.9mm) | 0.413” (10.5mm) | 0.476” (12.1mm) | 0.539” (13.7mm) |
| 20’ (6.1m) | 0.257” (6.5mm) | 0.314” (8.0mm) | 0.371” (9.4mm) | 0.429” (10.9mm) | 0.487” (12.4mm) |
| 25’ (7.6m) | 0.206” (5.2mm) | 0.251” (6.4mm) | 0.297” (7.5mm) | 0.343” (8.7mm) | 0.389” (9.9mm) |
| 30’ (9.1m) | 0.171” (4.3mm) | 0.210” (5.3mm) | 0.248” (6.3mm) | 0.286” (7.3mm) | 0.324” (8.2mm) |
| 35’ (10.7m) | 0.147” (3.7mm) | 0.180” (4.6mm) | 0.212” (5.4mm) | 0.245” (6.2mm) | 0.278” (7.1mm) |
| 40’ (12.2m) | 0.129” (3.3mm) | 0.157” (4.0mm) | 0.186” (4.7mm) | 0.214” (5.4mm) | 0.242” (6.1mm) |
| 45’ (13.7m) | 0.114” (2.9mm) | 0.140” (3.6mm) | 0.165” (4.2mm) | 0.190” (4.8mm) | 0.215” (5.5mm) |
| 50’ (15.2m) | 0.103” (2.5mm) | 0.126” (3.0mm) | 0.149” (3.6mm) | 0.171” (4.1mm) | 0.193” (4.9mm) |

*Table 1 – Cut out opening width “W” for varying radii (imperial and metric) for R22 forms*

## Section 9.3 - T-Wall Construction

T-wall connections can be done in a few ways with either factory purpose molded blocks or they can be constructed on site with straight blocks. As with any ICF wall, proper bracing and alignment are essential but T-walls require special attention before concrete placement.

1. T-wall connection must be marked starting with the first course of block.
2. Use Amvic T-blocks where applicable. Amvic's T-block come in pairs, a shorter and longer that stagger and create a running bond pattern on all three sides (see highlighted T-blocks in purple Figure 17).
3. Install bent horizontal 90° corner rebar with the proper lap splice length as per Part 6 of this manual or local building code/ engineering requirements.
4. For below grade and main/ground floor walls, additional bracing MUST be installed on the exterior side of the intersection. Failure to brace properly may cause a blowout during the concrete pour.
5. For above grade levels where there is no ground surface to anchor the exterior bracing to, use plumber straps (highlighted in red, Figure 17) fastened to the first two webs (highlighted in yellow, Figure 16). Do not tighten the straps yet.
6. Once the wall is formed to desired height, slide a 2x lumber down the backside of the wall that runs straight through in between the forms and the plumber straps. Tighten the straps to hold the lumber in place. Make sure the straps are placed at every course.

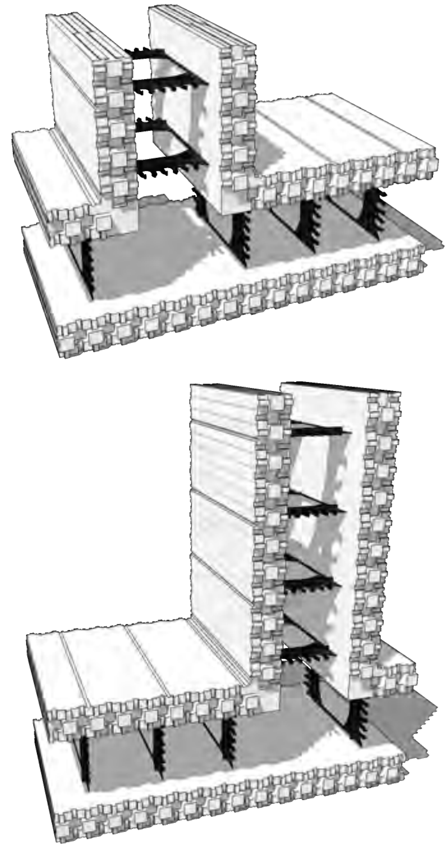


*Figure 15 – Amvic's molded 6" R22 short (top) and long (bottom) T-Block*

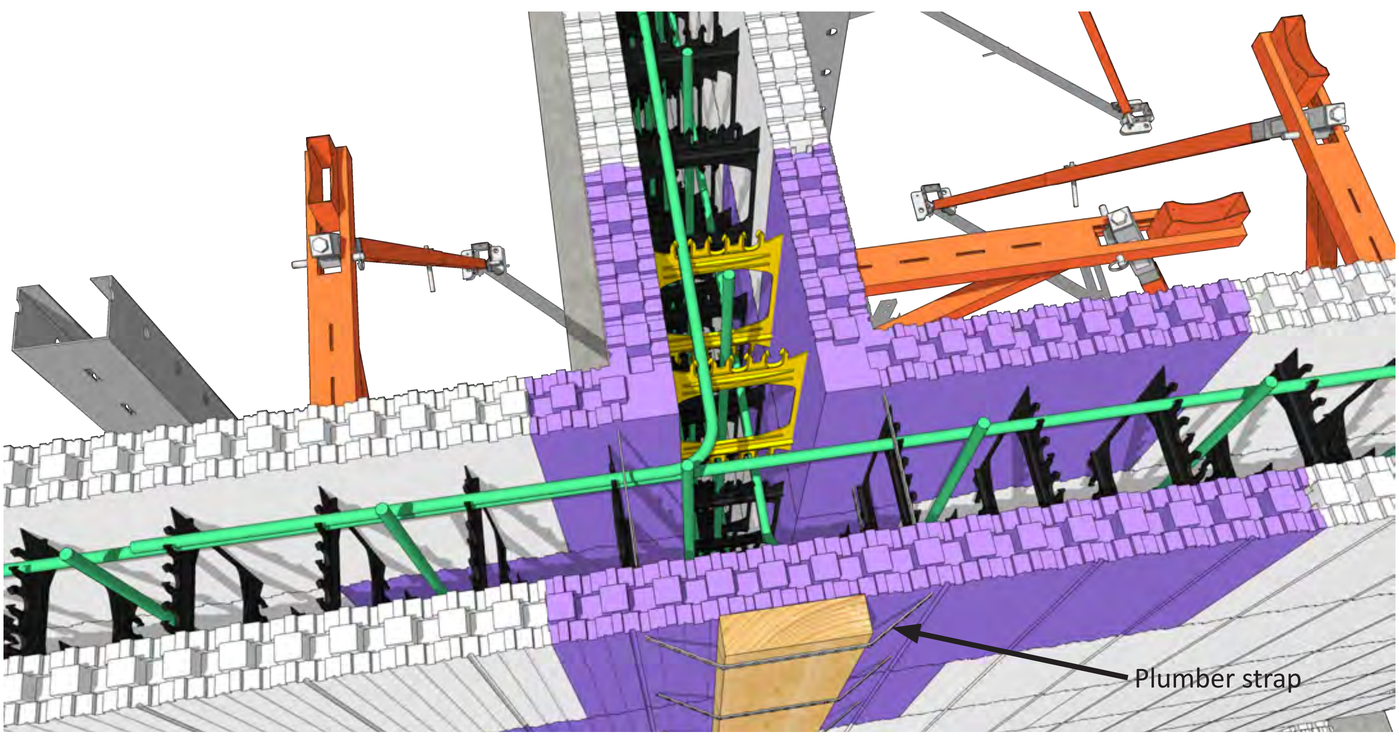



*Figure 16 – Typical T-wall connection diagram showing Amvic's molded R22 6" (152mm) blocks*

## Section 9.3.1 - Site Constructed T-Wall Connection

In some instances, where T-blocks are not available, a T-wall connection can be built on site with regular straight blocks. This methodology is applicable to all of the Amvic ICF block sizes and styles with minor differences in the actual configuration.

1. Cut the blocks as needed to fit the size and location for the T-wall connection. The T-wall should be abutting the exterior wall and not the other way around in order to maintain the correct level/plumb. Use spray foam adhesive to glue the blocks together.
2. Do not cut the web at the intersection to allow the horizontal rebar to slide through it (highlighted in blue).
3. Use two zip ties (highlighted in red) to tie the two closest webs (highlighted in yellow) to the 36" (900mm) horizontal #5 (15M) rebar (highlighted in purple) at every course.
4. Secure dimensional lumber on each side of the T-wall to the ICF webs to ensure blocks do not shift during concrete placement.
5. For below grade and main/ground floor walls, additional bracing should be installed on the exterior side of the intersection. Where an exterior brace cannot be installed, secure a 2x lumber to two icf webs (highlighted in yellow) using plumber strap at every ICF course.
6. Install bent horizontal 90° corner bars with the proper lap splice length as per Part 6 of this manual or local building code/engineering requirements.

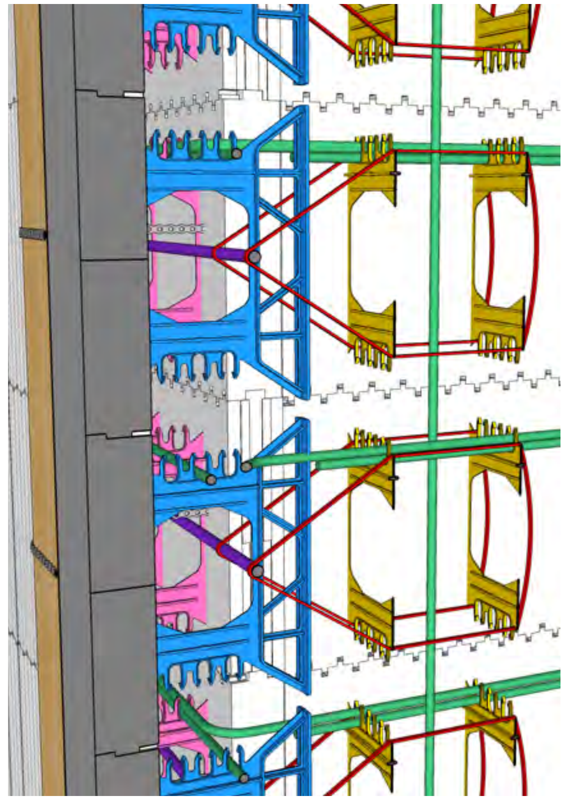


*Figure 17 – Section view showing location of #5 (15M) bar and zip ties*

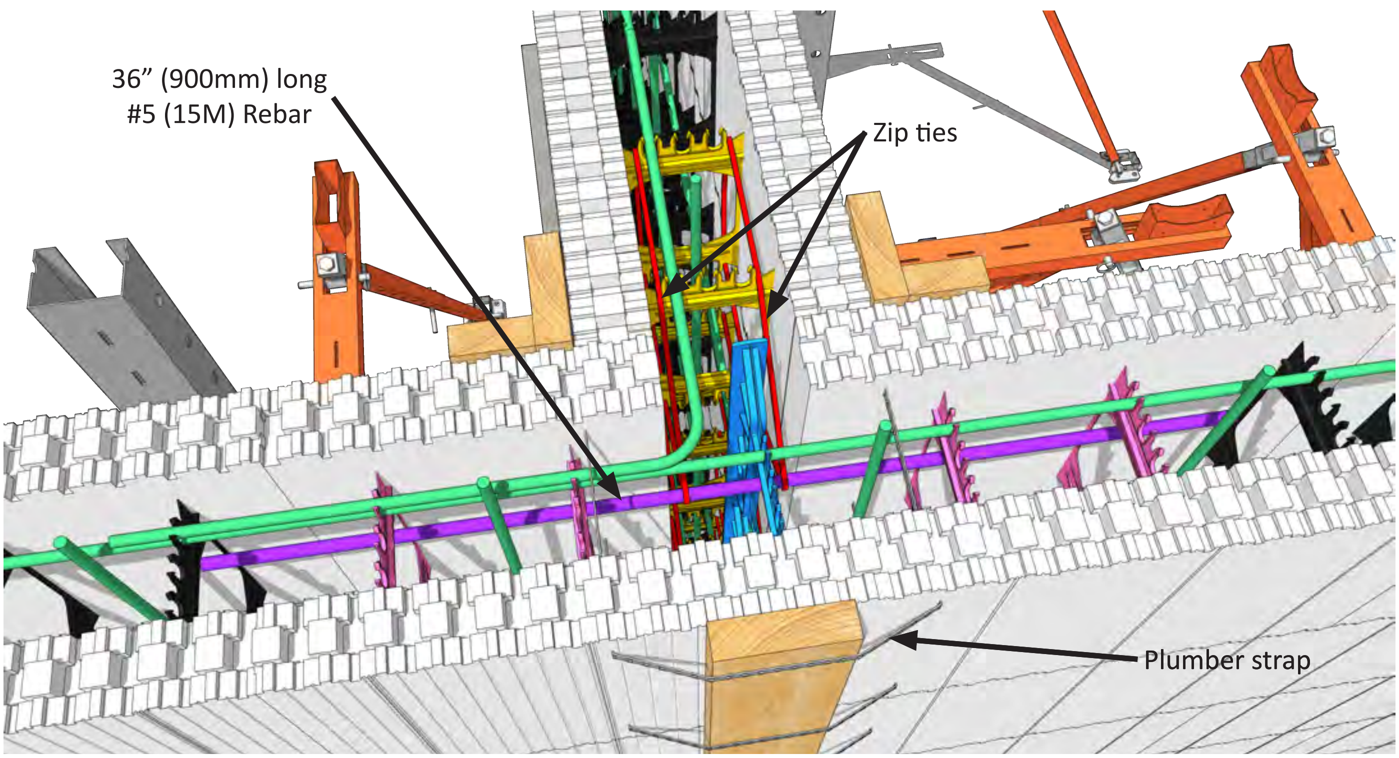



*Figure 18 – Typical site constructed T-wall connection usign straight blocks*

## Section 9.4 - 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 cladding which cannot be supported by screwing into the Amvic block webs.

Amvic has 3 types of brick ledge forms available (R22 6" (152mm) and 8" (203mm) cores and R30 6" (152mm) only). These are installed in exactly the same manner as straight blocks and provide the space and structural support needed for your exterior brick veneer, natural stone or other heavy cladding applications.

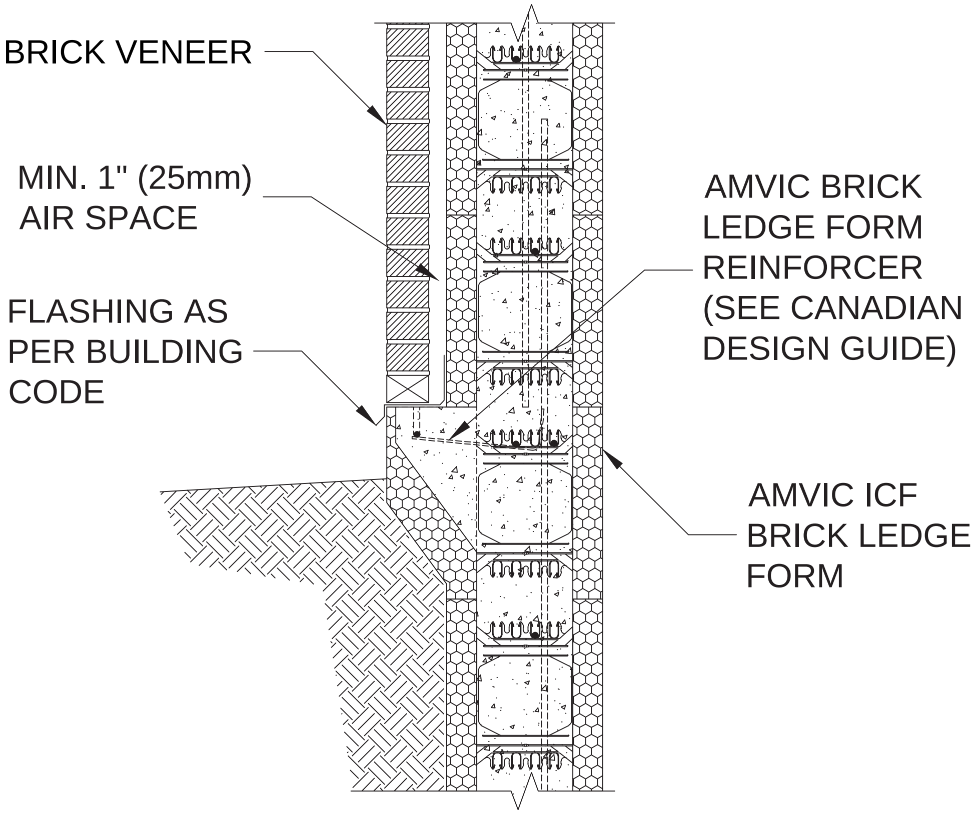



*Figure 19 – Brick ledge form used for supporting exterior masonry veneer*

Alternatively, the brick ledge block 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.

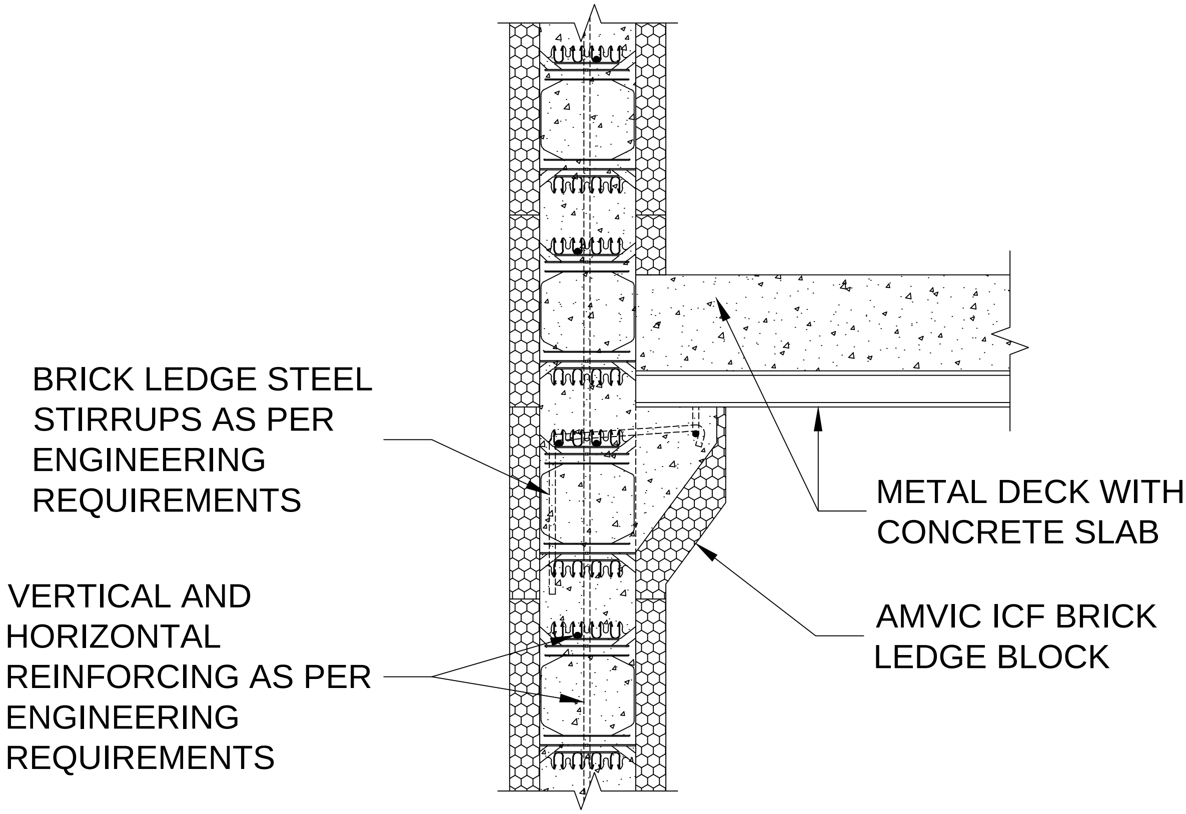



*Figure 20 – Brick ledge form used for supporting interior floor system*

## Section 9.4.1 – 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 (or Amvic Brick Ledge Reinforcer) on which the main steel stirrups are attached and anchored.

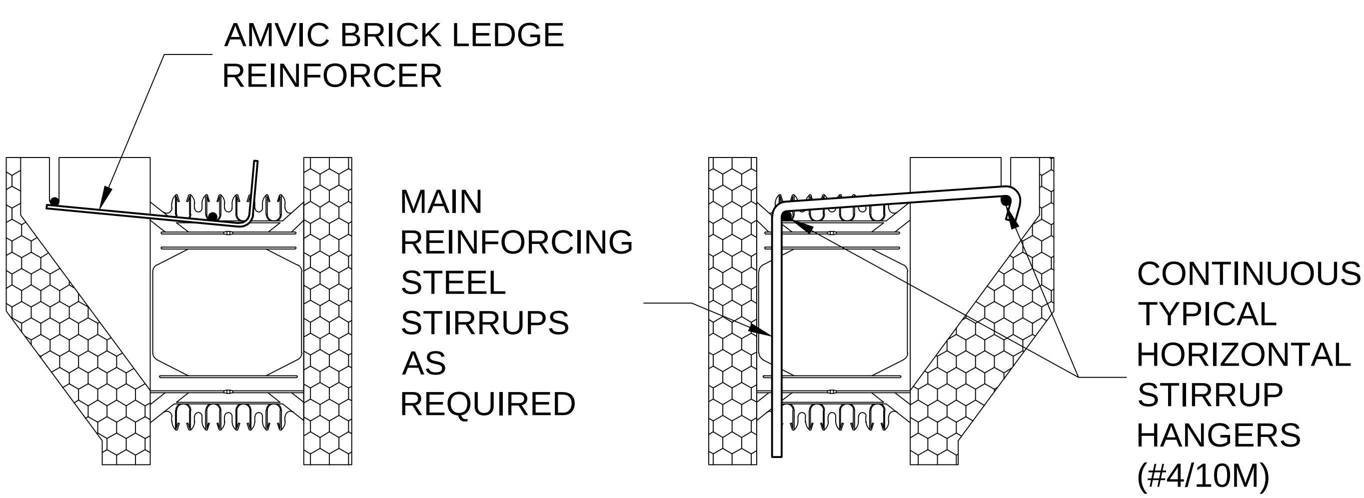



*Figure 21 – Cross section of 8” (203mm) brick ledge form with Amvic Brick Ledge Reinforcer or conventional stirrups*

*Figure 22 – Amvic brick ledge form installed as a single course*

*Figure 23 – Completed brick ledge installation for exterior brick veneer support*

## Section 9.4.2 – Installing Standard Brick Veneer

Whether Amvic brick ledge forms or the Brick Ledge Extension are used, standard masonry veneer can be installed in the same manner as regular construction bearing on the ledge support.

Follow building code requirements for typical flashing details with drip edge, and minimum air space size. A variety of masonry ties can be used, either surface mounted to the webs or embedded into the foam/concrete before the pour. Horizontal and vertical spacing of the masonry ties to be determined by engineering requirements.

*Figure 24 – Laying standard brick veneer on the brick ledge support*

*Figure 25 – Standard brick ties screwed into the Amvic webs*

## Section 9.5 – Brick Ledge Reinforcer

The reinforcing needs for a brick ledge form can be met in one of two ways, Amvic's Brick Ledge Reinforcer or traditional steel stirrups. The Amvic Brick Ledge Reinforcer is an engineered ICF brick ledge reinforcement system that is designed to replace conventional rebar in the Amvic ICF brick ledge forms.

It is a single pre-assembled, 4' (1.2m) long deformed welded wire reinforcement piece that is placed directly into Amvic's brick ledge blocks. The reinforcer is designed for masonry veneer loads and cannot support other structural components such as floors or roofs.

A more conventional approach of horizontal rebar and stirrups can be used for masonry veneer applications but generally adds complexity through added construction cost and engineering requirements. For masonry veneer Amvic's brick ledge reinforcer would be an easier and more economical fit but heavier load such as floors require traditional reinforcing with stirrups.

For such loads, the forms should be reinforced with a line of horizontal rebar and stirrups between the horizontal bars in both the ledge and the wall area of the brick ledge form. Spacing and size should be designed to the requirements outlined by a local licensed structural engineer and/or governing building code. Proper stirrup size and spacing is essential for the structural performance of the brick ledge.

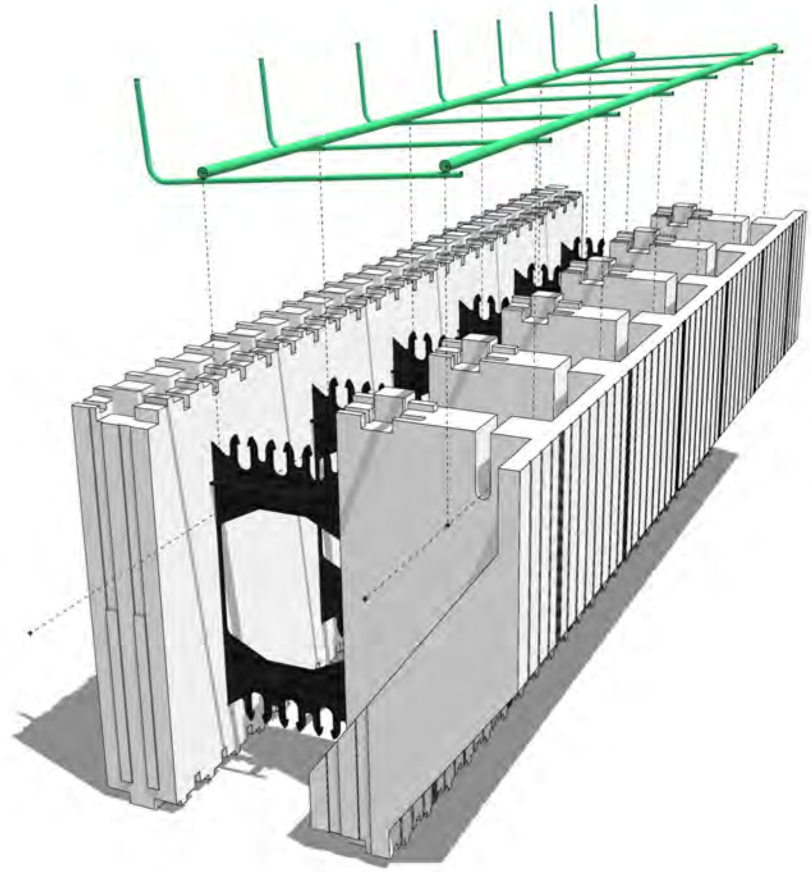


*Figure 26 – Align Amvic Brick Ledge Reinforcer with notches in the foam and the clips on the webs.*

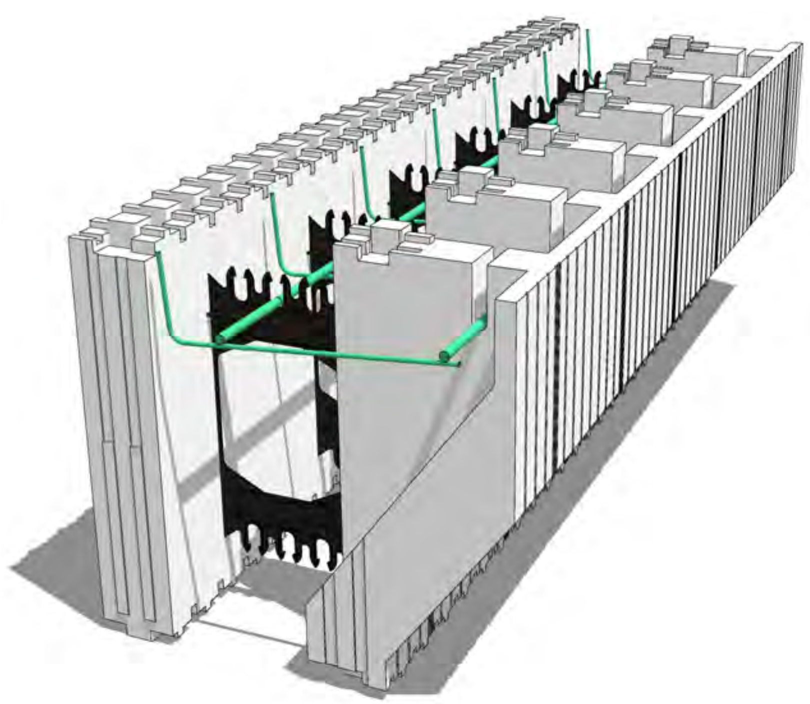


*Figure 27 – Place the Reinforcer into the form. No additional tying or securement is needed.*

## Section 9.6 – Brick Ledge Extension

In cases where brick ledge forms are not available due to supply or block size, the Brick Ledge Extension can be used to provide additional bearing at any point in the wall. It is easily installed and is compatible with both the Brick Ledge Reinforcer and conventional reinforcing steel stirrups.

1. Use regular straight ICF blocks as normal.
2. As per drawings details, cut out the EPS between the block webs at the correct elevation and size.
3. Secure the Brick Ledge Extension to the ICF webs with two assembled fasteners per web.
4. Place the Brick Ledge Reinforcer (for masonry veneer) or reinforcing steel stirrups (for floor bearing) as per structural design.
5. Once the first pour is complete, resume stacking the blocks normally.

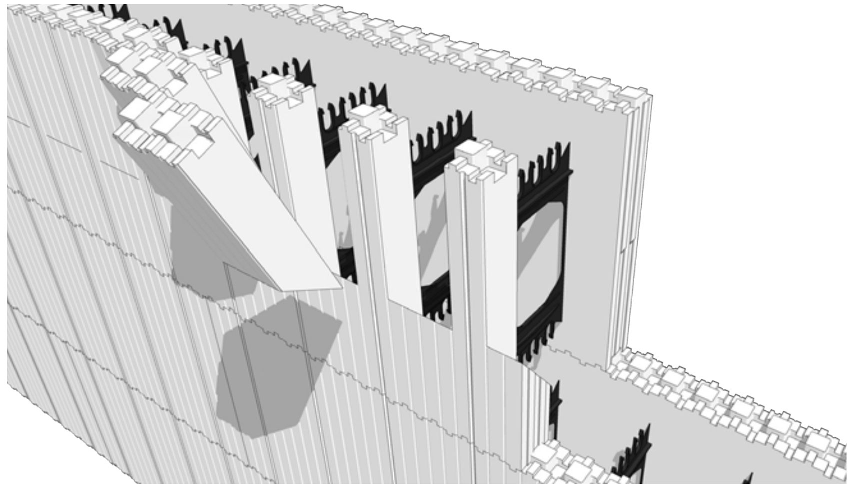


*Figure 28 – Cut the EPS foam between the webs as per spacing on the drawings*

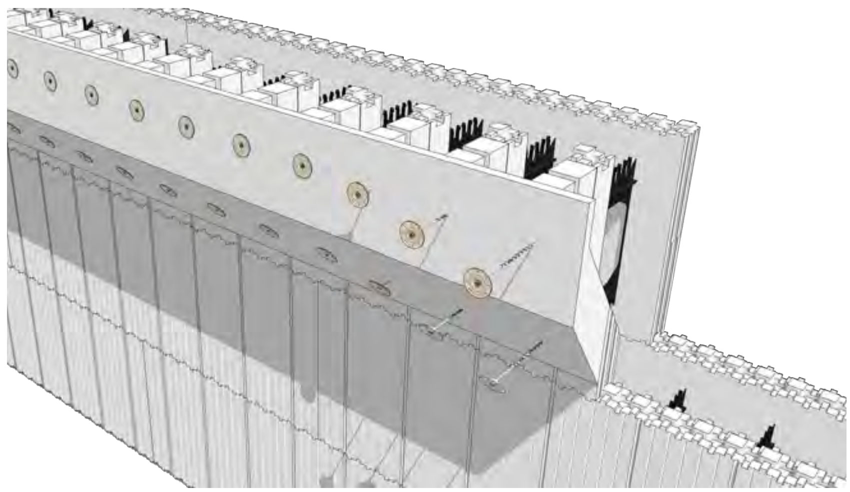


*Figure 29 – Install the Brick Ledge Extension by securing it to the ICF webs with Amvic's assembled fasteners*

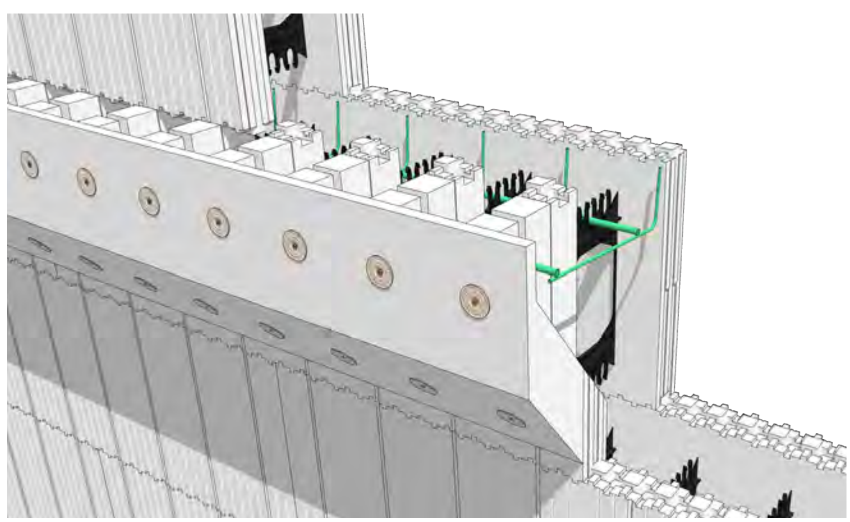


*Figure 30 – Once the foam extension is attached, place reinforcing into the cavity*

## Section 9.7 – Brick Ledge Extension Corner

Brick ledge forms are not available for all of Amvic's ICF product lines. The brick ledge extension can be used for ICF product lines that do not have dedicated brick ledge forms. There are no brick ledge 90 degree corner blocks and thus would require to be site fabricated using either straight brick ledge forms or the brick ledge extension.

Using the brick ledge extension for the corners is suitable for use with factory assembled brick ledge forms or independently. When using brick ledge extension with brick ledge forms, install a regular corner block at the corners.

Cut the sections from the exterior foam panel to align with the webs and spacing of the inserts (correct elevation and size). The bottom cut should be angled at a minimum of 45° to ensure optimal concrete placement.

Once the all section have been measured and cut out, measure and cut the brick ledge extension to the right size. Secure brick ledge extension to the corner block webs by using 2 assembled fasteners at each insert/web location. Install additional support if needed.

Once the brick ledge extensions are secured in place, rebar reinforcement can be placed as per structural design. Both brick ledge extension and factory assembled brick ledge forms are compatible with Amvic's reinforcer. The leftover interlock at the web locations allows to continue stacking regular corner blocks above.

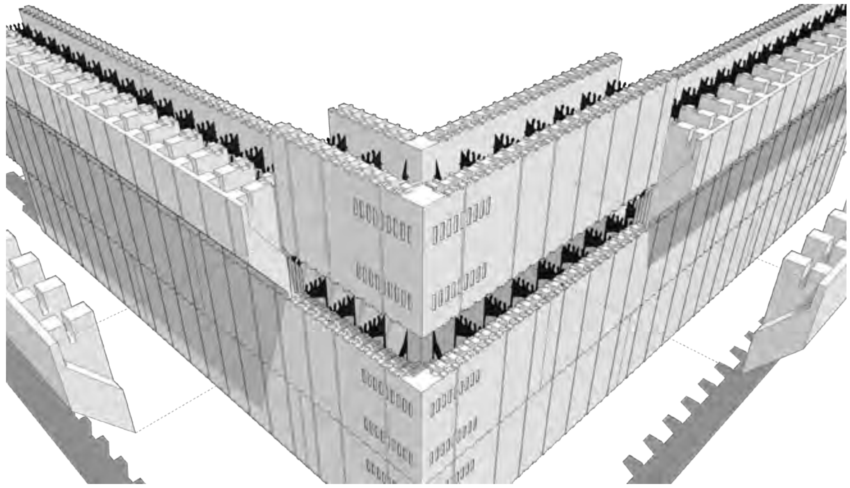


*Figure 31 – Regular corner blocks can be used at the same course as the brick ledge forms*

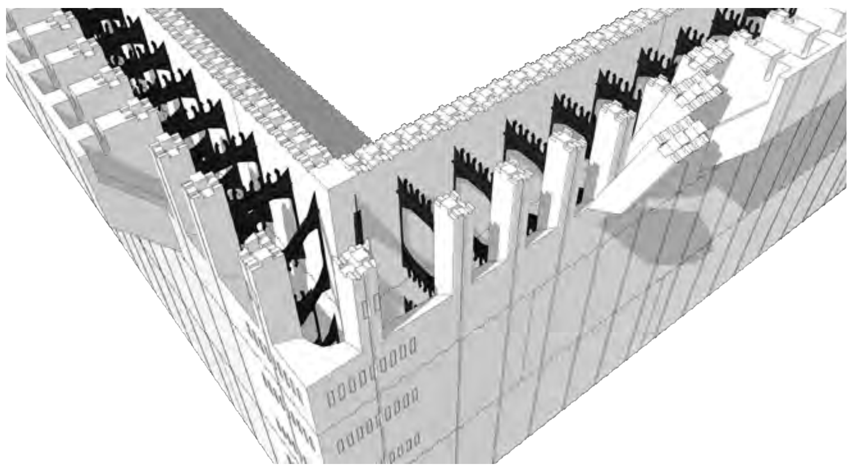


*Figure 32 – Cut section from the exterior foam panel to align with the spacing of the inserts in the brick ledge extension*

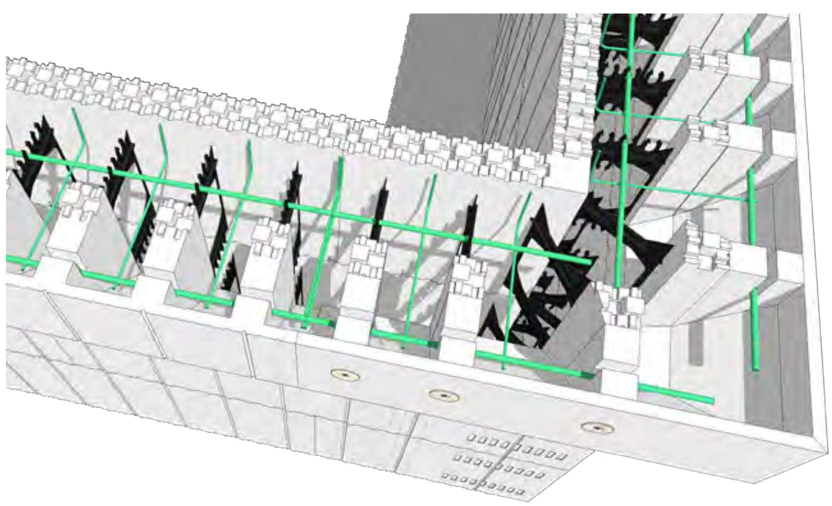


*Figure 33 – Cut the brick ledge extension to size and secure it to the corner block using the fastening kit*

## Section 9.8 - Gable Ends

Gable ends can be formed using one of the two methods; stepping forms or cutting forms. If using stepping forms method, the gable ends are formed by stepping the forms back as they are stacked to the peak. The vertical ends of the forms are blocked off and the concrete is poured. After the pour, the rest of the wall is framed in.

If using the cutting method, the gable ends are formed 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 34 – Cutting forms to the shape of the gable end pitch*

## Section 9.9 - Pre-cast Concrete Floor Systems

Hollow Core (HC) slabs are a widely used flooring system, consisting of pre-cast elements in which tubular cores are hollowed out. The sections are typically 4’ (1.2m) 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. This type of assembly requires structural engineering.

Installing a precast floor system:

1. Terminate the concrete wall at the correct 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 35 – Maneuvering a precast hollow core slab for placement on an ICF wall*

*Figure 36 – A precast slab panel placed on an ICF wall*

## Section 9.10 - Hambro® Composite Concrete Floors

Hambro composite floor 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' (1.3m). Concrete is poured on plywood sheets that are supported by the Hambro joists and roll bars. 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 correct height.
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.
4. Pour the concrete slab.
5. Once the slab has gained enough strength, remove the roll bars and plywood sheets for the next floor.

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

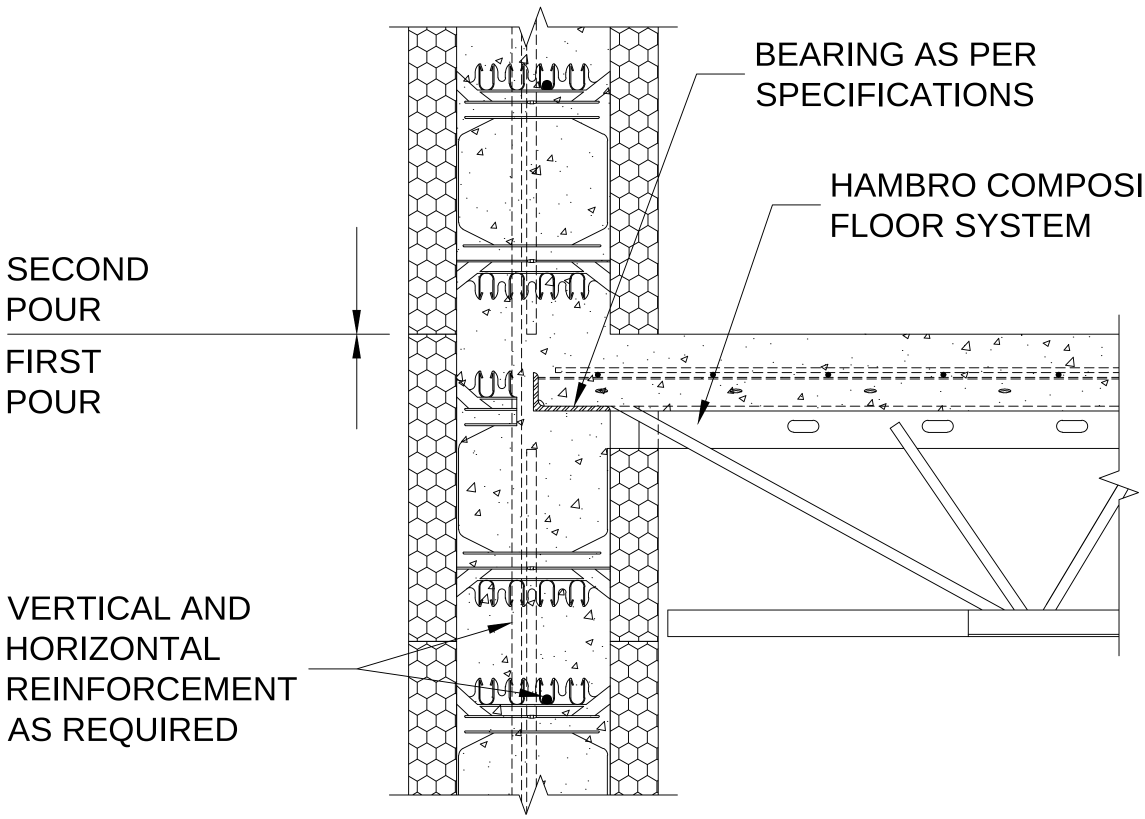



*Figure 37 – Typical Amvic ICF wall with Hambro® composite floor system*

## Section 9.11 - Composite Steel Deck

Composite steel decks are made from plain or galvanized steel sheet formed into ribbed profiles. The ribs are typically 3" (76mm) deep and 6" (152mm) wide and spaced at 12" (305mm) 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" (51 to 76mm) of concrete is placed over the ribbed deck to form a total slab thickness of 5 to 6" (127 to 152mm).

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.

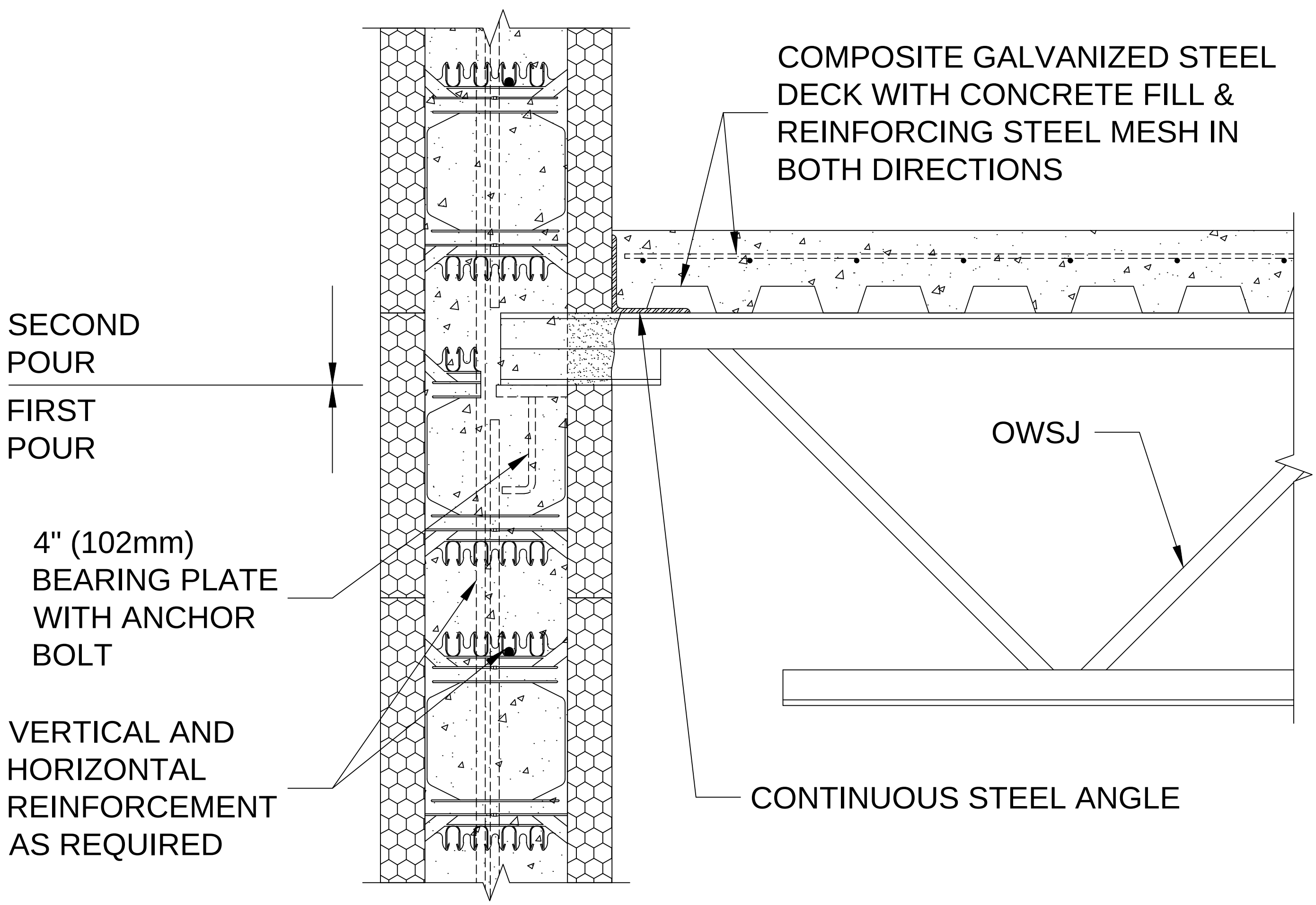



*Figure 38 – Typical Amvic ICF wall open web steel joist (OWSJ) installation*

## Section 9.12 - Amdeck Floor and Roof System

Amvic's Amdeck system is an insulated, stay in place concrete form that can be used for virtually any floor or roof construction. It is compatible with any wall type that would normally be used with typical concrete slab. It is a 3-in-1 system offering structure, insulation and finished attachment. Amdeck is a cost effective, resilient and environmentally friendly construction system helping revolutionize modern construction and change the way we build. This innovative modular system uses beam pocket cutouts in the foam to create a one-way concrete slab allowing the designer to maximize the clear spans. The system has integrated joists that are used to support temporary construction loads and provide a surface for interior finish attachment. Amdeck can be used in a horizontal or sloped configuration for floors and roofs with typical finished unsupported clear spans up to 30' (9.1m). It is perfectly suited for use with ICF walls or independently with other structural systems. Please refer to Amdeck technical manuals for installation guidelines and engineering details.

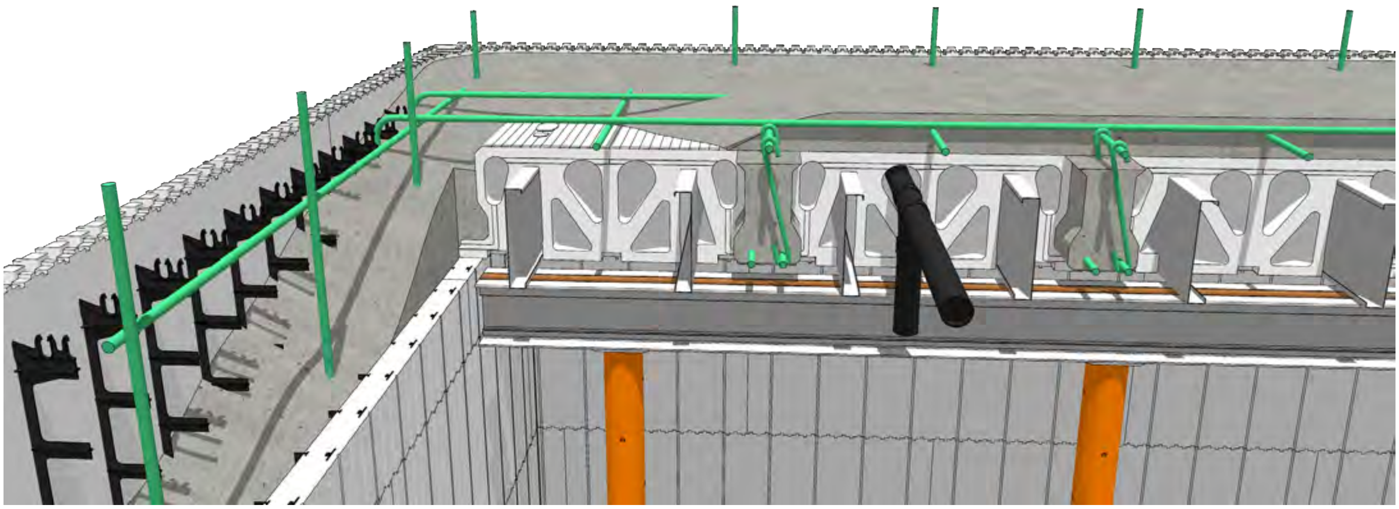


*Figure 39 – Section view of Amdeck Pro*

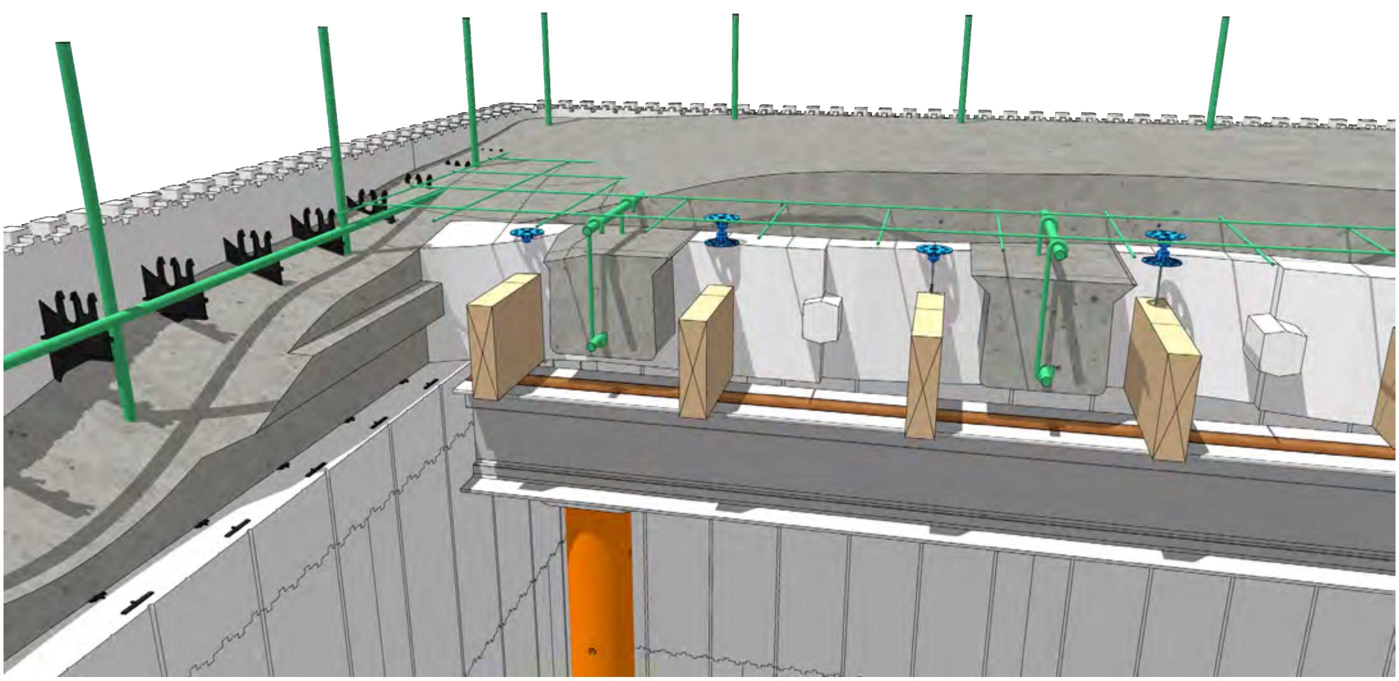


*Figure 40 – Section view of Amdeck Eco*

## Section 9.13 - Standing Seam (Stack Joint)

Amvic is one of the strongest Insulated Concrete Form in the market today; this is achieved by having a combination of 6" (152mm) on center webs (for R22) which support two 1.5 lb/ft$^3$ (24 kg/m$^3$) density EPS insulation panels.

This design supports 865 lbs (392 kg) of form capacity strength or the pressure exerted by 4 to 5' (1.2 to 1.5m) of concrete. Amvic R30 ICF has thicker foam panels (same density) while switching the spacing to 8" (203mm) on center and maintaining similar form capacity strength.

Amvic ICF blocks have a superior interlock called FormLock™. This interlock has a 1" deep recess with an alternating 1" nub which repeats itself every 2". A strong interlock is paramount to minimal foam deflection at course seams better overall rigidity of the wall.

In some instances, where the full blocks do not fit due to wall length or openings, it is possible to utilize a standing seam (also known as a stack joint) where instead of alternating the cut edges in running bond fashion (offset joint) the joint is vertical in the same spot in a wall section. This helps simply the erection process as long as the stack join is properly reinforced.

As blocks are being stacked, the ideal situation would be to have the "factory ends" meet one another for the total length of the wall. This will keep the interlock and webs lined up properly, which is how the form was designed to be used in an ideal scenario. However, buildings have varying wall lengths and will not always have dimensions that will fit full length blocks.

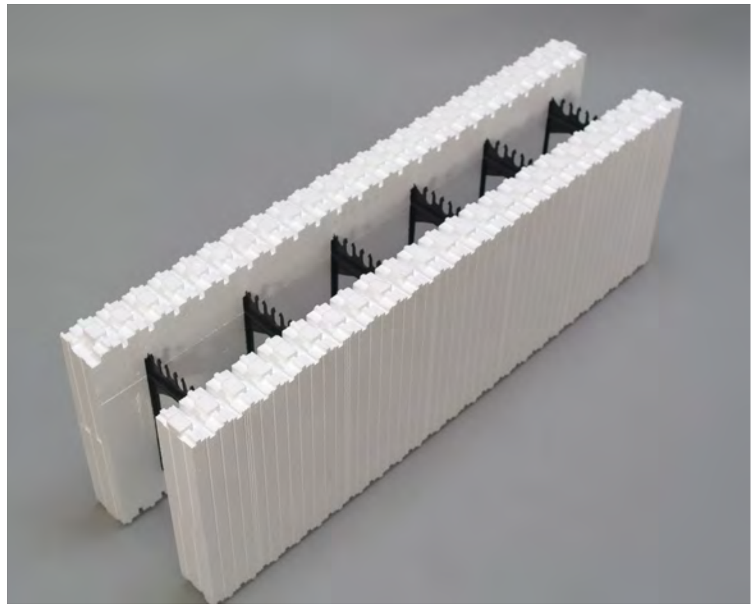


*Figure 41 – FormLock™ 1" (25mm) interlock in Amvic ICF*

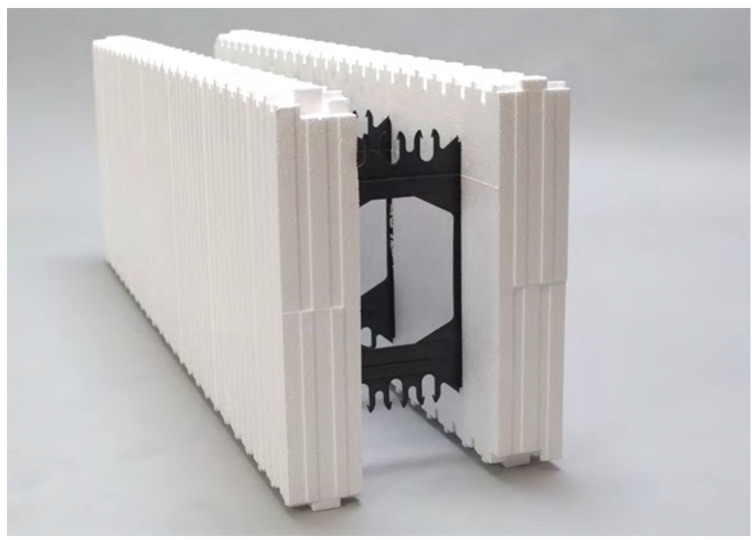


*Figure 42 – Amvic ICF factory finished ends with interlocking pattern*

In most cases, as the blocks are being stacked from the opposing corners, there will be a section which requires one of the blocks to be cut. In this situation, there is a need to create a stack or offset joint. At this location, the cut block will have one factory edge and one cut edge. If the blocks in the following courses are stacked in a way where the vertical seam is aligned from course to course, this will create a stack join.

Mini ICF: A cut form that has 3” [(76mm) for R22 and 4” (102mm) for R30] of foam from both sides of a web. This form can be placed anywhere in the wall and webs will align properly with the interlock and the webs allowing running bond to be maintained.

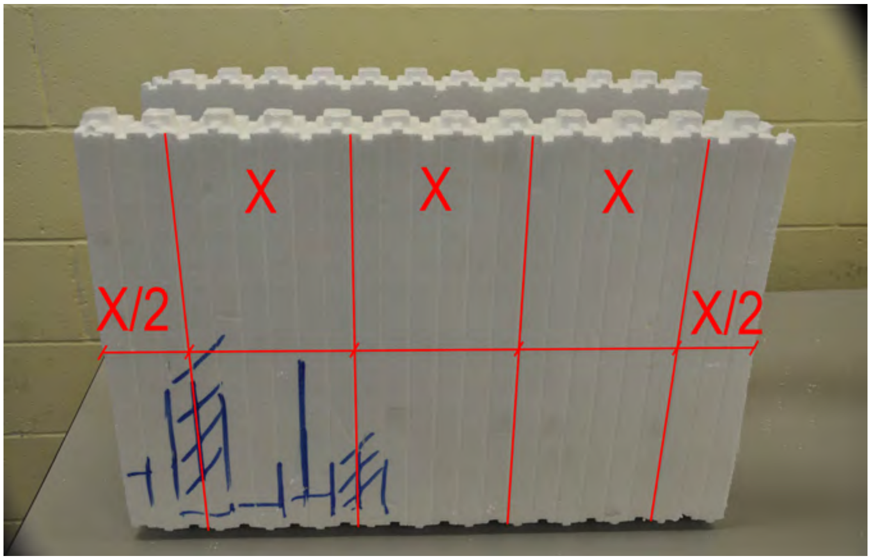



*Figure 43 – Mini ICF block*

Mark the standing seam at the first course of forms and each course thereafter with a sad face (or any visual que) using a marker. This serves as a visual reminder to reinforce the area. Strap a wailer and spray foam adhesive across the standing seam on “both” sides of the wall prior to placing concrete, as no interlock is functioning at this location.

*Notes:*

- *Have only one standing seam per wall section.*
- *Window or door openings are a good place situate a standing seam as it will eliminate some of the extra work required in (wailing) the standing seam.*
- *If possible, avoid standing seams in corners.*
- *Always assemble “one wall section at a time”, by laying down the two opposing corner forms and work towards the center of each wall.*

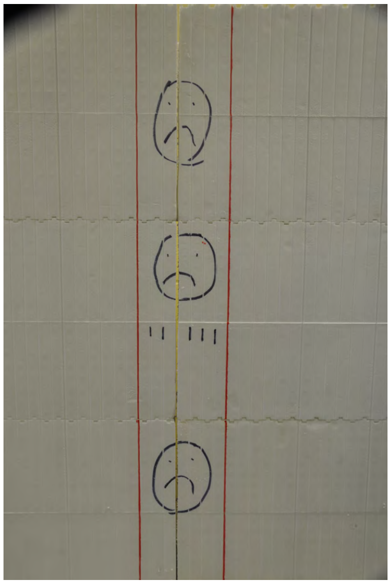


*Figure 44 – Vertical standing seam sealed with foam adhesive*

## Section 9.14 – Installation of HV Hook

The Amvic ICF Hook is an all-in-one metal wire clip designed to replace conventional nylon cable ties in ICF construction. The hook is engineered with seven bends to provide it with simultaneous horizontal and vertical locking capacity. It is able to lock three ICF blocks simultaneously (two horizontal and one vertical) in a single step.

It is easy to install with snap in place installation in all weather conditions (does not become brittle and break in low temperatures). The HV hook should be ideally placed in the center of the web but if that causes interference with rebar placement it can be moved to any of the slots.

It is recommended to install one hook every 4' (1.2m) for the bottom and top two courses as well as the full height at the corners. It is available in two sizes; HV22 for Amvic's R22 ICF (6" (152mm) web spacing) and HV30 for R30 ICF blocks (8" (203mm) web spacing).

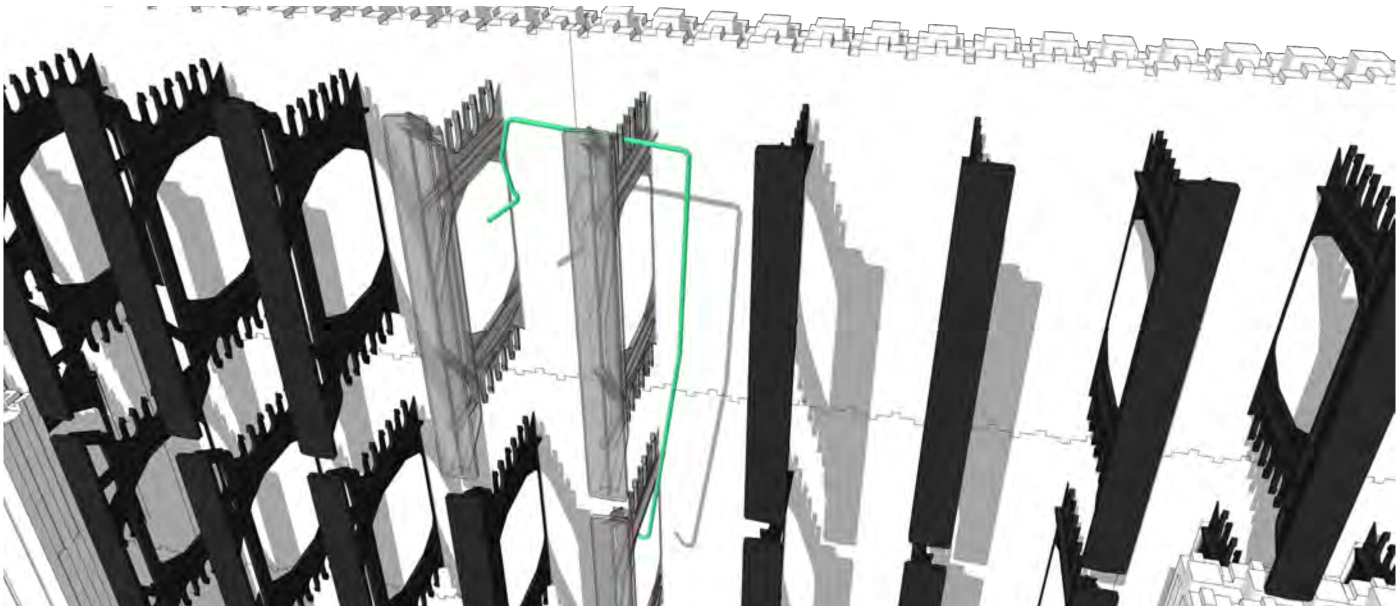


*Figure 45 - Place the bottom of the hook under the top portion of the lower block's web*

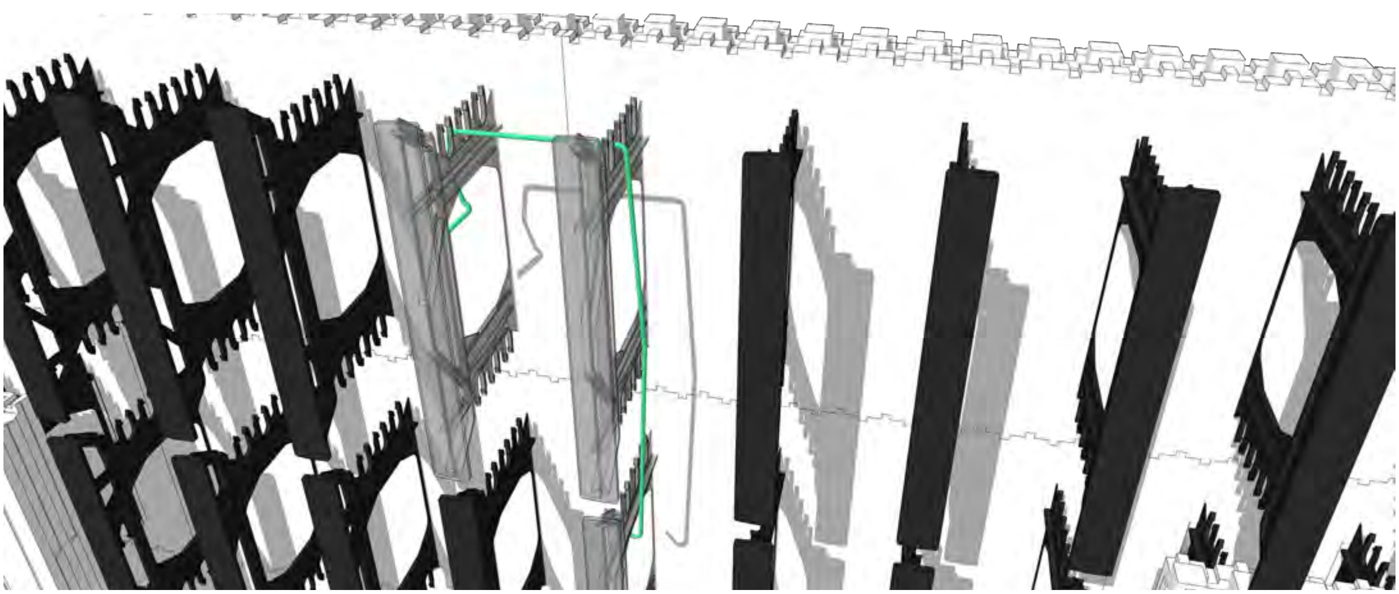


*Figure 46 - Bring the top portion of the hook up and over the top of the two webs and snap it in place (pull the lip up to unhook it)*

## Section 9.15 – Height Adjusters

When wall heights do not perfectly fit with ICF block heights, a height adjuster can be used. Amvic has created a double sided 4” (102mm) height adjuster. The height adjuster was designed to be installed between the ICF courses. This helps improve installation efficiency which is especially beneficial in commercial projects that have multiple floors.

Although the Amvic height adjuster is factory manufactured, it is possible to site fabricate a height adjuster. When a height adjuster of 4” (102mm) or taller is needed it is recommended to cut the block to the desired size. Cutting blocks 4” (102mm) or greater offers the benefit of having the web intact connecting the two foam panels. This greatly improves the strength of the height adjuster, reducing amount of bracing needed as well as installation time and labor. For site fabricated height adjusters of 8” (203mm) or less, a block will yield two height adjusters and must be used at the bottom or top of the wall only.

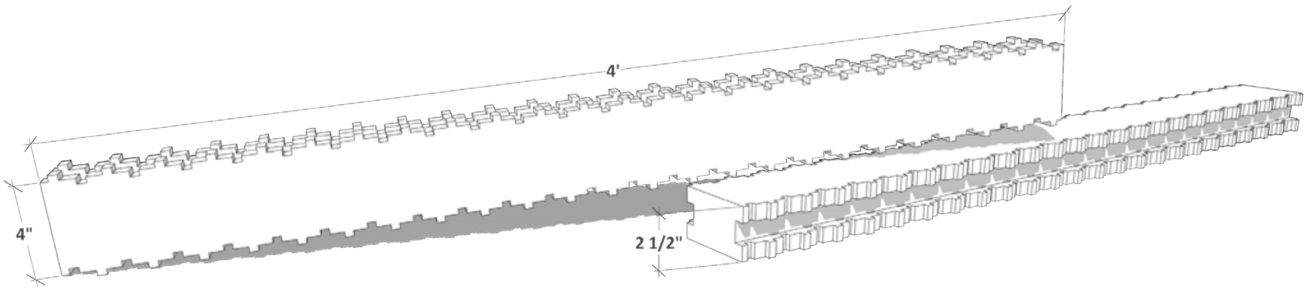



*Figure 47 - 4” (102mm) double side factory fabricated height adjuster (available for both R22 and R30)*

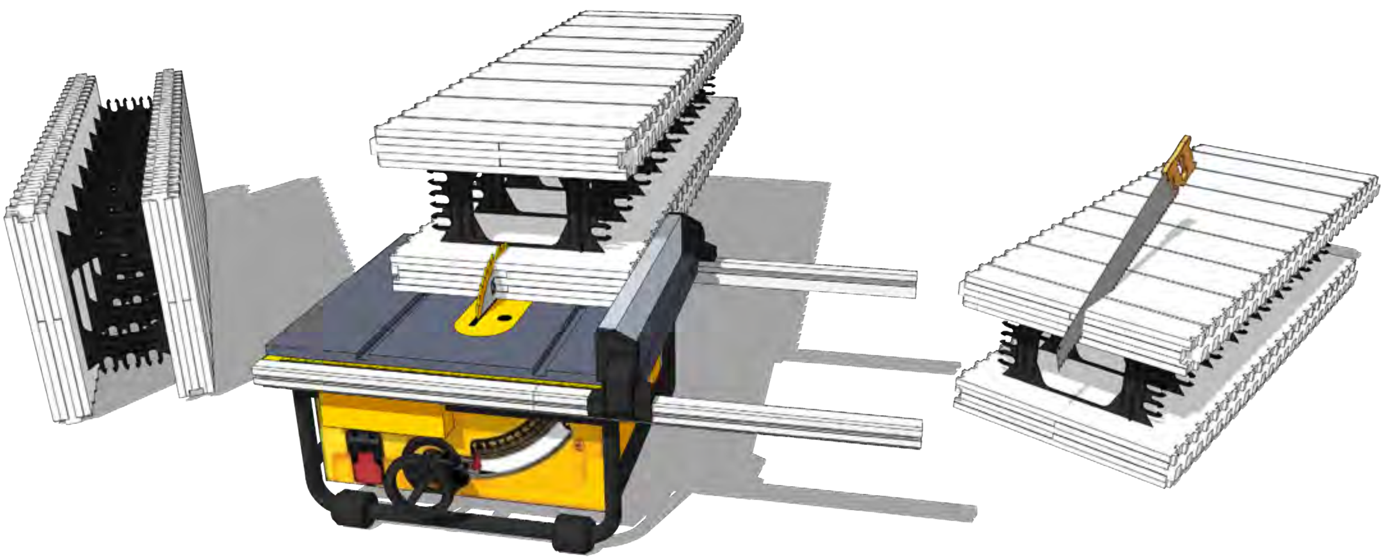


*Figure 48 - Site fabricated height adjusters can be manually cut using a hand saw or a table saw*

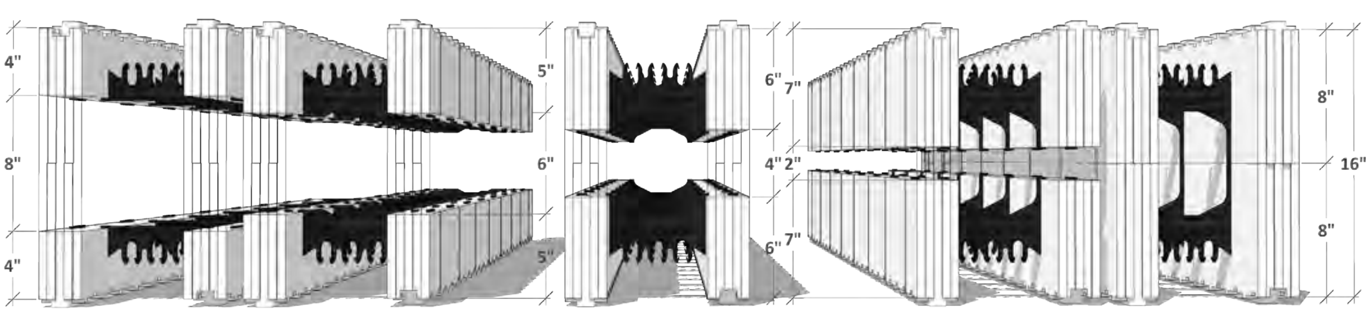



*Figure 49 - Site fabricated height adjusters with the web intact provide additional strength*

## Section 9.16 – Site Constructed 45° Corner

Amvic has dedicated 45° blocks which should be used for 45° corners, but when this is not possible due to size or other constraints, a 45° corner can be easily built using straight forms. Start by stacking blocks from regular 90° corner blocks toward the 45° corner. Once at the corner, measure and cut (hand saw or hot knife) the straight blocks at 22.5° as needed, creating a typical miter joint.

It is important to ensure the correct running bond patterns is maintained in the second and all subsequent courses of ICF. The site constructed 45° corner should be treated as a stacked/vertical joint. Spray foam adhesive should be applied to all cut edges. Two zip ties (highlighted in red) should be used to connect opposing webs at every course (Figure 51).

Apply two horizontal sheathing tape strips across corner of the foam along with 2 by lumber screwed to at least two webs and to itself to provide temporary support during concrete placement, up to 4’ (1.2m) height (Figure 52). For taller walls (as well as 10” (252mm) and 12” (305mm) ICF), exterior bracing must be provided, see Figure 53.

Install bent horizontal 45° corner rebar with the proper lap splice length as per Part 6 of this manual or local building code/engineering requirements. Horizontal and vertical rebar installation as per rest of the wall. One ICF brace should be installed within 2’ (610mm) on each side of the corner on the interior side.

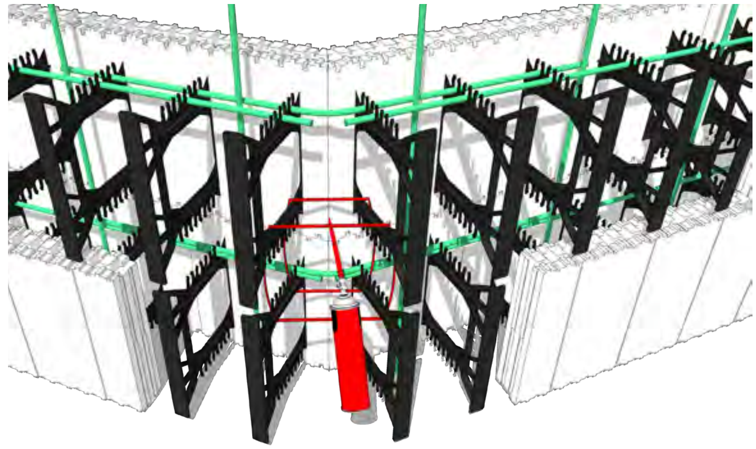


*Figure 51 – Use spray foam and zip ties to help secure site constructed 45° corner*

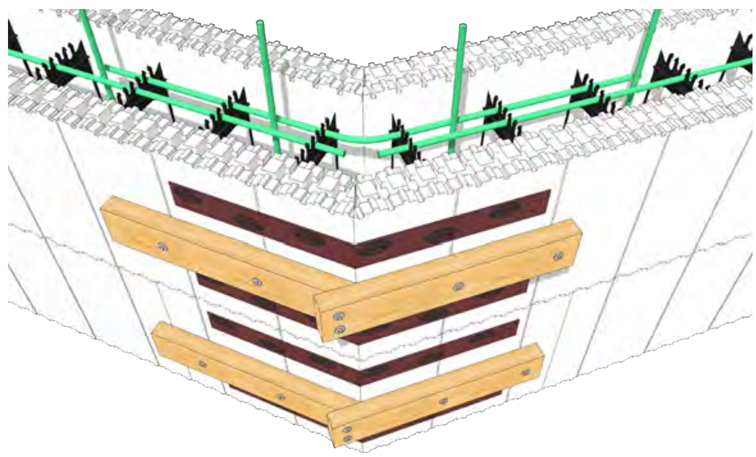


*Figure 52 – For shorter walls (<4’ (1.2m)), use horizontal bracing*

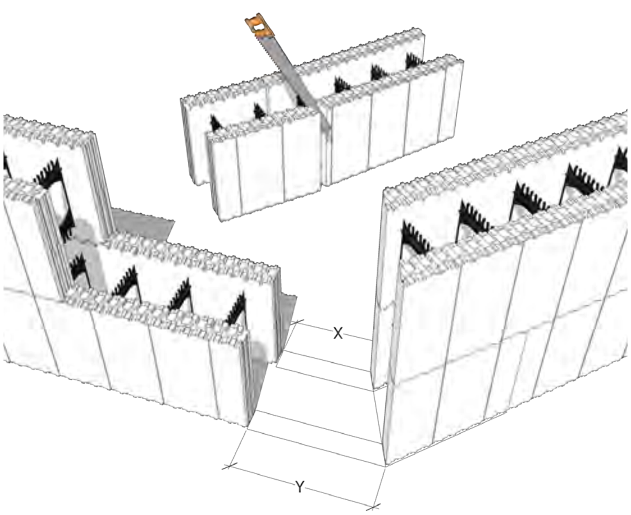



*Figure 50 – Use hand saw or hot knife (not shown) to cut blocks to size*

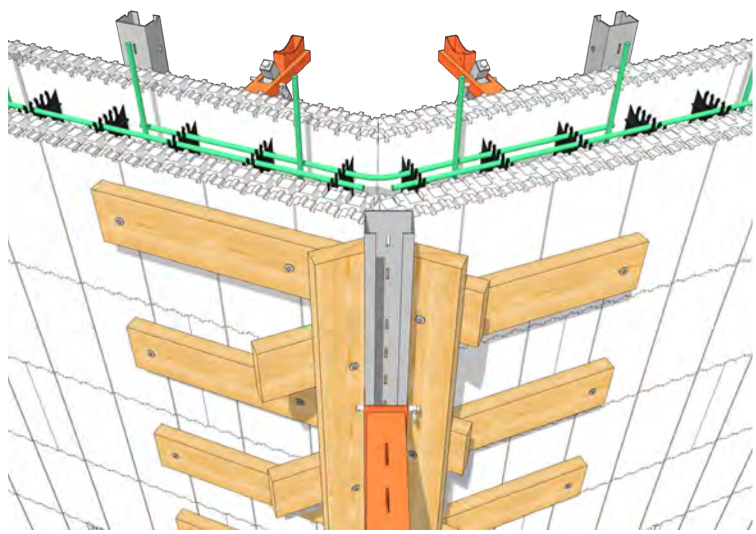


*Figure 53 – For taller walls (>4’ (1.2m)), exterior bracing is needed*

## Section 9.17 – Site Constructed Taper Top

Amvic does have dedicated taper top blocks which should be used when possible and available, but in instances where taper top blocks are not available, straight blocks can be converted into taper tops with relative ease. Amvic's molded taper tops are limited to double sided configurations for all sizes while single sided taper tops are only available for special order for 10” (254mm) and 12” (305mm) R22 ICF.

The first step in creating a site fabricated taper top is to cut off the upper portion of the interlock using a table saw or a hot knife. The interlock can be cut at various heights allow the user to match the height of the total ICF wall to what is needed for the project. The next step is to use a hot knife or a hand saw to trim the inside foam to create a slope surface. 45° is the minimum angle for the slope, 60° would be better, and if possible, going to half height of the block is recommend to match the molded taper top as much as possible. The web should remain encased in foam as shown in the images below, the minimum amount of foam width should be 1.5” (38mm) but not wider than 2” (51mm). This process can be repeated for the second side to create a double sided taper top if needed. Reinforcement placement is identical to molded taper top blocks.

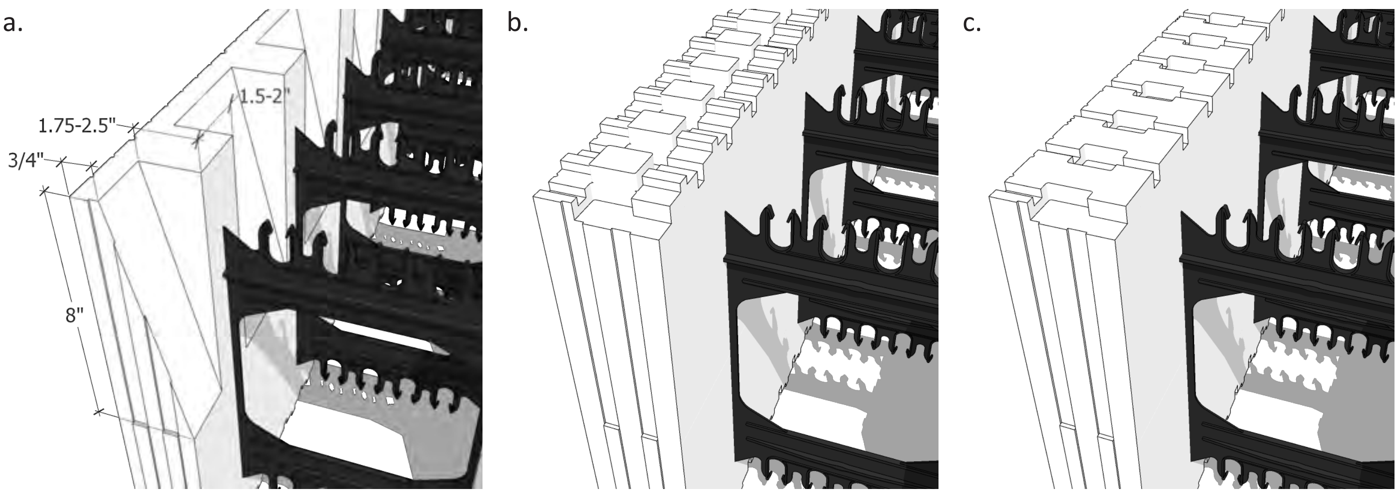



*Figure 54 – Typical taper top block (a), typical straight block (b), straight block after interlock removal (c)*

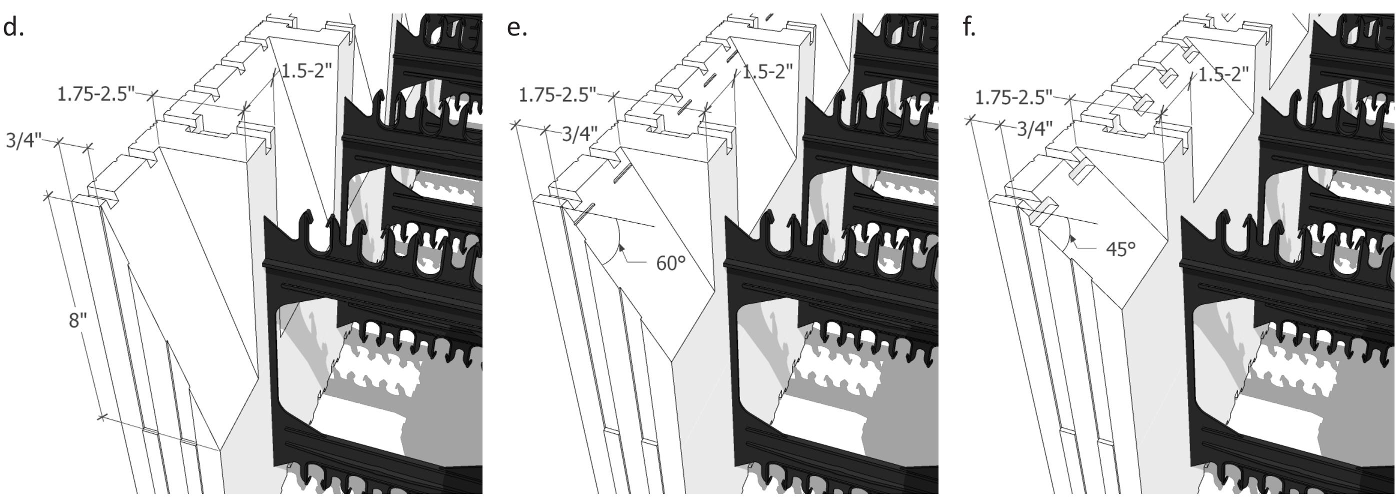



*Figure 54 – Half block height cut-out (d), 60° cut-out (e), 45 ° cut-out (f)*

This section of the manual covers the basic 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.

## Section 10.1 - Concrete Fundamentals

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

### Section 10.1.1 - Cement

The cement paste (also known as binder) 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.

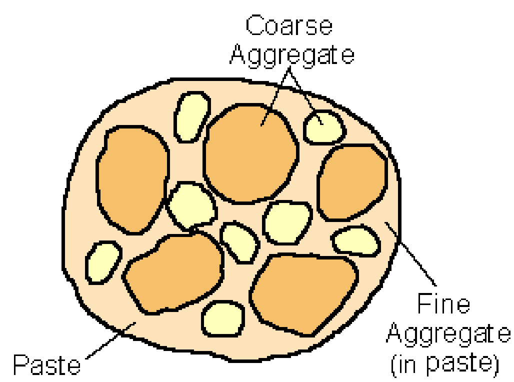



*Figure 1 – Illustration of typical concrete mix constituents*

There are many different types of cement available but for the purpose of this manual, we will concentrate on the most common one which is 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 types of Portland cements;

- 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

### Section 10.1.2 - Aggregates

There are two categories of aggregate (also known as filler) used in concrete;

- Coarse aggregates (gravel/crushed stone) are any particles greater than 0.19” (4.8mm), but generally range between 3/8” (9.5mm) to 1.5” (38mm) in diameter.
- Fine aggregates (natural sand/crushed stone) are any particles smaller than 3/8” (9.5mm) in diameter.

Selection of aggregates for use in concrete is important since they make up about 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.)

## Section 10.2 - Quality of a Concrete Mix

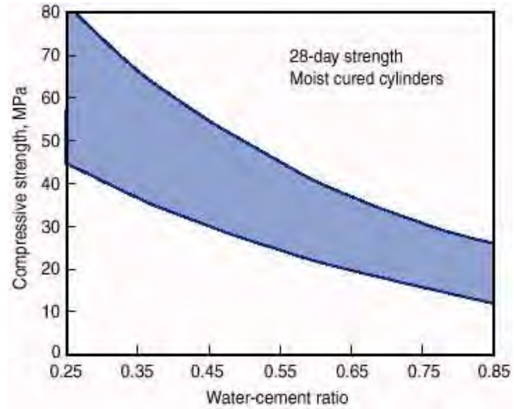



*Figure 2 –Relationship between W/C ratio and concrete strength*

### Section 10.2.1 - Water / Cement Ratio (W/C)

The most important factor which determines the quality of a concrete mixture is of 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. The water 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 causing the paste to harden and bind 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 3 – Testing the concrete cylinder for compressive strength (left) and concrete beam for flexural strength (right)*

### Section 10.2.2 - Concrete Strength

There are two types of concrete strengths: compressive and flexural. For most intended structural purposes, the compression strength is what is important for the designer.

**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” (305mm) high by 6” (152mm) wide cylinder of concrete is cast and cured for the appropriate time (usually 28 days) and 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.

*Figure 4 – Concrete mix with low slump*

### Section 10.2.3 - 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-C143 standard (CSA A23.2-5C test method) using the slump or Abrams cone. This is an inverted cone, 12” (305mm) tall and is open on both ends. The top is 4” (102mm) wide and the bottom 8” (203mm) 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.

*Figure 5 – Concrete mix with high slump*

A relatively dry sample will slump very little and be given a slump of 1-2” (25-51mm), while a relatively wet concrete sample may slump as much as 6-7” (152-178mm).

## Section 10.2.4 - 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 places 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 into the open air. The humidity within the concrete mix will drop very quickly until there is not enough to sustain the hydration process causing it to stop altogether and may 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.

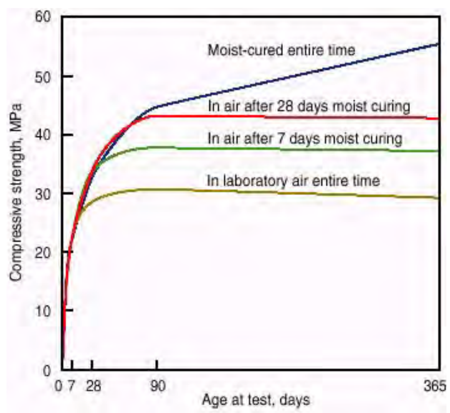



*Figure 6 – Illustration showing effect of curing on concrete strength over time*

## Section 10.2.5 - 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 relatively improving the workability of fresh concrete.

## Section 10.2.6 - 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.

## Section 10.3 – 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.

| 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, de-icing 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<br>Reduce water-cement ratio<br>Reduce water demand (minimum 12%) |
| Water reducer (ASTM C494, Type A) | Reduce water demand at least 5% |
| Workability agents | Improve workability |

*Table 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<br>Partial cement replacement |
| Pozzolans | Pozzolanic activity<br>Improve workability, plasticity, sulfate resistance<br>Reduce alkali reactivity, permeability, heat of hydration<br>Partial cement replacement<br>Filler |
| Pozzolanic and cementitious | Same as cementitious and pozzolan categories |
| Nominally inert | Improve workability<br>Filler |

*Table 2 – Commonly used mineral admixtures*

## Section 10.4 – Specifications of Concrete for Amvic ICF

The following table suggests some appropriate 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 | Values for Different ICF Core Sizes | | | | |
|---|---|---|---|---|---|
| | 4" (102mm) | 6" (152mm) | 8" (203mm) | 10" (254mm) | 12" (305mm) |
| Min 28-day compressive strength F'c[1] | 2500 psi<br>20 MPa | 2500 psi<br>20 MPa | 2500 psi<br>20 MPa | 2500 psi<br>20 MPa | 2500 psi<br>20 MPa |
| Recommended Slump[2] | 6" (152mm) | 6" (152mm) | 5-6" (127-152mm) | 5-6" (127-152mm) | 5-6" (127-152mm) |
| Recommended max water to cement ration W/C | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 |
| Max aggregate size | 3/8" (9.5mm) | ½" (13mm) | ¾" (19mm) | ¾" (19mm) | ¾" (19mm) |
| Recommended air entrained % | 3-5% | 3-5% | 3-5% | 3-5% | 3-5% |
| Recommended cement type[3] | Type 10 (Type I) | Type 10 (Type I) | Type 10 (Type I) | Type 10 (Type I) | Type 10 (Type I) |

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

*Table 3 – Guideline specifications for concrete mix*

## Section 10.5 – Concrete Placement

This section of the manual provides a step by step instructions and other important supplementary information to familiarize contractor with the specifics of placing concrete with Amvic ICF.

## Section 10.5.1 - Pre-Pouring Checklist

It is beneficial to have extra copies available of the following list to make sure all present trades are on the same page for concrete placement.

Checking Walls

- □ Check and make sure walls are straight, plumb, square and level. Make necessary adjustments.
- □ Check if corners are square and plumb. Make necessary adjustments.
- □ 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 jamming 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. Make necessary adjustments
- □ Check if anchorage for buck material been provided.

Checking Reinforcing Steel

- □ Check if reinforcing steel bars size and placement including horizontal and vertical are as per the specified engineering/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 clearly marked for wet-setting into the concrete.

Checking Bracing & Alignment

- □ Check if alignment & bracing system is properly installed and planking has been secured.
- □ Check if all T-joints braced adequately and properly.
- □ Check if all offset and stack joints are braced adequately and properly.
- □ For bracing system taller than 6’ (1.8m) 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 if all penetrations (Electric, plumbing, HVAC, dryer vent etc.) have been accommodated and all form support 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 or go out of order.
- ◻ Make sure the concrete ordered is acceptable for the method of placement and engineering or local building code requirements.
- ◻ Make sure that you have you coordinated and confirmed the delivery times for both the boom pump and the concrete.
- ◻ Make sure you have a “blowout kit” prepared and ready.

Checking Jobsite

- ◻ Check that site is cleaned up and there is enough room for trucks, workers, etc.

## Section 10.6 – Safety Tips for Handling and Placing Concrete

The following points are some simple suggestions, precautions and safety measures for anyone handling wet concrete.

**Wear Hard Hats**

Wear a hard hat for head protection. Working on a construction site presents a variety of items to avoid that can cause serious head injury. Construction equipment and tools are frequent potential hazards to concrete contractors, Amvic ICF installers and do-it yourself home builders.

**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, the following is recommended;

1. Wear water proof gloves, long sleeve shirt and long pants. If you will stand in fresh concrete, wear rubber boots high enough to prevent concrete from getting into them.
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.
5. Wear clean, dry, clothing each work day or for your project.

**Protect your Eyes**

Splattering concrete can enter your eyes during the pour. Wear full cover goggles or safety glasses with side shields

## Section 10.7 – Rate of Pouring Concrete

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

1. Rate of concrete pour
2. Unit weight of concrete
3. Type of cement
4. Concrete slump
5. Concrete temperature
6. Height of pour
7. Depth of internal vibration

Amvic ICF blocks have an ultimate forming capacity of 864 $lbs/ft^2$ (41.4 kPa) as tested according to section 6.4.4 of the Canadian CCMC technical guide for modular expanded polystyrene concrete forms. Table 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’ (4.2m) pour height** | **To 14’ (4.2m) pour height** |
| 1 | 305 | 600 psf | 600 psf |
| 2 | 610 | 600 psf | 600 psf |
| 3 | 690 | 690 psf | 600 psf |
| 4 | 1219 | 870 psf[3] | 660 psf |
| 5 | 1524 | 1050 psf[3] | 720 psf |

[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” (178mm) maximum slump, without additives and a vibration depth of 4’ (1.2m) or less.

[3] Lateral Pressure exceeds Amvic ICF forming capacity.

*Table 4 – Concrete pressures for walls internally vibrated*

Amvic’s recommended pour rate is between 3-4 ft/hr (915-1200 mm/hr). However, it is evident from the table above that concrete pour rates of up to 5 ft/hr (1.5 m/hr) are possible in warm temperatures (70°F (21°C)).

## Section 10.8 – 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 suitable for placing concrete in Amvic ICF.

| Placement Method | Type of work best suited for | Adantages | Special Notes |
|---|---|---|---|
| **Concrete Boom Pump** | Used to convey concrete directly from discharge point like concrete truck mixer into Amvic ICF wall. | 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” (76mm), 2.5” (64mm) or 2” (51mm) 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 wall. | Provides clean discharge and there are many bucket capacities available. Cranes may be used to convey other materials such 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 ground level directly from discharge point into Amvic ICF wall. | 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 wall 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 5 – Most common method for concrete placement used with Amvic ICF*

*Figure 7 – Using boom pump to pour concrete in Amvic ICF*

## Section 10.8.1 - Placing Concrete with a Boom Pump

Using a boom pump to place concrete into Amvic ICF forms is by far the most preferred and efficient method. 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 safety concerns.

Many ICF contractors will also use 3” (76mm), 2.5” (64mm) or 2” (51mm) reducer fittings with a flexible hose. Although the reducers may make it more convenient to pour the concrete into the Amvic ICF forms, 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 decide which fittings are the most appropriate for a given project so long as they stay within the recommended rates and do not damage the forms.

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

## Section 10.8.2 - Crew Size

On pour day a total crew of 4 is generally a minimum to work with plus the pump operator. There is a need for three on the scaffold; one person on the hose, and two people on the vibrator. On the ground one person at least will be filling and blocking window bucks, thumping the wall, cleaning slops, untangling the electric cords of the vibrator, etc. A crew of 5-6 is generally better and is recommended.

## Section 10.9 - Pouring the Concrete

Important Notes:

- Remember, concrete should always be poured at a steady rate and in lifts between 3’ to 4’ (0.9 to 1.2m) maximum at a time. Using the recommended pour rate, a typical 9’ (2.7 m) high wall should be poured within a span of 3 hours.
- If 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.

### Section 10.9.1 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 issue is to equalize the concrete pressure on both sides of corner blocks as much as possible. The following precautions should be followed;

1. Start by pouring concrete at approximately a distance of 2-3' (0.6-0.9m) away from the corner center.
2. As you fill up 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.
3. 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.
4. You should not pour concrete for a subsequent lift in and around the same corner block until at least an hour has passed.
5. Ensure proper concrete consolidation.


*Figure 8 – Pouring concrete for 90° corner*

## Section 10.9.2 - 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 and then screeded off.
    a. Depending on the 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.
2. Window and door bucks should not be fully filled on one side at one time. Fill both sides of the opening using a back-and-forth rhythm and avoid spilling concrete into the window and door headers (also known as lintels) in doing so.
    a. With a 2-3” (51 -76 mm) reducer on the pump hose, it is frequently possible to hold back the flow of concrete briefly by placing one’s rubber gloved hand over the end of the nozzle and quickly swinging the hose to the other side of the window or door.
3. Pour concrete normally into straight sections up to the required lift height.
4. As the walls are filled 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.
5. Stop short of pouring concrete into a second corner by approximately 2-3’ (0.6-0.9m). Follow the recommendations given above for concrete placement in corner blocks.


*Figure 9 – Pouring concrete at window sills*

*Figure 10 – Using internal vibrator to consolidate concrete*

## Section 10.10 – Quality Control

### Section 10.10.1 – Slump

It is recommended to perform a field slump test from 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 officials, then an engineer will be on the jobsite and this test in most cases becomes a requirement and not an option.

*Figure 11 – Performing the slump test in the field*

### Section 10.10.2 – Compressive Strength

It is recommended to randomly retain fresh concrete into proper size cylinders. The cylinders will then be later 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 officials, then an engineer will be present on the jobsite. Taking random samples of concrete to be later tested for compressive strength becomes a requirement and not an option.

*Figure 12 – Taking random samples of concrete for compressive strength testing at 28 days*

## Section 10.11 – Concrete Consolidation

### Section 10.11.1 - 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

## Section 10.11.2 – Methods of Consolidation

The concrete industry has accepted two types of concrete consolidation, internal and external. Internal consolidation can be further divided into two types;

1. Mechanically using 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 not a practical method for use with Amvic ICF and does not provide adequate consolidation of the concrete.

Amvic highly recommends using a 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, experience has shown it is not as effective as internal mechanical vibration. External vibration methods such as manually tapping on the outside of the forms are NOT ACCEPTED as an adequate means of consolidating concrete in Amvic ICF and must be AVOIDED.

## Section 10.12 - Using Concrete Vibrators

### Section 10.12.1 - 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 or gasoline. The vibrating head is usually cylindrical with a diameter ranging from ¾-7" (19-178mm). 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 13 – Immersion type concrete vibrator with gasoline engine*

| Specification | 4 and 6" (102 and 152mm) ICF | 8, 10 & 12" (203, 254 and 305mm) ICF |
|---|---|---|
| Maximum vibrator head diameter | 1" (25mm) | 1.25" (32mm) |
| Frequency (vibrations per minute) | 10,000 vpm | 9,000 vpm |
| Minimum Radius of Action | 4" (102mm) | 6" (152mm) |
| Insertion on center spacing | 6" (152mm) | 9" (229mm) |
| Centrifugal Force | 220 lbs (100 Kg) | 500 lbs (227 Kg) |
| Compaction rate | 2-4 $yds^3$/hr (1.5-3 $m^3$/hr) | 2-5 $yds^3$/hr (1.5-3.8 $m^3$/hr) |

*Table 6 – Recommended immersion type concrete vibrator specifications for use with Amvic ICF*

## Section 10.12.2 – 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.
- Hold the vibrator 5 to 15 seconds then slowly lift up, approximately 3”/sec (76mm/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.

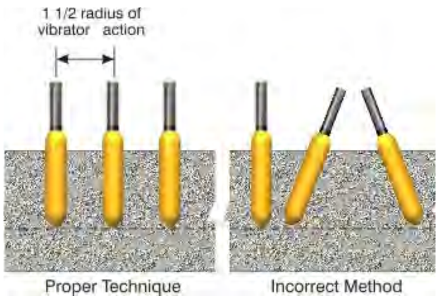



*Figure 14 – Vibrator head placement*

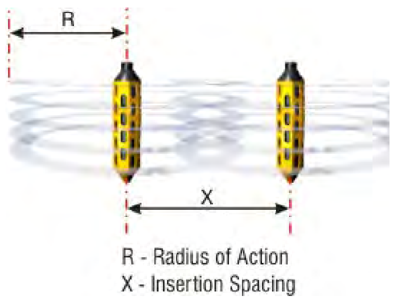



*Figure 15 – Radius of action of concrete vibrator*

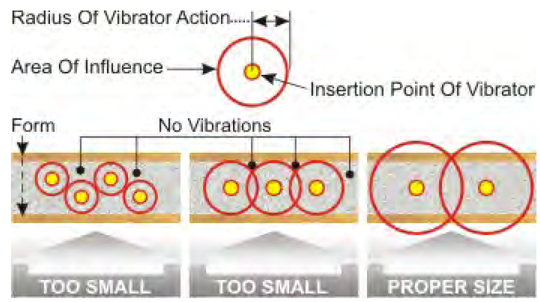



*Figure 16 – Insert vibrator head at 1.5 times radius of action*

- Allow vibrator to penetrate 6” (152mm) into the previous layer to ensure proper bond and eliminate cold joints.
- Pour concrete into the walls in lifts of 3-4’ (0.9-1.2m) high 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” (152mm).
- Stop vibration when the surface becomes shiny and there are no more breaking air bubbles.
- 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 follow immediately after the person working the pump hose as each layer is poured.

Practices to Avoid;

- Do not use 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.

## Section 10.13 – Finishing the Concrete Pour

If a second floor will be constructed, stop filling the top course of block at least 2" (51mm) 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 wet setting 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 or it can be recessed within the block cavity so that the EPS foam extends unbroken to the rafters.

It gets very busy at the end of the pour, the anchor bolts locations be marked on the sides of the block before the pour, and the anchor bolts be distributed onto the scaffolding near where they will be placed.

## Section 10.13.1 - After the Pour: Recheck Wall Straightness and Adjust

After pouring is complete, immediately check the corners again for plumb and the wall for straightness. You have a short window in which the bracing system can push and move the wall. If realignment is required adjust the bracing to do so. It is good to 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.

## Section 10.14 - Preparing a Blowout Kit

Before the pour, make up a kit to respond to blowouts that has the following:

- A few pieces of OSB or plywood, 24x24" (610x610 mm) or so.
- A container of drywall screws
- A fully charged electric driver drill
- A portable ladder sufficient to reach whatever height is involved on the side of the wall away from the scaffolding.

Before all pours, brief everyone on the crew on procedures to handle a blowout. If a blowout occurs, the ground man should:

1. Waive off the pump and vibrator
2. If the foam has only bulged and not separated from the webs, install a piece of form support at the same location. You can use an extra bracing for that purpose.
3. If foam has broken out, remove it and clean out concrete, reinsert the broken piece of foam so that it is flush with the wall
4. Install one or more pieces of OSB with multiple screws into intact webs or bucks on either side of the failure location
5. Go back to work as normal, a very minor event if you are prepared

As with any below grade structure, it requires protection from moisture ingress and in some areas also needing protection from termites as well. ICF construction is used throughout North America in various climates and soil conditions and can easily be adapted to meet the local needs of a given area. It is always a good practice to enlist an experienced designer and builder to make sure the correct system is used with ICF for below grade protection which will be both long-lasting and cost effective.

## Section 11.1 – Moisture

Currently all building codes in the US and Canada require walls below grade to have damp proofing or waterproofing protection. In areas where only damp proofing is required, it is still highly recommended to install waterproofing on the ICF below grade. This provides the best performance and longevity.

### Section 11.1.1 - Damp Proofing vs. Waterproofing

Damp proofing serves as moisture control material which resists the passage of water when there is no hydrostatic pressure. When applied properly, damp proofing can keep below grade structures in a dry condition as long as there is no hydrostatic pressure due to water table.

Waterproofing on the other hand is meant to stop the water from infiltrating the foundation walls even with hydrostatic pressure. In most applications, waterproofing is more expensive than damp proofing, however the investment is well worth it considering the potential repair costs involved, if a basement wall starts to leak water inside the structure.

### Section 11.1.2 – Damp Proofing and Waterproofing According to Building Codes

Damp proofing is required for foundations walls enclosed within soils where hydrostatic pressure does NOT occur. If however 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.

### Section 11.1.3 - Foundation Drainage System

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 slab (for slab on grade) 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 below illustrates a typical French drain system also known as weeping tile which has been used successfully for residential construction in North America.

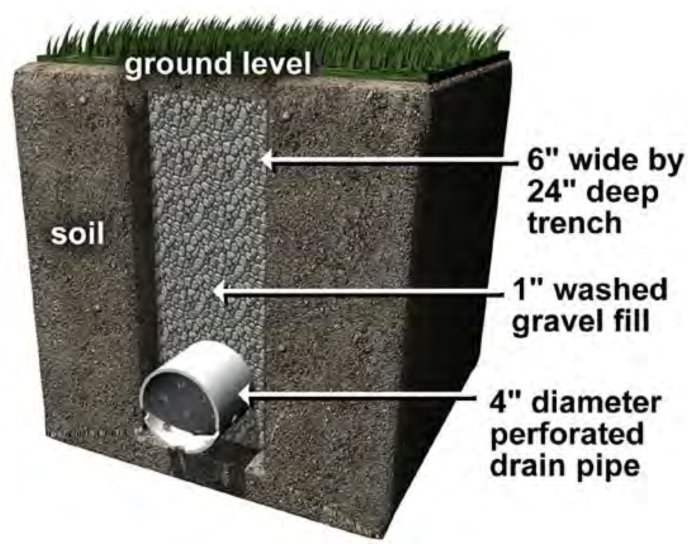



*Figure 1 – Typical weeping tile system*

## Section 11.1.4 – Maintaining a Dry Basement

The following recommendations help ensure that the new ICF basement stay dry and warm.

1. Make the extra investment and insist on full waterproofing for your foundation or basement walls. For best performance, terminate the waterproofing membrane 2-3” (51-76mm) above grade.
2. Build up the ground around your house so that water flows AWAY from the basement walls. Also examine sidewalks, patios, decks, and driveways. These can settle over time and cause water to drain back towards the foundation walls.
3. Extend downspouts so that water flows away from the house and does not pool next to the basement walls or windows. If the downspouts are connected to the home’s sewer system, disconnect them.
4. Clean debris from gutters regularly. If they overflow even when clean, replace them with larger size gutters and downspouts.

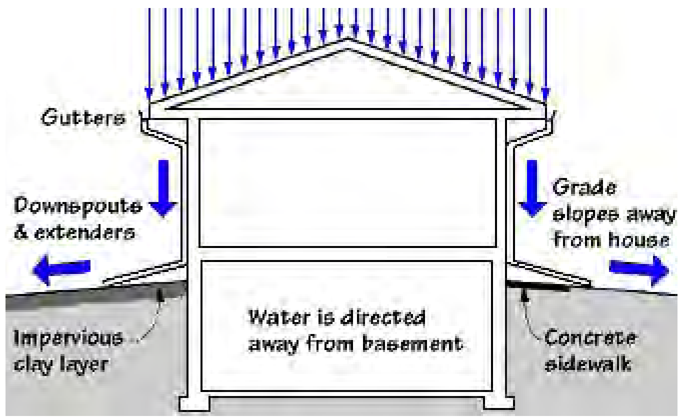



*Figure 2 – Recommendations for dry basement*

## Section 11.1.5 – Damp Proofing & Waterproofing Applications for Amvic ICF

There are three types of membranes that can be applied to Amvic ICF including liquid applied membranes, peel & stick membranes and dimpled membranes. Each of the above-mentioned types have advantages and disadvantages and the choice to choose one of the other is left up to the designer/client. However, factors to consider before making a choice are:

- Local availability – Check with your local Amvic distributor to inquire about the availability of applicable products to Amvic ICF in your area.
- Product Technical Information – Ensure that your product of choice has the proper technical information with regards to specifications, installation instructions and meets the local building code requirements.
- Manufacturer’s warranty – The product manufacturer should have a product warranty against production deficiencies. Some manufacturers offer up to 30 years of warranty on their products.
- Installer’s Warranty – The contractor installing the product should offer an installation warranty to guarantee that product is installed properly and will perform up to the requirements for a given period of time.
- Installer’s reference – It is recommended to ask your installer about his experience using the specific product of choice.
- Price – Higher performance products will almost always cost more than less performance ones. Carefully weigh the benefits against the costs before deciding on which product to use.

Regardless of which type and brand of application to be used, always follow the manufacturer’s installation procedures for ICF application.

## Section 11.1.6 - Liquid Applied Damp Proofing/Waterproofing systems

Liquid applied membranes usually come in pails of 5 US gallons (18.93L) 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 membrane. The protective boards/membrane will be applied over the liquid applied membrane and have the added benefits of additional moisture protection and provide air gap for water to be carried by gravity to the weeping tile/drain. For ICF installations, liquid applied damp proofing/waterproofing membranes MUST be water based and free of any solvents.

*Figure 3 – Spraying liquid applied membrane on Amvic ICF*

Compatible liquid applied waterproofing membrane products for Amvic ICF include:

- Henry Company, BLUE SEAL™ ICF and Concrete Construction - **www.ca.henry.com**
- Henry Company, Aqua-Bloc 720-33 - **www.ca.henry.com**
- Henry Company, Aqua-Bloc 720-38 - **www.ca.henry.com**
- Carlisle, CCW BARRICOAT - **www.carlisleccw.com**
- EPRO, e.spray - **www.eproinc.com**
- Advanced Coatings, Rub-R-Wall - **www.advancedcoatings.on.ca**

## Section 11.1.7 – Self-adhered Damp Proofing/Waterproofing systems

Self-adhered membranes 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 can be adhered in place as per the specific installation guide of the manufacturer. 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 (might be required for cold weather applications). As with any membrane or primer on ICF, if a primer is used it MUST be water based and free of any solvents.


*Figure 4 – Self-adhered waterproofing membrane installed and ready to be backfilled*

Recommended self-adhering waterproofing membrane products for Amvic ICF:

- SOPREMA, COLPHENE ICF - **www.soprema.ca**
- Henry Company, Blueskin® WP 200 - **www.ca.henry.com**
- Carlisle, MiraDRI 860/861 - **www.carlisleccw.com**
- Polyguard, 650 Membrane - **www.polyguardproducts.com**

## Section 11.1.8 – Dimpled Membrane Damp Proofing/Waterproofing Systems

Dimpled membranes are wrapped around the foundation walls with the dimple side facing the EPS on the Amvic ICF creating an air gap between the backfill 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, dimpled membranes are very effective in maintaining a dry below grade environment.

*Figure 5 – Installed dimpled membrane on Amvic ICF foundation*

Dimpled membranes products for Amvic ICF:

- Armtec, Platon Foundation Wrap - **www.armtec.com**
- Dörken, DELTA®-MS - **www.dorken.com**
- DMX Plastics, AG Foundation Wrap - **www.dmxmembranes.com**

## Section 11.1.9 – Parging

Most building codes in North America require the exterior finish siding to start at a distance not less than 6-8 inches (152-203mm) above grade level. The exposed EPS area between the grade and the exterior siding finish must be covered. Aside from skirting the transition area with cement board, a parge coat (cementitious coat) can be 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. Using Durock's B-2000 base coat with reinforcing fiber mesh or equivalent provides a durable finished surface. The parging coat should overlap the damp-proofing/waterproofing membrane by 2" (51mm).

Steps for applying parge coat:

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

## Section 11.2 – Termite

Termites are a type of subterranean insects which feed on dead plant material (e.g. wood). They can be found in some parts of North America forcing local municipalities to require preventive measures to be incorporated into the building envelope design, including ICF. 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 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 cut 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 shear numbers.

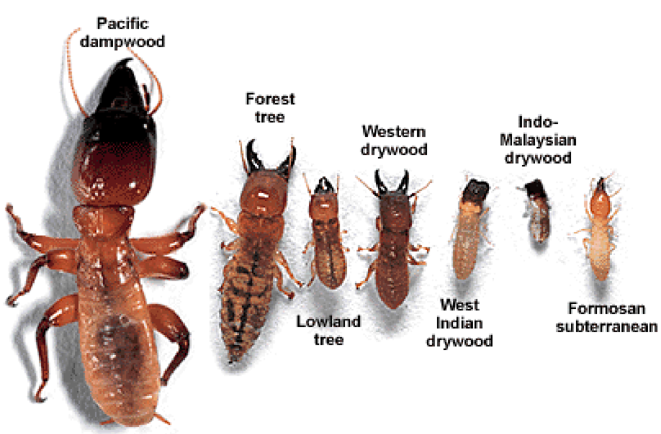



*Figure 6 – Most common species of termites found in North America*

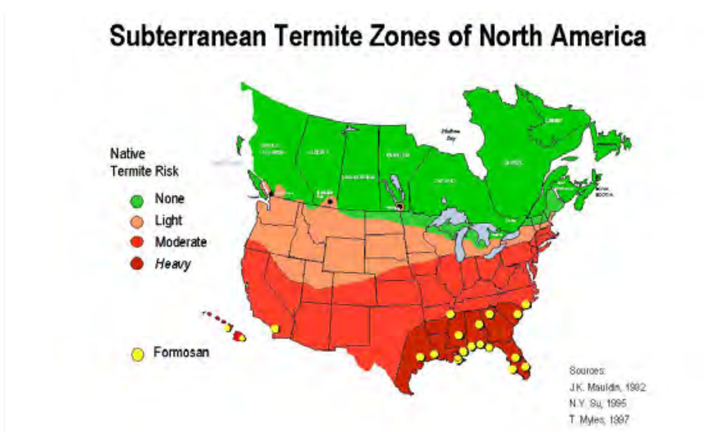



*Figure 7 – Termite risk map of Canada (excluding territories) and US*

## Section 11.2.1 – 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.

## Section 11.2.2 - 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, which makes the use of EPS foam acceptable.

## Section 11.2.3 - 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:

- Chemical soil treatment
- Pressure treated wood in accordance with AWPA standards
- Naturally termite resistant wood
- Physical barriers such as metal or plastic termite shields
- 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), 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" (152mm) between foam plastics installed above grade and exposed earth.

Exceptions in the code:

- Building structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or pressure treated wood.
- In addition to requirements of R320.1 an approved method of protecting the foam plastic and structure from subterranean termite damage is provided.
- On the interior side of basement walls.

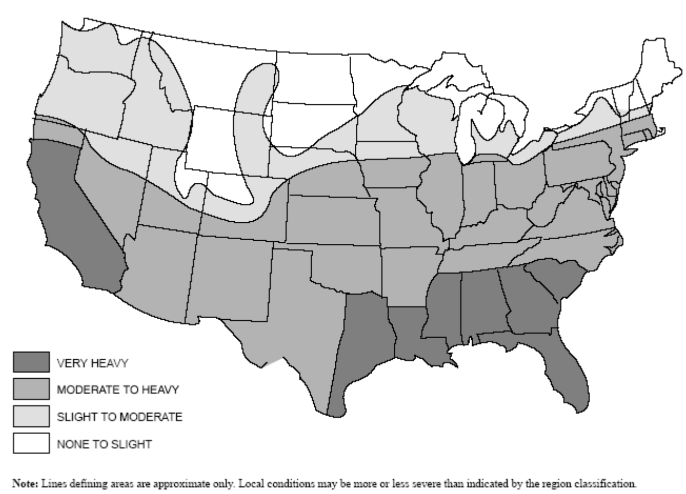



*Figure 8 – Illustration R301.2(6) as per IRC 2003 showing probability of termite infestation*

## Section 11.2.4 – 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 300mm 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 450mm 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.

## Section 11.2.5 - 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.

## Section 11.2.6 - Physical Barriers

**Waterproofing and Termite Barrier System.**

Polyguard TERM® Foundation Barrier membrane is specifically designed for ICF foundation walls and can be used for foundation waterproofing as well as termite protection.

Compliance of Polyguard TERM® Foundation Barrier membrane with building codes issues pertaining to waterproofing and termite protection is covered under the International Code Council ICC-ES ESR-3622 Evaluation Report which can be located here: **https://www.icc-es.org/wp-content/uploads/report-directory/ESR-3632.pdf**

For more information on Polyguard's TERM® Barrier System, please visit: **http://www.polyguardproducts.com/term/structures/icf-structures/**

### 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.

### 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° 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 9 – Metal termite shield using copper metal on top of foundation wall*

*Figure 10 – Detail of metal shield at inside corner*

### 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 1.4-2.8mm (0.055-0.11") 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 which was invented in Hawaii and is currently being used extensively throughout the US for new commercial and residential construction.

**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 ICC-ES Evaluation Report ESR-1860: **https://icc-es.org/report-listing/esr-1860/**

For more information on this product and its availability please refer to following website: **http://www.termistopusa.com/**

## Section 11.2.7 – Suppression

**Termite Baits**

Termite bait systems were developed based on the social behavior of insects to groom and feed each other to transfer 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 11 – 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:

- Sentricon® Termite Colony Elimination System
  www.sentricon.com
- BASF Trelona® Advance Termite Bait System
  www.basf.com
- Ensystex EXTERRA Termite Baiting System
  www.ensystex.com
- FMC FirstLine® Termite Defense System

**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 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, resulting 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.

**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.

- Building sites should be cleared of stumps, roots or other woody material that remains beneath or adjacent to the building.
- All stakes, forms and building debris should be removed from beneath and adjacent to buildings. Do not backfill over such debris.
- 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.
- No wood (stair supports, posts or other wood) should project through concrete floors or foundations.
- 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” (152-203mm) of clearance between the bottom of siding or stucco and the ground.
- Slabs, concrete floors and foundation joints should be sealed against moisture, and regularly inspected for cracks which should be immediately sealed.
- In areas determined to be very heavily infested with termites, it is recommended to remove an 8” (203mm) 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.

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 professional PCOs. Take remediation action when termites are discovered

## Section 12.1 - ICF Wall Penetrations

For wall penetrations there are two methods of doing them with ICF construction. The first method is to pour the concrete as one normally would and then cut out the openings where needed after the concrete consolidated. This method eliminates the need to preplan before the pour and save a little bit of labor in the beginning but becomes quite an expensive and time consuming after. Generally, this method should only be used if there was an issue or change to the design and there is an absolute need for penetration to be at that given location.

The second method is to block out the penetrations before the pour. This adds a little bit of time during the final stages of the ICF blocks erection but saves on concrete coring later on. 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.

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, will be drained to the outside. Sleeves should be sealed with a weather tight caulk or foam after all wiring have been installed.

## Section 12.1.1 – Electrical Installation

### Electrical Panel

The electrical panel is generally mounted on the interior side of the ICF wall. It is good practice to mount a piece of plywood/OSB to the wall (directly on ICF or on top of the gypsum board) to provide for a good and flexible mounting of the panel, accessories and wiring. For some localities, it might be a requirement to mount the panel on piece of plywood/OSB.

*Figure 1 - Electrical panel installed on Amivc ICF*

### 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 (hot knife can be used as well albeit slower) with a depth stop installed. It is recommended to cut 2” (51mm) deep to reduce the risk of nail/screws hitting the wiring during or after gypsum board installation. To maintain the continuity of the thermal envelope, it is recommended to backfill the channels with spray foam.

The Romex wires stay embedded in the EPS panels by friction. If the channels were not fully covered with spray foam, use spray foam adhesive to spot glue the wires to the EPS roughly every 24” (610mm) in a similar manner as 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 2 – Cutting a channel in the EPS panel using an electric chainsaw*

It is recommended to run the majority of the horizontal span of wiring in the joist space and bring the wiring down vertically where the receptacle or light switch are. This reduces the amount of foam cutting needed, increases installation speed and reduces the potential of nail penetrating the wiring (since there is less wiring in the foam).

*Figure 3 – Embedding Romex into the EPS panels*

If horizontal wiring is still needed, it is recommended to create the horizontal channels in the seam between two horizontal courses. Since the ICF webs are only 15” (381mm) while the blocks are 16” (410mm) in height, when they are stacked, there is a 1” (25mm) between the webs allowing for easy cutting. If an electrical fixture must be at a given location, cutting through the webs is also acceptable but can take a little more effort if cut with something other than a chainsaw.

## Section 12.1.2 – Conduits

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.

## Section 12.1.3 – Electrical Boxes

Electrical 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 R22 ICF are 2.5" (63.5mm) thick and 3.25" (83mm) for the R30 forms. Standard depth electrical boxes can be used with the thicker R30 panels while a shallow electrical box is needed for the R22 blocks.

If electrical boxes of more than 2.5 inches (63.5mm) 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.

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 and drill through the concrete.

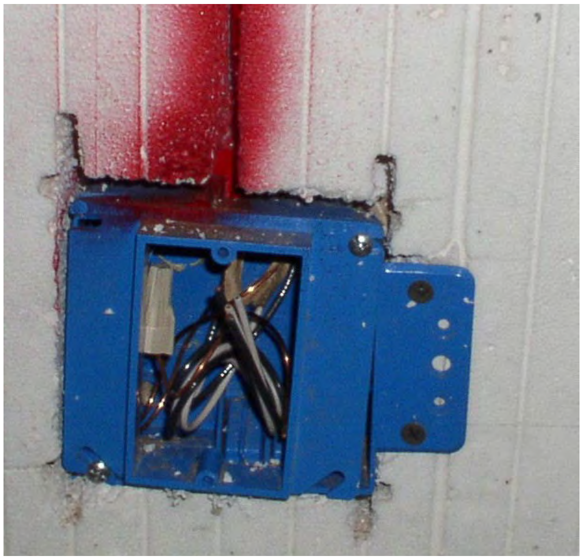


*Figure 4 - Electric box with flange attached to the webs*

DO NOT drill additional holes than what is provided in plastic electric boxes. This will void the UL/ULC rating.

## Section 12.2 - 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 as well as fill in the gap. Plumbing and electrical wiring can share the same channels. It is more common to run the plumbing in the partition wall to ease of access and reduced labor.

*Figure 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” (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.

## Section 13.1 – Interior Finishes

Currently all building code models in the 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 ½" (13mm) gypsum board also known as drywall. Drywall is to be attached using typical #6/#8 drywall screws with either fine or coarse thread.

The Amvic ICF polypropylene webs provide a horizontal and vertical furring strip to which the gypsum boards can be directly attached. The spacing and size of the screws should follow the local building code requirements. Gypsum boards can be installed vertically or horizontally with no particular advantage of one way over the other. For the purpose of meeting the building code requirements regarding gypsum board installation, Amvic has conducted the following tests which are available upon request:

- 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.
- Room fire test standard for in accordance with UBC-1997 standard 26-3 for protection of interior foam plastics using ½" (13mm) gypsum board.
- 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 ½" (13mm) gypsum board.

## Section 13.1.1 – Mounting Cabinets or Shelving

As with any construction project, the final goal is to create a comfortable and habitable space for the occupants. In order to achieve that there needs to be a provision to hang various items from the ICF walls such as upper cabinetry, shelving and blinds or curtains.

### Cabinetry

The webs in the ICF blocks serve is the nailing/fastening members in a similar way as studs. Unlike studs, the webs do not form a continuous vertical solid surface and there could be situation where fastening screw might miss the webs. There are several ways which this can be circumvented.

The first method involved some planning before the concrete is placed. Roughly where the upper cabinets would be installed, two horizontal strips would need to be removed from the foam panel and replaced with two-by lumber. The lumber would include some anchoring to the concrete (similar fashion to a door/window jamb) and once the concrete is cured, it provides for an excellent anchoring point.

The second method can be used once the concrete is already cured and requires some sheathing boards such as OSB or plywood. The sheathing board is installed roughly in the area where the upper cabinets will be and fastened to the ICF webs. The sheathing board is fastened with screws roughly every 16" (410mm) and provides a solid surface to mount the cabinets.

### Shelving

Depending on the type of shelving and what is to be stored on them, they can be installed in a similar fashion to the kitchen cabinets. Since only a strip of sheathing is required for shelf installation, it is beneficial to choose the same thickness sheathing as the gypsum board which will allow it to be sanded and painted to uniform. For smaller areas such as closets it might be easier to install OSB sheathing on the entire height of a wall or two and then cover it with gypsum board. This will provide easy mounting at any height and location while maintain a smooth and clean finished surface.

**Blinds/Curtains**

For curtain rods or blind installation above windows a similar methodology can be used as for the shelving. A strip of plywood of similar thickness as the gypsum board can be installed above the window overshooting by however much might be needed. This piece is fastened to the ICF webs and will provide a sturdy mounting surface. It can be sanded and finished to look indistinguishable from the gypsum once painted. Alternatively, drywall anchors can be used to mount the curtain rods or blinds.

## Section 13.2 Exterior Finishes

Amvic ICF is compatible with a wide range of exterior cladding types, ranging from stucco, EIFS, siding and masonry veneer. Each cladding system type can either be directly applied to the surface of the ICF blocks or require additional foresight during the design stage such as including a brick ledge form for masonry veneer cladding.

### Section 13.2.1 – Stucco

Stucco is a material that consists of a binder, aggregates and water. It is applied wet to a surface and hardens to a dense solid. It serves as first layer of protection to the wall and comes in many finishes and colors. In North American construction it is primarily known to have been applied over a substrate such as sheathing, concrete or masonry. Various manufacturers have created different products with various names.

Stucco installation can be as simple as preparing the surface, applying base coat with fiber mesh (for reinforcement) and a finish coat, but one should always follow manufacturer's installation instructions. Transition areas such openings, jambs, sills, headers, etc. should be carefully detailed and sealed to prevent unwanted ingress of moisture and air. It also important to check with the local building code to see if there is a requirement to use a weather resistive barrier (under the base coat), a metal lath or other requirements related to stucco application.

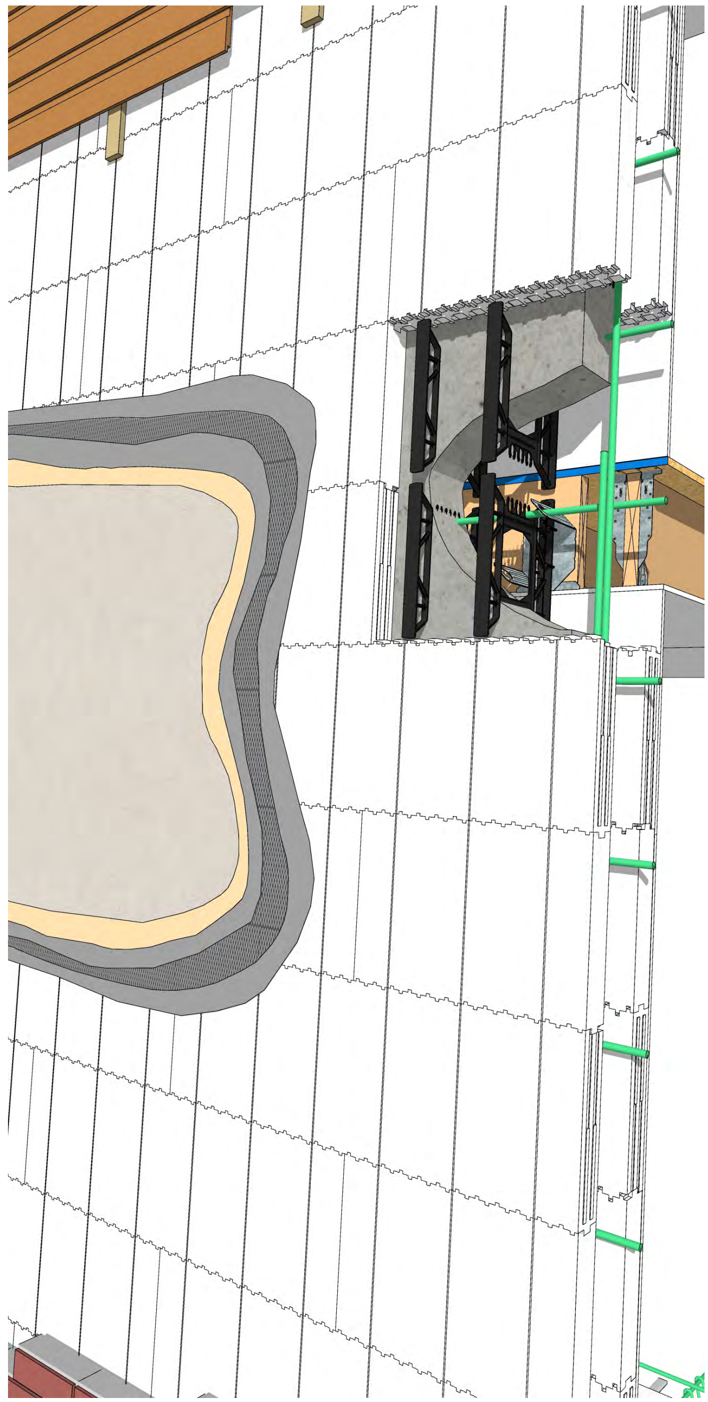


*Figure 1 – Typical stucco application over ICF*

## Section 13.2.2 - Traditional vs. Acrylic

For stucco finish there are two primary types, traditional and acrylic. Traditional stucco is generally made from Portland cement, sand, lime and water and essentially looks and feels like cement. It comes in a variety of finishes and color. Acrylic stucco is made from acrylic resins or polymers that somewhat resembles glue or paint.

Acrylic stucco does have sand in it as well which gives it textured surfacing. Acrylic stucco shines in the vast color selection it offers while traditional stucco has slightly better variety of textures. Traditional stucco is cheaper than acrylic stucco. Since acrylic stucco is also considered water resistant (it repels water), it can be used for one coat, three coat and EIFS applications whereas traditional stucco is permeable and is able to absorb water but also dry out. Traditional stucco can be also be used for one and three coat applications but is not used for EIFS.

## Section 13.2.3 – EIFS (Exterior Insulation and Finish System)

EIFS is a multi-component exterior finish system 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 name has changed to TAFS (Textured Acrylic Finishing System). EIFS wall cladding, like stucco, has many textures and colors that can be applied to the finish acrylic coat to produce the desired architectural effect. A typical EIFS cladding system consists of:

1. Weather resistive barrier
2. Foam insulation layer with built-in drainage
3. Fiber mesh reinforcing layer embedded in the base coat
4. Textured finish coat

*Figure 2 – ICF building with stucco*

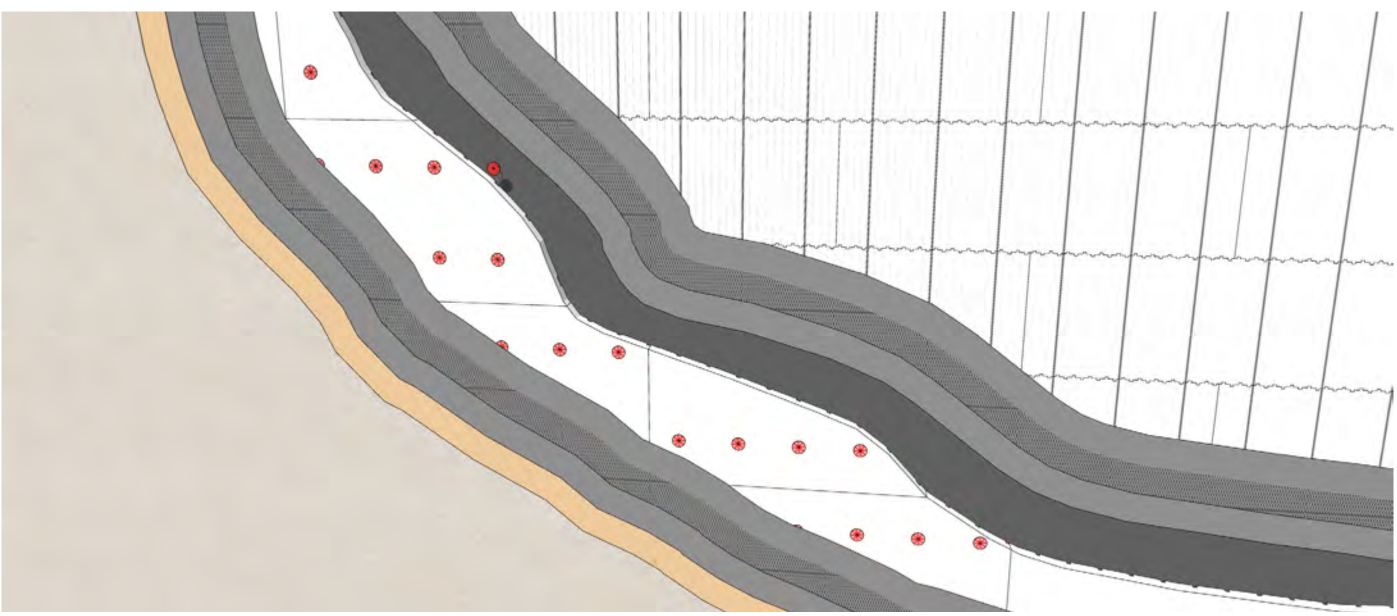


*Figure 3 – EIFS over ICF*

The EPS foam that makes up the Amvic ICF panels is a suitable substrate for applying EIFS cladding directly without the need for an additional foam board. This foamless EIFS configuration can sometimes be called DEFS (Direct Applied Exterior Finish System in the case of DuROCK) and is essentially a proprietary acrylic stucco system.

For ICF applications, stucco-based systems can be applied in various ways. One of the easier ways is to install the base coat with reinforcing mesh (can be metal or fiber) and then the finish coat. Although not necessarily needed, a liquid applied weather resistive barrier might be required or even a step further, a fully drained system (EIFS). In such cases consult the manufacturer.

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

## Section 13.2.4 – 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. This can be achieved either with a brick ledge form or installing a steel angle and anchoring it back to the concrete core.

The masonry veneer ties can be screwed directly to the Amvic polypropylene webs using approved fine thread or coarse thread screws or if using a different proprietary tie, it can be inserted in the foam before the concrete pull. For ties that are inserted into the foam, the back end of the tie gets embedded in the concrete providing improved pull out strength.

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 for an engineering analysis 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.

*Figure 4 – Brick veneer construction with Amvic ICF*

*Figure 5 – Stone with ICF retaining wall*

Follow the standard building code requirements for:

- Weep holes
- Flashing with dripping edge
- Proper material specifications for anchored masonry veneer ties

## Section 13.2.5 – 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, it is highly recommended for wood or metal strapping to be installed on the Amvic EPS surface by screwing directly to the ICF propylene webs. Wood or fiber cement siding can then be installed over the strapping using approved nails or screws.

Vinyl siding products in most cases can be installed by directly screwing into the Amvic ICF propylene webs with no furring straps. Check local building code requirements for use of weather resistive barrier before installing sidings over Amvic ICF. Always follow installation instructions given by the siding manufacturer for ICF applications.

*Figure 6 – ICF house with siding and stucco finishes on the exterior*

Amvic ICF is a high quality, innovative construction system designed for both residential and commercial applications. Competitive pricing, extensive product distribution and excellent technical support are combined to provide our clients with a simplified approach to a superior finished product. If any questions or concerns are not completely addressed in this manual, please contact us and our staff will be happy to answer any question. At Amvic, we pride ourselves in offering our customers an exceptional level of customer service.

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This manual provides a basic guide for the installation of Amvic ICF and is intended to supplement, rather than replace, the basic construction knowledge of a construction professional. All installations of Amvic ICF must be in accordance with all applicable building codes and/or under the guidance of a licensed professional engineer. In all cases, applicable building code regulations take precedence over this manual.

**Technical Support**

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

Phone 1 (877) 470-9991 (toll free)

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The Amvic website is updated regularly with the most current news, including testing reports, technical bulletins and evaluation reports. This document is available both in print and as a downloadable file from www.amvicsystem.com

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