amvic building system

## Architectural Notes

1. Structurally speaking, building with Insulating Concrete Forms (ICFs) is simply conventional poured-in-place reinforced concrete construction. In addition, the forms stay in place after pouring, subsequently provide very effective insulation, are an air and vapor barrier, and include a vertical imbedded nailer every six inches.
2. The main broad scale design differences to accommodate are:
    a. The walls are thicker (11, 13 or 15″ thick) and in converting a conventional design, the outer dimensions are usually stretched to maintain the same internal dimensions,
    b. Upper story concrete walls are best supported directly by concrete walls below,
    c. Effectively, the structure is a balloon framing design wherein the walls are continuous. (multi-story using precast floors being the sole exception)
3. ICF is used only for the exterior shell in residential construction with interior walls being framed conventionally. In commercial/institutional, ICF walls are often used as part of the interior wall structures to provide shear walls, and or to provide acoustic, thermal, or fire protection separation between rooms or floors.

**Architectural details in AutoCAD and PDF format may be viewed and downloaded at: www.amvicsystem.com**

4. ICF blocks in general, can be cut to almost any dimension desired. Significant compromises to the design to accommodate the block are *not* recommended, particularly with regard to wall lengths. Draw the plan to work within normal good design practices and the block can be adjusted to accommodate that. The Amvic forms were specifically designed so that the majority of cutoffs can be reused within the walls and reducing overall waste to typically less than 1-2%. Wall heights, to some degree are an exception to this advice. To reduce waste and speed construction, it is advantageous to design for the standard block heights for the ICF block in question and to adjust the wall heights accordingly. (More about that later).

5. **Forming corners.** There are 90-degree and 45-degree blocks pre-manufactured. They are placed first in construction and then straight blocks are used to infill. Corners of any other angle can readily be field constructed with no difficulty.
6. **Building heights.** Currently 8 story buildings have been built using ICF as the outer structural wall supporting floors. Taller buildings are being planned wherein the structure is conventional steel frame and the ICF is being used as a skin.
7. **Pouring walls.** Typically walls are poured one story at a time in a single pour of 8-14′. Monolithic pours of 24 to 28+ feet are possible with special alignment bracing & scaffolding and placement practices.
8. **Typical floors.** Conventional wood or steel joist supported interior floors are generally hung from ledgers attached to the concrete of the wall either with imbedded anchor bolts or with Simpson ICFLC ties. These ledger supported floors can be installed *at any vertical spacing on the walls,* irrespective of the block courses.

9. **Elevated concrete floors** are also used – occasionally in residential and extensively in commercial/institutional construction. These can be accommodated by ICF formed poured-in-place methods (such as Amvic's AmDeck™ or InsulDeck™), conventional bar joist supported form work, Hambro™ composite trusses, or hollowcore precast. The ICF formed concrete floors using systems like the Amvic AmDeck provide the best thermal and acoustic separation floor to floor. In commercial/institutional, hollowcore precast can provide the fastest on-site construction and where overall height limits are concerned, they are the thinnest floor section that can be used, controlling overall building height.

10. **Design freedoms**. ICF construction lets you can do some different things.

    a. More glass can be used than in a wood or steel framed structure and still comply with energy code requirements due to the high R-value of the rest of the wall (R-22-27).

    b. The inherent high shear value in a concrete wall similarly provides added design freedom with regard to large wall openings that could be problematic in frame construction.

    c. The specification of concrete strength and rebar eliminates hold downs, shear panels, and most of the steel that is necessary in frame construction.

    d. Curved walls of nearly any radius can be built with less difficulty than would be experienced in conventional construction.

11. **Typical block size.** Typically, six-inch block (six inch concrete core with 2 ½ inches of foam on each side for total width of 11") is appropriate in nearly all residential situations, and has been used in apartments as the structural shell up to 6 stories. Conventionally 8-inch block is usually called out for basement walls where more than 6-7 feet of retaining is involved. Retaining more than 8' may dictate using the 10-inch core block.

12. **Basements, daylight and full.** Dry comfortable basements of perfect quality can readily be constructed with Amvic ICF. On hillside properties it is most common to design for a full basement under the structure. If needed retaining walls can be added at the sides to allow windows/doors to be installed bringing light and access to the sides at the rear, particularly if required for egress. ***Note: On a hillside, extending the basement to be a full basement instead of a half basement may be a <u>very</u> inexpensive addition to the structure, costing much less than the other space of the structure***. This is the case because the ICF already provides an engineered wall and in the case of a full basement there is a single perimeter footing as opposed to multiple footings for a half basement plus stem wall. And adding the full basement does not add to exterior claddings, roof, floor systems, nor does it typically add significantly to the HVAC system needs. Also by doing so, construction time is often sped up as the builder effectively is building off a flat pad instead of working up a hill side with multiple footings.

13. **Basement waterproofing.** We have full waterproofing details to properly assure dry and waterproof basements. Care needs to be taken to assure that waterproofing materials must be specified that are compatible with EPS foam blocks as many are not. We recommend applying a water-based liquid membrane directly to the block and subsequently installing an air gap drain board to cover the membrane and provide a vertical drain path for liquid water. *These details are available as a technical note from Amvic Pacific and can be downloaded at www.amvic-pacific.com*

14. **Projections and cantilevers** need to be considered differently. The most straightforward approach is to support upper story concrete walls by placing them directly above a



530-265-9085 or www.amvic-pacific.com

corresponding concrete wall below. Otherwise, detailed structural engineering and steel beams will be required with consequent disproportionate added construction cost. *Upper story concrete walls cannot be supported either by wood frame or light gauge steel frames.* However, when using concrete flooring systems, cantilevering modest distances becomes more feasible without substantive added costs. If cantilevering is considered, it is prudent to have early discussions with a structural engineer before getting too far down the design road.

15. **Mixing frame walls with ICF.** In some cases it may make sense to switch over to conventional framing in a segment of the wall. That is acceptable. In such case, all structure above the wood or steel frame should continue as wood or steel.

The Amvic ICC Evaluation Report can be downloaded at
www.amvic-pacific.com/Downloads/Amvic ICC- ESR-1269.pdf

## DETAILING WORKING DRAWING.

1. Dimensioning. Generally you don't need to design to any specific dimensions. However, there are some standard dimensions that, if used, reduce construction costs due to reducing labor and minimizing waste. Guidelines are included on the last page of this guide.
    a. **For a wall segment with two outside corners**, the base minimum dimension that should be used is 41 inches when using 6-inch block and 45 inches when using 8-inch. (see pg. 8.) This number represents the exterior dimension of a short and long leg of a standard corner block. If the wall segment is adjusted to increment this dimension in 12 or 24" increments, this will assure that cut block can be reused with zero waste.
    b. **For a wall segment with an inside and outside corner**, (typical on a bumpout) the minimum dimension that should be used is 18" for the 6-inch block and 20" when using 8-inch. This short segment will require some additional bracing but works ok. A slightly larger bumpout of 30" with 6-inch block, or 32" with 8-inch block, will allow laying block to interlock in a running bond and will minimize bracing required.
2. **Garages. We recommend attached garages be constructed with an ICF outer shell the same as the main house. It is largely a myth that it will reduce cost of construction to switch over to frame construction for an attached garage.** The added cost to construct the garage from ICF is very small. If the garage is constructed with ICF, then the wall between the house and the garage which would otherwise typically be ICF, can be conventional framing, and as the garage door area has very little block due to the large openings, the amount of block added to do a 2-3 car garage is essentially only one to 1.5 side wall of block. Also, several of the costs associated with ICF construction are essentially fixed costs (deployment, pumping, redeployment) these costs don't increase proportionately if the small additional wall space to do a garage is included. The values of doing a garage in ICF are substantial: *same fireproof nature as house*, energy savings if heating, more comfortable all year otherwise, and *same durable substrate for exterior cladding as the main structure*. Also construction time is reduced by several days.
3. **Gables.** Gables of virtually any pitch may be constructed with ICF if desired, or you can switch over to conventional framing. If there is a cathedral ceiling in the interior space,

completing the gable with ICF is the recommended solution. Alternatively the ICF wall can be stopped at the plate line and the gable framed conventionally.

4. **At corners**, the placement of window and doorjambs needs to respect that there is an 11-inch wall on the other side of the corner. ***Rule of thumb: doors and windows should be set in at least 16″ from corners.*** Remember to leave added room for interior trim.

5. **Columns**. When forming columns of concrete, adequate space is needed to install rebar and properly place and vibrate the concrete. ***Rule of Thumb: The space between any two openings (door jambs or windows) should not be less than 12 inches.***

6. **Door and window bucks.** Bucks are a framework that holds back the concrete during the pour, provides the opening for installation of doors and windows. They can be either wood or vinyl.
   a. **Wood bucks.** The simplest buck is a 2x12 or 2x14 that is ripped to the appropriate width to correspond to the block thickness and constructed into a box that is inserted into the wall. Untreated lumber can be used if a moisture barrier is installed between the concrete and the wood.
   b. **Vinyl bucks.** Vinyl bucks, such as V-Buck are an alternative system. They have the advantage of being a non-biodegradable product and being more compatible with long term durability of the structure. ***Using a vinyl buck system provides greater assurance that you will not have future water or mold damage*** as the vinyl is not a wicking agent as wood is, is not a medium that will support mold growth, and is not subject to bio decay as is wood. Vinyl bucks will cost slightly more than wood, adding perhaps $1-2 per linear foot of window wrap at current prices.

7. **Windows.** With 11″ or 13″ thick walls, the option exists of mounting the windows to the exterior as is typical for frame construction, or recessing the windows to the inside with a deep exterior reveal.
   a. If mounted conventionally to the exterior, then the windows are attached to the buck with a nail fin and flashed in with ICF compatible adhesive flashings. In this case, the standard RO should be specified the same as in frame construction.
   b. If the windows are to be recessed either partially or fully to the inside then this should be detailed in the plans as the bucks must be built to accommodate the recess. The recess can be accommodated either by a second window stop inserted in the buck and the window attached with a nail fin to that, or by using a block style window without a fin.

8. **Bay windows** can be detailed by any of the following:
   a. Including concrete posts between windows (min 12″ between R.O.'s)
   b. Frame out the bay as a large open rectangle in the concrete with a concrete lintel above either in line with the wall, or following the line of the bay, and then to box out the bay itself with conventional framing. The advantage of this is that you provide greater structural strength of the structure by providing a continuous concrete band around the top.
   c. Break the concrete wall at the bay, and wood frame the entire bay *and* wood frame the rest of the structure *above* the window.
   d. Imbed structural steel posts.

9. **Door placements.** The hinge side of a door needs to respect the thickness of the wall. Hinged doors that are hung in the ICF block should be installed so that the hinge is flush with the inside wall so the door can open fully without hitting the door jamb. Doors should be specified with jam extensions and importantly *extended thresholds* to reflect the 11-inch block plus the thickness of the interior and exterior claddings.

10. **Top plates** are typically either pressure treated lumber or non-treated with a moisture barrier between the concrete and the wood. Top plates are typically 1 ½ inches thick, although a few building departments are now requiring a full 3 inches. Most builders desire that the top plate extend the full 11 or 13 inch width of the block. In that way cladding or sheetrock subcontractors have a nailer at the top of the wall. Generally, anchor bolts are wet set during the pour and the plate installed later.

11. **Connectors**:

    a. **Ledger connectors**. Simpson Strong-Tie has developed an ICF ledger connection system that reduces the labor & cost of installing ledgers/rim joists. Use of the Simpson ICFLC-CW will eliminate the need to install anchor bolts to handle the vertical loading. Alternatively, anchor bolts can be set into the walls and used to attach the ledger. Details for both are included in the Amvic CADD details.

    b. **Lateral ties.** Typically engineers will require imbedded ties to use the floor diaphragm to transfer loads laterally between walls. The most common connector in use for this purpose is the Simpson PA or similar which is poured in place in the wall and subsequently nailed down into the floor joist through the sheeting. When being installed perpendicular to the floor joist, blocking between the joists is required.

    c. **Rafter/truss connection.** In typical western construction the Simpson H3 connector is used most frequently to connect rafters to the top plate. In high wind zones of the Midwest, Southeast and Gulf Coast regions, imbedded hurricane ties are poured in place that wrap the rafters.

12. **Plumbing**: Where possible, keep plumbing on interior walls. Plumbing can be run in the outside walls, but vents and drain lines may have to be installed prior to the pour. Supply lines can easily be run in the block after the pour in the same manner as electric. In bathrooms firring out the wall is another option to provide more room.

13. **Residential electric wiring:** Romex and boxes are installed *after the walls are poured* and are installed in channels routed within the 2 ½ inches of foam covering the concrete.

14. **Commercial electric.** In commercial construction, if it is required, conduit can be placed within the concrete core as the walls are being assembled. What is easier and preferable however is to place the conduit in a channel cut into the foam after the walls are poured. In the latter cases, metal boxes should be employed that have side knockouts provided.

15. **Attic insulation.** R-40 or better blown cellulose or spray foam insulation over the ceiling is recommended. It is recommended to consider the Building Sciences Corporation Unvented Attic design as a thermal improvement. Details are available at their website at www.buildingscience.com In any case, fiberglass insulation is less than optimum and should be avoided.

16. **Backing**. Normal cabinetry, shelves, etc. can be securely attached by screwing into the face of the imbedded webs and no special provisions are required. Any especially heavy fixtures that will hang from the ICF wall should have imbedded backing installed before the walls are poured.

a. B Curtain rods, towel bars, tissue holders, etc. Perforated steel backing plates ("Grappler" plates) are available as an ICF accessory. These plates can be pressed into the surface of the foam block at locations where fixtures will be installed, and then the sheetrock installed over the plate and mechanically fastened to the adjacent webs. Subsequently, screws then will grab the perforated metal plate and be firmly held in place.

17. **Utility penetrations**. Any penetration is easy to accommodate prior to the walls being poured. If there is uncertainty or future potential requirements, a small buck can be installed and filled with foam and left in place so that an opening can be made easily later. Exterior lighting, water faucets, dryer vents, service entrances, etc. are obvious candidates to pre plan.

18. **Flashing windows and doors.** Appropriate ICF compatible adhesive backed membrane flashings should be used with ICF such as ProtectoWrap BT20XL. Adhesion is enhanced by specifying a compatible adhesive water-based primer.

19. **Termite protection.** Obviously termites can't eat concrete. Termites however, can *potentially* tunnel through the EPS foam to reach a wood food source. This is a localized issue, which should be evaluated on a case by case basis. Waterproofing with a membrane by itself offers a level of protection when the membrane wraps the footing. If you determine that complete termite protection is required, the easiest solution is to use ***Polyguard 650XTP Waterproofing Membrane with Termite Barrier*****.**

20. **Mixing block sizes.** Different thickness blocks can be combined either on subsequent levels or on different wall faces of the same level. In either case there is a two inch step that has to be accommodated either on the inside or exterior. ***This step in the block is usually concealed at either the top or the bottom of the upper floor joists.*** Waste can be minimized by design that includes this so that block doesn't have to be cut.

21. **Engineering.** In the Northern California/Northern Nevada seismic zones, in all cases a licensed engineer will be required to perform all of the structural calculations. Selecting an engineer who is already familiar with ICF will be advantageous. Amvic Pacific can assist with engineering referrals.

22. **Testing Reports**. The primary product testing and evaluation report is issued by ICC Evaluation Service Inc. It is ICC ESR-1269 dated April 1, 2005. Copies are available at the www.icc-es.org website, or at the www.amvic-pacific.com website.

23. **Planning department approvals.** This varies greatly by local jurisdiction. Almost all Northern California and Nevada counties have approved numerous ICF projects and the procedures are fairly well established. Individual inspectors may occasionally not yet have seen a project but in virtually all cases their departments have.

24. **Architectural details** are available from AMVIC in several AutoCAD formats. You may download them from www.amvicsystem.com As new details are being added frequently typically we no longer send out CAD details via CDROM as downloading assures that you have access to the most current details at all times.

25. **Special Engineering Inspections**. When 3000psi concrete is specified within the wall cavities, generally that mandates the requirement for a Special Inspection of the concrete during the pour by a qualified engineering technician. This varies somewhat by jurisdiction.

## Vertical Coursing

| Course height | | |
|---|---|---|
| 1 | **1′** | **4″** |
| 2 | **2′** | **8″** |
| 3 | **4′** | **0″** |
| 4 | **5′** | **4″** |
| 5 | **6′** | **8″** |
| 6 | **8′** | **0″** |
| 7 | **9′** | **4″** |
| 8 | **10′** | **8″** |
| 9 | **12′** | **0″** |
| 10 | **13′** | **4″** |
| 11 | **14′** | **8″** |
| 12 | **16′** | **0″** |
| 13 | **17′** | **4″** |
| 14 | **18′** | **8″** |
| 15 | **20′** | **0″** |
| 16 | **21′** | **4″** |
| 17 | **22′** | **8″** |
| 18 | **24′** | **0″** |
| 19 | **25′** | **4″** |
| 20 | **26′** | **8″** |
| 21 | **28′** | **0″** |
| 22 | **29′** | **4″** |
| 23 | **30′** | **8″** |
| 24 | **32′** | **0″** |

4, 6, and 8-inch AMVIC Block is 16″ high. (The 10-inch block is 24″ in height.)

**Changing block sizes**. You can use thicker block on individual walls or on different levels and transition to a smaller block size above. Where a size change is made, the blocks are kept flush on the exterior and the 2″ jog is on the inner wall. That jog normally is concealed at the floor level with the jog occurring at either the top or the bottom of the intersecting floor trusses. In that case, floor heights must be planned to line up with the block size change.

**Adjustments to height:**

Wall heights can be adjusted by ripping block as required. Typically a course of block is ripped on either the first or last course.

Blocks can be ripped in the center as well creating 8″ high blocks, and both halves are usable due to the reversibility of the block.

Note that ledgers can be adjusted up and down without any regard for the course heights of the ICF block.

It is builder-friendly to have window tops come out on an even block line (or 1.5″ below) if possible. This is a labor and material saver during construction.

In multi-story construction, the window tops can be designed to come out on or 1.5″ below block line by manipulated the ledger up or down (adjusting the floor to ceiling ht). Nonetheless, any height can be made to work.

**AMVIC Technical Data**

- EPS Thickness 2.5″ per panel, 5.0″ total
- EPS Material: Type 2 Flame Retardant Expanded Polystyrene (EPS), density 1.5 lbs/cuft
- EPS complies with requirements of ASTM E-84 and CAN/ULS-S701-97
- Thermal resistance with concrete Thermal Mass Effect: R-30+
- Sound insulation: STC-55
- Reinforcement placement complies with ACI 318
- Minimum concrete pouring temperature: Minus 4 degrees F.
- Fire Rating: 3+ hours
- Concrete wall: flat and solid
- ICBO Evaluation number ER-5948
- BOCA Evaluation Research Report No. 21-95
- SBCCI PST & ESI Evaluation Report No. 2212

Additional assistance can be obtained from: Amvic-Pacific phone: 530-265-9085

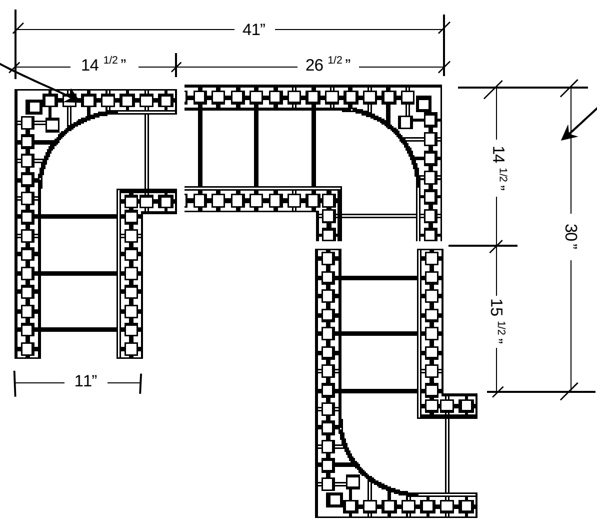
# 6″ Amvic Block
# Wall segment "friendly" dimensions

Note: Blocks are not exact and precise in their size — they're only *approximately* 48″ long. They undergo expansion and contraction as a part of the manufacturing process, and may frequently average 1/32nd to 1/16th inch longer than nominal size. As they are all within a tolerance range this doesn't affect their assembly in construction.

HOWEVER, if you try to calculate a long run of block to come out on an exact dimension it frequently doesn't work as the variation in the block size accumulates. For example a wall segment of straight block that is 48′ long will be 12 blocks nominally. However, 12 blocks interlocked with a running bond, can end up measuring 48′ 3/4″ inch with 1/16th oversize block.

**AS A PRACTICAL MATTER, we do not recommend attempting to make long runs of block work out to even block sizes ... it just doesn't work out. For any wall segment longer than 6-8′, disregard block dimensions and make the wall segment work with good functional design for the structure. The block will be cut in the field to make it work.** *It is never cost effective design to try to save 50¢ on block only to increase other affected costs by several dollars.*

**Outside to Outside corners.** A minimum dimension that works is 41″ (for 6-inch block). That provides the ability to create a running bond overlap between the blocks. Increasing the segment length by adding increments of 48″ would keep a wall length that would not require any block cutting. Alternatively, incrementing from 41″ in 6-inch increments would require block cutting, but still maintain zero waste.




**Outside to Inside corners.** A minimum dimension that works to maintain an interlock is 30″ (for 6-inch block). That provides the ability to create a running bond overlap between the blocks. Increasing the segment length by adding increments of 48″ would keep a wall length that would not require any block cutting. Alternatively, incrementing from 30″ in 6-inch increments would require block cutting, but still maintain zero waste.

* **With 8-inch block, bumpouts** (short wall segment with both an inside and outside corner) should be a minimum of 20″ and 32″ works even better.