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Manufacturers of FASWALL®

General Application and Technical Information (GATI) version 2.5

FOR FURTHER INFORMATION, CONTACT:
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Visit our web site at www.Faswall® .com

Warranty:

We guarantee all products to be manufactured according to the Quality Control standards required by the International Code Council (ICC). All products are supported by independent laboratory testing (ASTM), which is available upon request.

FASWALL® Wallforms are made of a wood-cement fiber composite. The wood chips have been mineralized to protect them from decay after which they are bound by portland cement. The wallforms dry-stack to build a wall system without the need for mortar. Each block weighs approximately 28-30 pounds. This weight, the striation of the cement-wood chip composite, and the interlocking ends of each wallform, create a stable wall even prior to the concrete infilling. Minimal bracing and alignment is required prior to infilling the wall forms with concrete. However, Faswall wallforms are not designed to carry any structural load other than the temporary concrete pressures that they are specified to contain during construction. All cut wallforms must be properly secured and installed according to the guidelines presented in this technical manual.

Faswall® wood-cement forms consist of 85 % wood and 15% cement binder and like any wood-based product wall forms will shrink or expand during the curing process (about 28 days). However, once cured, the dimensional tolerance of the wall forms is consistent. Wall forms can withstand the moisture and temperature fluctuations occurring on a construction site over many months and even years. The wall forms cut very easily with circular saws and reciprocating saws and can be cut to any length required in the building design. Please consult the Materials and Tools section of this manual for further suggestions.

Disclaimer:

Faswall ® provides technical and installation support, however, cannot control the quality of workmanship or the inspection of building conditions or applications. FASWALL® Insulating Wood-Concrete Forms are designed so that the cores are filled with concrete and steel reinforcement. It is the concrete cores and rebar within the wallform that are the primary load carrying material of the wall system. Design of the Faswall wall system should be reviewed by an engineer. Faswall wallforms must be used according to the Manufacturer's General Application and Technical Information (GATI) and in compliance with all applicable Building Code and local regulations. The Manufacturer otherwise assumes NO responsibility.

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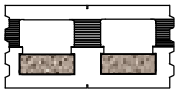
1.0 Specification and Description of Faswall® insulating Wall Forms (WF)

1.1 Wallform definition

Wallforms are cast from wood-concrete, a mixture of mineralized wood chips and portland cement. The Wallforms are designed as stay-in-place units which become part of a load-bearing wall only after being filled with reinforced concrete. See Figure 1 and 2 on subsequent pages for Wallform schematic and in-place views.

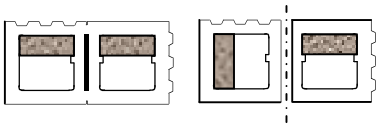
There are seven basic Wallforms that provide enough versatility to build any structure.

Standard Wallform; part 1224-STD

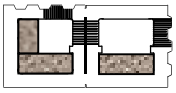


cuts in half to form ½ size wallforms

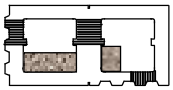
AP- Wallform; part 1224-AP



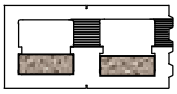
Outside Corner Wallform; part 1224- OC



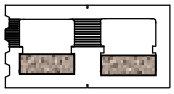
Inside Corner Wallform; part 1224-IC



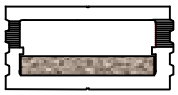
Male End Wallform; part 1224-EB-M



Female End Wallform; part 1224-EB-F



Large Core Wallform; part 1224-LC



The beam notches in each wallform, which allow for the formation of a horizontal beam of concrete, must be continuous throughout the whole wall system. The only wallform requiring field notching is the AP wallform which usually is cut in half to form ½ size units.

The standard wallform; part no. 1224-STD. It measures 24" long (L) x 12" wide (W) x 8" high (H) and is designed to hold a up to a 3" thick mineral wool or foam insert but can also be used for projects in which no additional thermal insulation is necessary (see page 40 for R-

values). The standard wallform is typically supplied with a 3" insulation insert in the cells. This creates a core size for concrete that is 5" x 8.875". In some situations the engineering will dictate additional concrete in the core which will require thinner insulation inserts or no inserts. This vertical core space provides for internal concrete columns which can be reinforced with steel rebar according to various schedules that can be designed by licensed engineers or architects and/or is based on local Building Code requirements (e.g. IBC 2007, IRC 2006) or applicable prescriptive standards.

The AP wallform; part no. 1224 AP. The dimensions of the AP wallform is 24"L x 12"W x 8"H. This wall form is designed to be field cut in half to form two half size wallforms for use at window and door openings. Each of the half sized wall forms has a flat smooth surface on one end to form the openings. The core size with the typical 3" insulation insert is 5" x 8.875" wide The AP WF is shipped without notches for the horizontal core. The notches for the horizontal core need to be cut on the jobsite (easily cut with standard saws). The AP WF may also be used in the same capacity as the standard WF, as the dimensions are exactly the same.

The Corner wallform; part no. 1224 OC (outside corner) and **1224 IC** (inside corner)
It is 24"L x 12"W x 8"H and is designed to turn a 90° angle by receiving a standard or half-size wallform. This wall form has grooves on the side wall into which the tongues lock into from the intersecting wall form. The core size with typical 3" thick insulation inserts is 5" x 8.875" wide.

The End Block wallform; part no 1224 EB-M and 1224 EB-F.
These WF's are designed for window and door openings. They have a solid smooth end to form smooth surfaces for the mounting of windows and doors directly to the Faswall composite material.

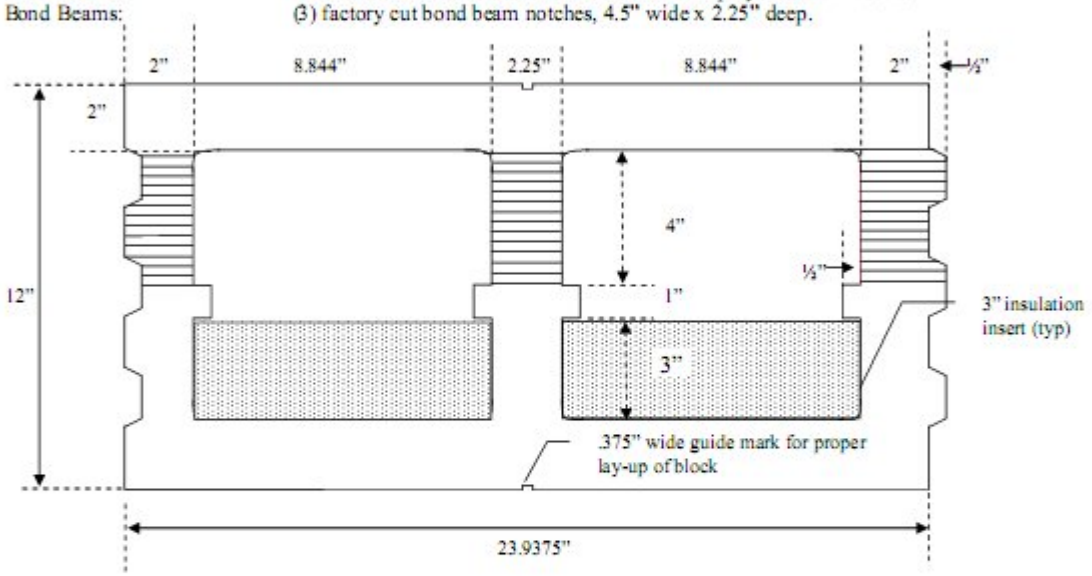
The Large Core wallform; Part no. 1224 LC. It is 24" L x 12" W x 8" H and is designed to provide shear wall strength where required in discrete areas of wall runs. The core size is 20" by up to 8" thick. The Large Core WF is a versatile tool to solve specific wall engineering challenges.

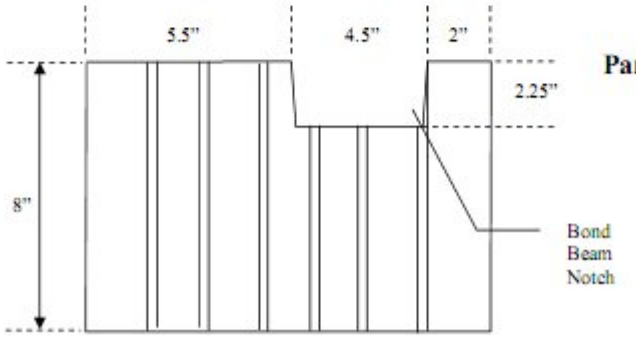
1.2 <u>Specifaction Sheets of each Wallform</u>

SPECIFICATION SHEET

FASWALL® STANDARD WALL FORM-PART NO. 1224 STD

Overall dimensions:	23.9375" long x 12" wide x 8" high (length and width dim. tolerance +,- .09375")
Wall Area:	1.33 ft^2
Composition by volume:	85% woodchips, 15% Portland cement and mineral coating
Weight:	
With 3" mineral wool inserts:	28-32 lbs
With 3" poly-iso foam inserts:	26.5-30.5 lbs
R value:	R-21 with 3" mineral wool inserts. R-25.5 with poly-iso foam inserts.
Bond Beams:	(3) factory cut bond beam notches, 4.5" wide x 2.25" deep.





Part No. 1224 STD

End View

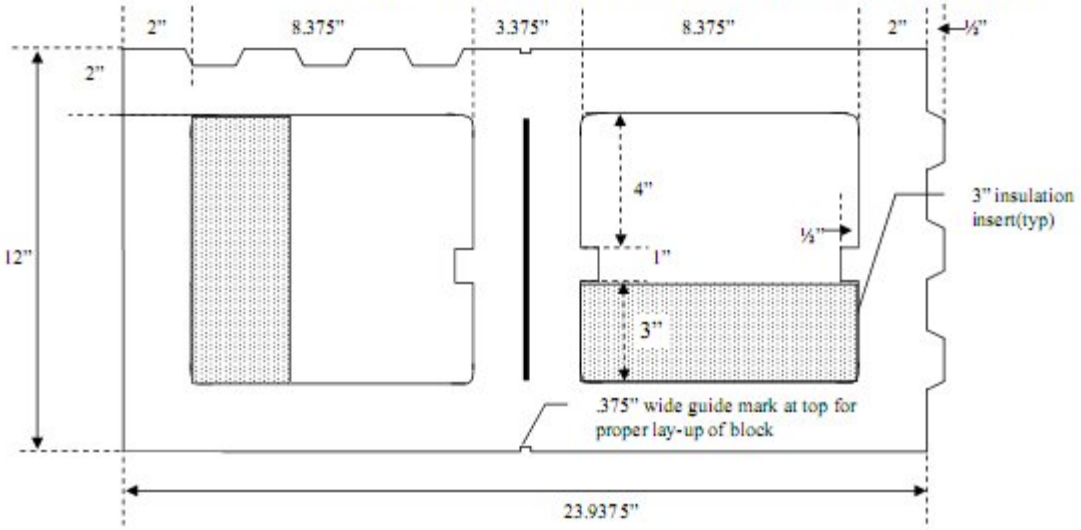
SPECIFICATION SHEET

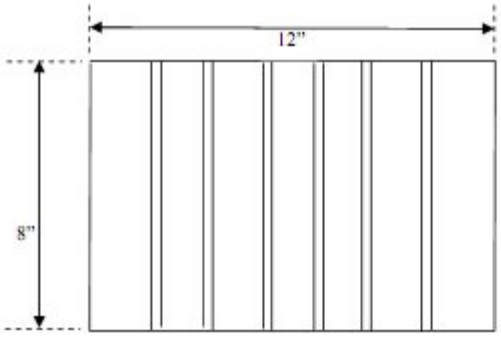
FAEWALL® ALL PURPOSE WALL FORM-PART NO. 1224AP

Used primarily to make ½ size wallforms (splittable)

IMPORTANT: THIS WALLFORM NEEDS FIELD CUT BOND BEAM NOTCHES

Overall dimensions:	23.9375" long x 12" wide x 8" high (length and width dim. tolerance +,- .09375")
Wall area:	1.33 ft^2
Composition by volume:	85% woodchips, 15% Portland cement and mineral coating
Weight:	
With 3" mineral wool inserts:	28-32 lbs.
With 3" poly-iso foam inserts:	27-31 lbs.
R value:	R-21 with 3" mineral wool inserts. R-25.5 with poly-iso foam inserts.
Bond Beams:	(2) 4.5" wide x 2.25" deep to be field cut appropriately for openings.
	(3) 4.5" wide x 2.25" deep bond beam notches to be field cut if used within a wall run.





End View

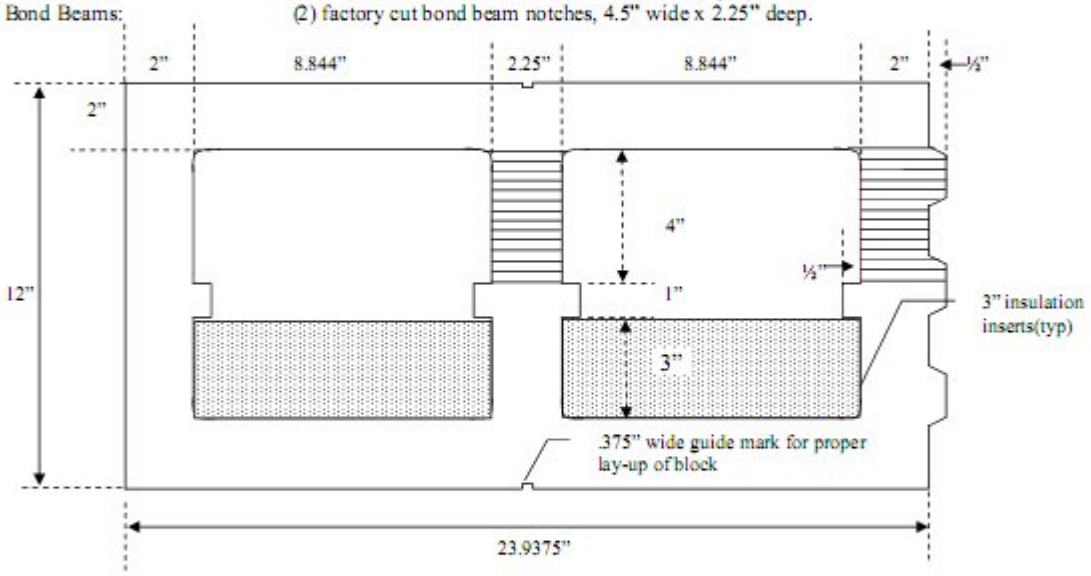
Part No. 1224AP

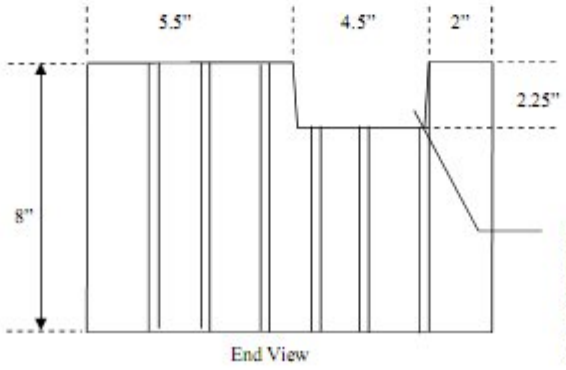
SPECIFICATION SHEET

FASWALL® END BLOCK WALL FORM-PART NO. 1224 EB

NOTE: There is a 'female' END BLOCK and a 'male' END BLOCK. Male version is shown.
END BLOCKS are typically supplied in a 'male' and 'female' pair since they are typically installed in pairs at door and window openings.

Overall dimensions:	23.9375" long x 12" wide x 8" high (length and width dim. tolerance +,- .09375")
Wall Area:	1.33 ft^2
Composition by volume:	85% woodchips, 15% Portland cement and mineral coating
Weight:	
With 3" mineral wool inserts:	28-32 lbs
With 3" poly-iso foam inserts:	26.5-30.5 lbs
R value:	R-21 with 3" mineral wool inserts. R-25.5 with poly-iso foam inserts.
Bond Beams:	(2) factory cut bond beam notches, 4.5" wide x 2.25" deep.



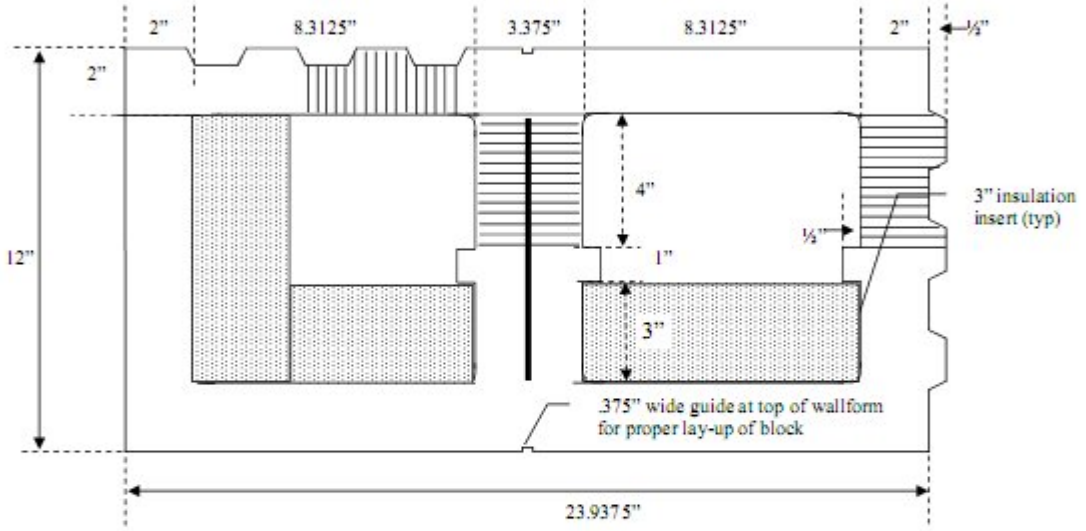


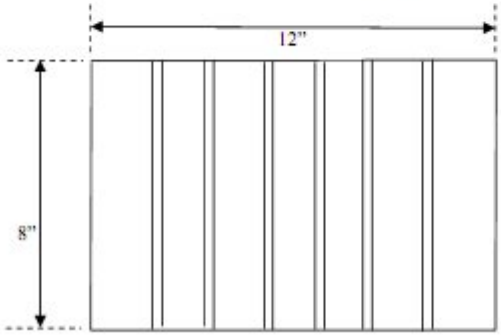
Part No. 1224 EB

SPECIFICATION SHEET

FASWALL® OUTSIDE CORNER WALL FORM-PART NO. 1224 OC

Overall dimensions:	23.9375" long x 12" wide x 8" high (length and width dim. tolerance +,- .09375")
Wall area at a corner:	2 ft^2
Composition by volume:	85% woodchips, 15% Portland cement and mineral coating
Weight:	
With 3" mineral wool inserts:	28-32 lbs.
With 3" poly-iso foam inserts:	27-31 lbs.
R value:	R-21 with 3" mineral wool inserts. R-25.5 with poly-iso foam inserts.
Bond Beams:	(3) 4.5" wide x 2.25" deep bond beam notches.



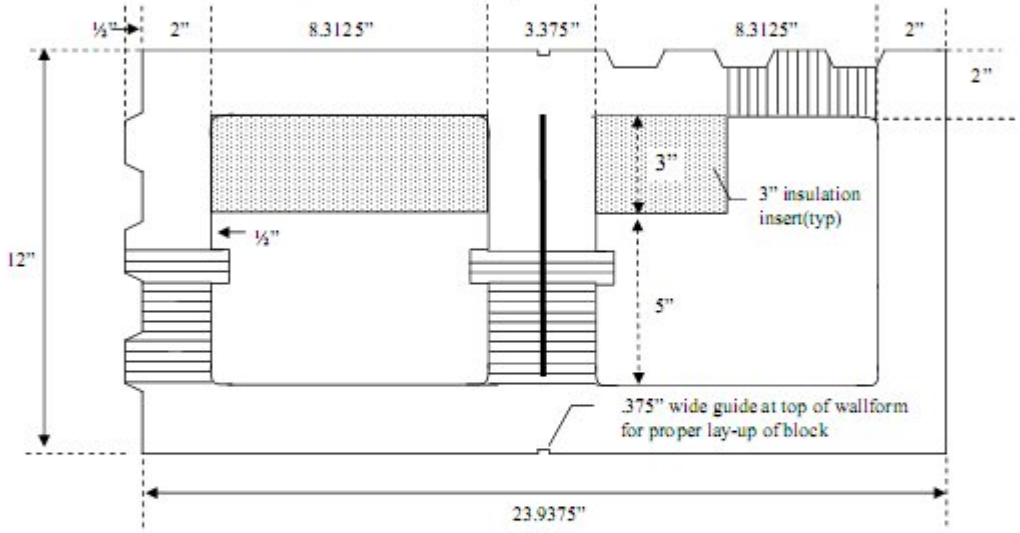


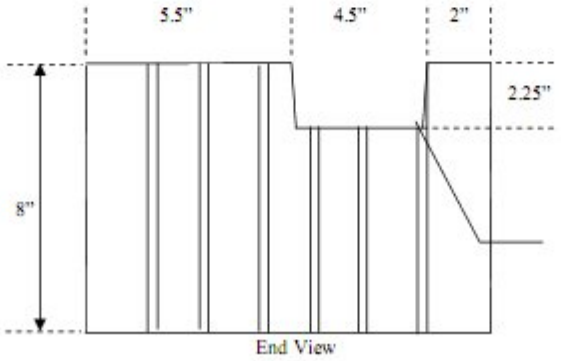
End View

Part No. 1224 OC

SPECIFICATION SHEET
FASWALL® INSIDE CORNER WALL FORM-PART NO. 1224 IC

Overall dimensions:	23.9375" long x 12" wide x 8" high (length and width dim. tolerance +,- .09375")
Wall area at a corner:	2 ft^2
Composition by volume:	85% woodchips, 15% Portland cement and mineral coating
Weight:	
With 3" mineral wool inserts:	28-32 lbs.
With 3" poly-iso foam inserts:	27-31 lbs.
R value:	R-21 with 3" mineral wool inserts. R-25.5 with poly-iso foam inserts.
Bond Beams:	(3) 4.5" wide x 2.25" deep bond beam notches.





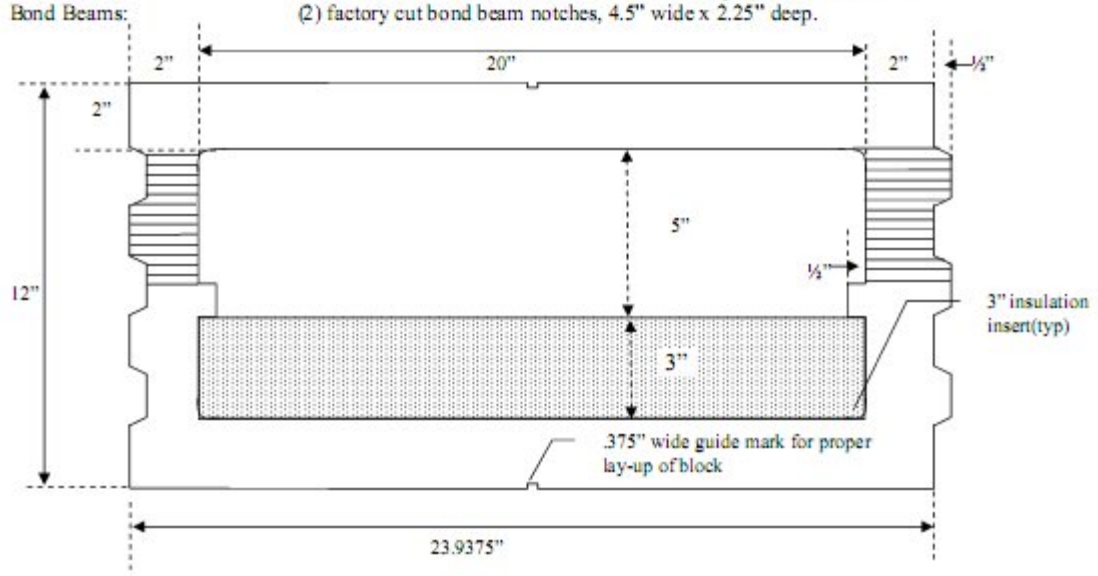
Part No. 1224 IC

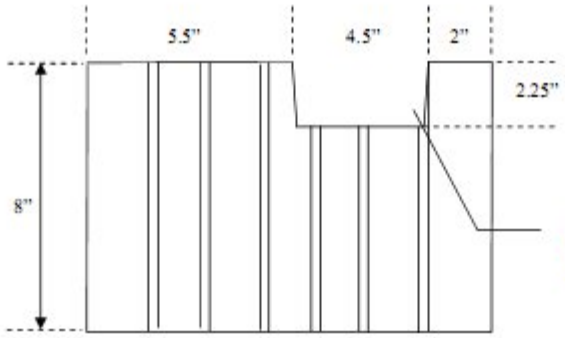
SPECIFICATION SHEET

FASTWALL® LARGE CORE WALL FORM-PART NO. 1224 LC

NOTE: For special engineered wall sections only. Use judiciously as these wall forms are weaker without the central web.

Overall dimensions:	23.9375" long x 12" wide x 8" high (length and width dim. tolerance +,- .09375")
Wall Area:	1.33 ft^2
Composition by volume:	85% woodchips, 15% Portland cement and mineral coating
Weight:	
With 3" mineral wool inserts:	27-31 lbs
With 3" poly-iso foam inserts:	25.5-29.5 lbs
R value:	R-21 with 3" mineral wool inserts. R-25.5 with poly-iso foam inserts.
Bond Beams:	(2) factory cut bond beam notches, 4.5" wide x 2.25" deep.





Part No. 1224 LC

End View

1.3 Post and Beam or Screen Grid

The WFs are trimmed to height at the factory within a tolerance of 1/16". When stacked, Faswall® Wallforms provide the framework for a reinforced concrete post and beam wall (see Figure 1). The post and beam system is referred to as a "screen-grid" (SG) wall system. A horizontal core is formed at 16" centers vertically in the Faswall® ICF wall system. For special structural situations Faswall® WF's can be installed to form horizontal cores on 8" centers as well.

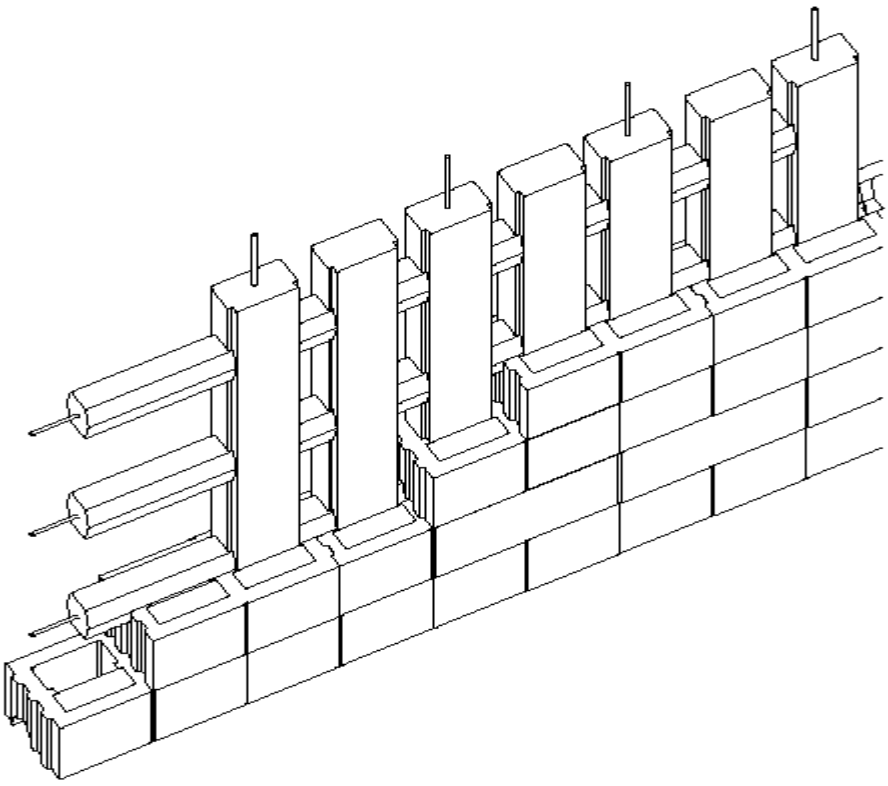


Figure 1- Filled Wallform Schematic

The FASWALL® wallforms are shipped on 48”x36” or 48”x48” pallets; each pallet containing entirely one type of wall form. A helpful feature of the Faswall system is that all wallforms are interchangeable dimensionally. This gives the installer options if he lacks a particular type of wallform for a given part of the build. For example, the AP unit can be used as a standard wall form, or a corner wall form (notching required) if necessary.

NOTE: Wallforms are designed to be filled with concrete and are not intended to stand alone as load bearing blocks.

2.0 R Value and U Values

Wall Design	R-Value*	U-Value
Concrete filled Faswall wall with 3” mineral wool inserts, interior plaster, exterior stucco coating	R-21	.048
Concrete filled Faswall wall with 3” polyisocyanurate foam inserts, interior plaster, exterior stucco coating	R-25.5	.039
Concrete filled Faswall wall with NO additional insulation.	R-11.8	.085

*Thermal Mass Factor, although not calculated, adds substantial benefit

3.0 Designing with Faswall® Wall forms

3.1 General Design Principles

The ideal Faswall design results in little to no cutting of the wallforms. Stack wallforms-insert rebar-fill with concrete-DONE. *By following a few fundamental design rules you can achieve a 30% reduction in installation labor and eliminate cut wallform waste.*

3.1.1 DESIGN RULES:

Rule #1: Design all wall runs to the foot using odd numbers: e.g.: 5', 15', 17', 33' long walls. Even for bumpouts USE odd numbers to the foot.

Rule #2: Layout all openings on a one foot increment from the corners of each wall run.

Rule #3: Design all openings using a 12" increment horizontally and 8" increment vertically. (exception are standard door rough openings which are typically not in the 12" x 8" increment.

Rule #4: Use Faswall as the rough opening for the attachment of windows and doors in lieu of installing permanent wood framework at each opening.

Following these simple instructions will result in:

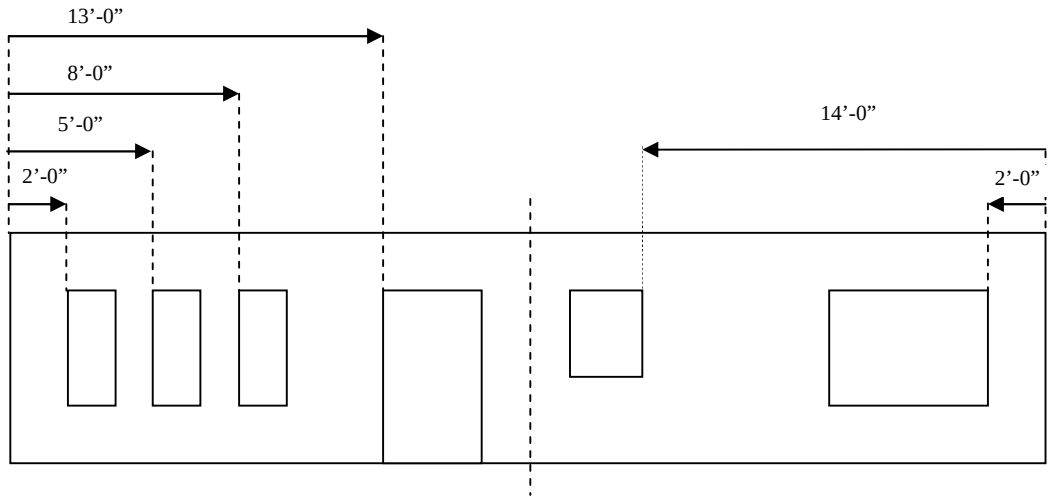
- Least amount of waste of product.
- Very little, if any, permanent lumber.
- Fastest installation (far less cutting of block).
- Perfect alignment of the wall forms insuring straight, plumb walls with no compromise of the structural concrete infill.

3.1.2 Procedure

Design wall runs to the odd foot in dimension Layout the rough openings in the wall runs so that they fall on 1' increments from the corners. It is good practice to layout the openings from each corner working towards the middle since the wall forms "grow" by a small amount as they are laid out end-to-end (approximately 3/4" every 20'). Rough openings shall be designed using a 1' module horizontally and an 8" module vertically. This results in openings being 1'-0"; 2'-0", 3'-0", etc. in width and 16", 24", 32", 40" etc in height. And finally, use Faswall for the rough opening for window attachment thereby eliminating the use of permanent wooden frames. Use 'masonry' style windows that are fastened through the side frame into the walls.

Result: Fastest installation, least amount of waste.

--Layout openings from each corner towards the middle of the wall run.



3.2 Engineering

Faswall structures are usually engineered. Typcially, ACI 318 is the basis for an engineered solution. Faswall® formed concrete structures may be utilized for 1-3-story buildings such as; residences, motels, schools and commercial buildings. In addition they serve well for such structures as firewalls and retaining walls. They can also be engineered for use in specific locations in high-rise buildings. More complete engineering data is available from ShelterWorks that includes physical testing of the wallforms, load tables, fire testing, termite testing, acoustical testing, etc. ShelterWorks has an engineer that can discuss engineering details with the engineer on record for the project.

4.0 General Information and Getting Started

The following technical notes contain recommended instructions for the practical use of Faswall® Wallforms. Jobsite conditions, worker experience, or other factors may sometimes make it necessary to deviate from these instructions, but under no circumstances should applicable building codes or standard construction practices be ignored.

4.1 Tools and Materials needed to install Faswall®

Tools:

- Circular saw or miter saw 7" – 12" diameter with carbide blades for specialty cutting.
- Reciprocating saw with 12"-16" pruning blade for rough cutting the Wallforms.

- Electric chain saw is very useful.
- Electric rotary sander/grinder to level out small irregularities.
- Rubber mallet for positioning wall forms prior to filling is an essential tool.
- Cup Bits for drilling holes for ledger boards
- Cordless drill and appropriate selection of bits for driving fasteners.
- Level, string, plumb bob to assure a plumb and level wall.
- Adequate moveable set of scaffolding system in proportion to the job
- Rebar bending, fastening, and cutting equipment

WARNING: Protect eyes with safety glasses and mouth & nose with dust mask when cutting Faswall® forms!

Materials:

- Wood: For temporary wood bucks (frames) at each opening use 2x10 lumber for the sides and header and two 2x4's on edge for the sill. 2x lumber or ply wood is needed to form corner boards at wall corners.
- Plywood; 4' x 8' sheets to be used to fabricate temporary strengthening cover plates and coarse threaded fasteners (#9 x 3" deck screws) for applying to weakened areas of the wall or cut/altered block.
- Wood shims for occasional leveling of courses (usually not necessary). Plastic shims for leveling the first course if that approach is selected (see 3.7.3).
- Fasteners; coated deck screws. #9 x 3" and #9 x 3.5" for fastening corner units, for modifying wallforms, for fastening bucks and stabilizing plywood to the wall forms.
- Mortar mix (as the first row may be laid in mortar). A professional mason is best qualified to do this, since it is very important that the first row be perfectly level to build up the wall.
- Construction adhesive such as "Concrete Repair" (gray), Polyurethane Concrete & Masonry Sealant (gray), "Liquid Nails", or nonexpanding urethane foam to fill small gaps or secure a wallform that has been cut. Such adhesives should be used only as a supplement to the patching (see Figure 4, page 7)

4.2 Concrete in-fill approximate volume

Wallform with 3" Insulation Insert:	**.333 cubic feet per square foot of wall area**
Wallform with no insert:	**.5185 cubic feet per square foot of wall area**

Reminder: The AP wall form is not notched for the horizontal core. This has to be done at the jobsite to fit the situation. Two cuts with a saw are sufficient to knock the center piece out with a hammer. A reciprocating saw is the recommended tool for this, or a circular saw.

Faswall® Wallforms MUST be filled with concrete; they are not designed to be stand-alone load bearing concrete masonry units. Mortar should be used only as a bed for leveling the first course of wall forms on a footing or slab that is uneven. Alternatively plastic shims may be used to level the first course (see 4.7.3).

4.3 Receiving and Unloading Wallforms

Carefully unload the wall form pallets from the truck using a pneumatic tired forklift. **Be careful in traversing rough terrain with pallets of wallforms as they can tip if severe rocking occurs**. Place them on level ground close to the jobsite where they will be used. When unloading by hand, you should use caution and avoid reckless handling of the wall forms.

Check each pallet for wallforms that may have been damaged in shipment. After examination of the shipment set aside on a separate pallet any wallforms that have been cracked or broken and are not safe for use. It is important to notify the manufacturer so that arrangements can be made for the replacement of any damaged wall forms.

All damages to Faswall® products should be noted on the trucking company's delivery ticket and the driver should verify the damage and sign the papers before the truck leaves the jobsite. Claims for damaged products should be made promptly and the manufacturer should be made aware of the claim.

4.4 Layout at the jobsite

Thoroughly study the building plans and make note of all details that must be given special consideration throughout the project.

The footing or slab should be checked with a level to assure accuracy. Areas of the footing/slab that are uneven should be marked. Layout the placement of vertical rebar on the footing/slab and also mark the locations of doors and windows on the footing/slab.

Make note of the locations for electrical conduit and plumbing lines on the footing/slab.

4.5 Getting familiar with the Faswall Wallform

Before workers begin to lay out the Wallforms on the building perimeter, they must understand that the forms are not conventional concrete blocks. Faswall® Wallforms must be handled with more care and placed more carefully in order to make proper use of the precise sizing and interlocking design. Installers need to carefully study this guide and the accompanying diagrams and illustrations. If there are any questions about the proper use of Faswall® Wallforms, do not hesitate to contact the Faswall® Wallform manufacturer. In order to realize all the benefits and advantages of the system, it is vitally important that the system be used correctly.

Faswall® Wallforms are easily cut with circular and reciprocating blades. Some also prefer using a chain saw. Diamond blades are unnecessary and do not cut as well as carbide blades. Workers should wear eye protection and gloves when cutting and handling the Wallforms.

Wallforms must be laid tight with no gapping between adjoining forms. Adjust the positions of the Wallforms with a rubber mallet (essential tool). Never strike the wallform with a hammer, except to remove a sawn piece that is being removed to form a notch.

4.6 Foundations-slab design

Foundations-slabs shall be designed/engineered and constructed in accordance with all applicable building codes and ordinances as well as engineers specifications if an engineer's involvement is required. The design professional can use the following information in the calculation of the dead weight of the completed Faswall® Wallform assemblies. These weights

should be considered in the foundation/slab design and are wet weights (weight includes freshly poured concrete). See Table 1 below.

Table 1. Faswall® Fresh Concrete Wall Weights

Wallform type	8' wall height (12 courses of Wallforms)	16.66' wall height (25 courses of Wallforms)
Faswall® wall form with 3" insulation inserts and wet concrete	675 lbs/lf	1406 lbs/lf
Faswall® wall form with no insulation inserts and wet concrete	929 lbs/lf	1935 lbs/lf

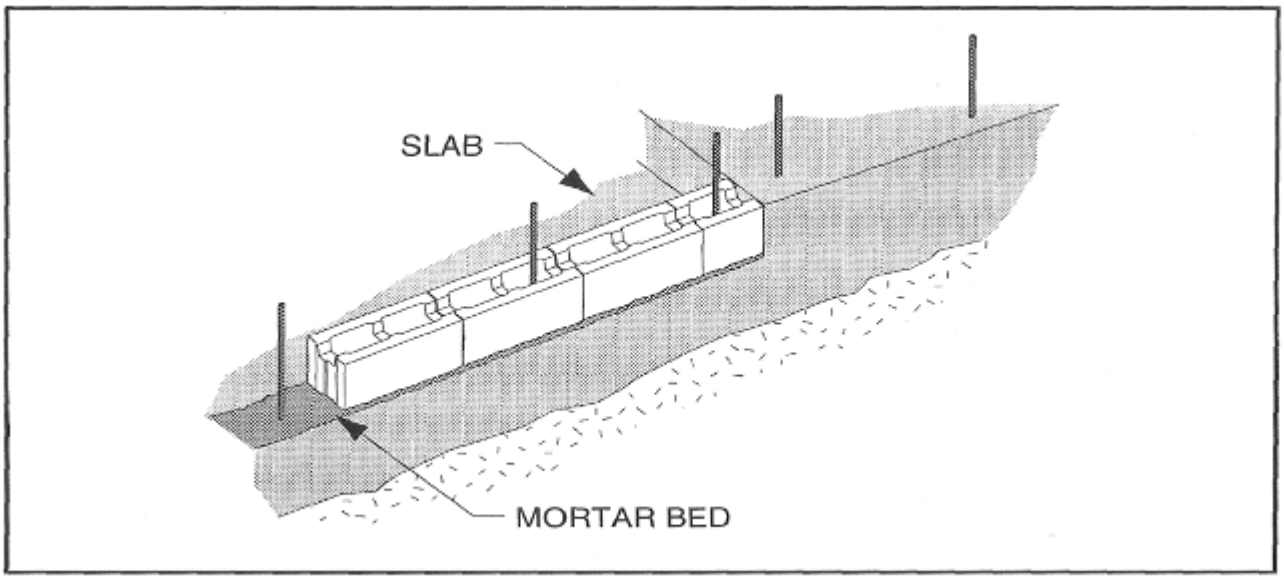


FIGURE 3

4.7 First Courses

4.7.1 Buck material preparation

Bucks (framing for the openings) can either be permanent or temporary.

A temporary buck is constructed from 2x10 lumber for the sides and header and two 2x4's on edge for the sill area. See photo at 5.1.2 for this buck design.

Bucks are installed as a guide for stacking at openings as well as providing support for the lintel blocks above the openings. As was discussed earlier, the preferred method is to fasten windows and doors directly into the wall form material. The End Blocks and Half Blocks are designed to build openings as they have smooth ends to which windows can be fastened with screws.

Alternatively 2x lumber frames can be built and fastened to the Wallforms to provide permanent bucks (typically pressure treated) for window and door fastening. If permanent wood bucks are used, an option is to make two frames with a gap to create a thermal break between frames. An alternative to using 2x lumber is to use 3/4" plywood. Temporary window and door bucks need to remain in place at least 12 days for curing of the concrete before removal.

4.7.2 Set the Corner Wallforms

Using a laser level, or transit, set the Corner Wallforms in mortar at the exact outside dimensions of the building, at exact level. They must be placed in the proper orientation for the tongue and groove interlocking to work out around the entire perimeter during lay-up (see section 4.8.1). After the first course mortar has set, full lay-up may begin. The corners will be built up higher than the center courses. Then, string lines can be pulled which will enable rapid positioning of the course in between. The strings are easily secured to the corners by small screws in the wallforms.

4.7.3 First Course Wallform leveling

Setting the first course properly is absolutely essential for the construction of a level, plumb, and square structure. Footings and slabs are never 100% level and true. After setting the corners at exact locations, build from the corners into the center of each wall run on a mortar bed. The last wallform in the course will need to be trimmed to fit. (Figure 3). Or, using plastic shims, shim the block to level the entire first course. When using the shim method, fill the cores of the first course of wallforms with a runny mortar mix. The mortar will fill the gaps between the footing and the wallforms. If choosing to lay a mortar bed for the first course as opposed to shimming the first course work 10'-15' sections of a wall at a time in order to avoid working with an excessively dry mortar mix. Check positioning of wallforms frequently to assure control of all three planes. .

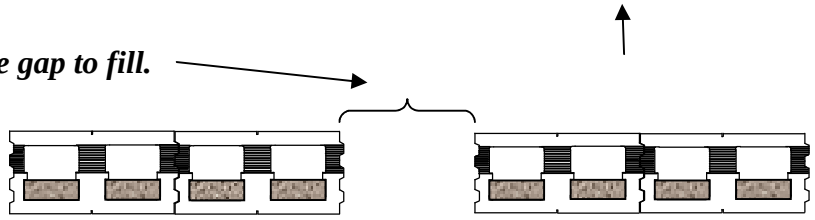
4.7.4 Joining adjacent Wallforms

Always make certain that the male and female ends of the wallforms mate properly. They are designed to fit together tightly, assuring maximum insulation value and fire resistance. Fasteners (nails, screws, construction adhesive, etc.) are generally not needed to join wallforms. There are occasions when gapping occurs between wall forms that will require the use of a galvanized fastener, or adhesives to close gaps. Later, when walls are erected it is recommended to foam any gaps >3/16" with a non expanding urethane foam adhesive on both inside and outside surfaces.

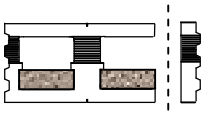
4.7.5 Cutting the last Wallform in each course

Build the walls in from the corners. In most cases the last wallform in each course will need to be custom cut to fit due to the slight growth in the wall as you stack the wallforms end-to-end (approx. ½-3/4" every 20') . The best method is to cut off the end of the filler wallform, shorten the wallform, then re-attach the end using screws. This returns the structural strength of the modified wallform. Proper attention to this detail will assure that the cut wallform will hold up when the forms are filled with wet concrete and that the insulated side is sound.

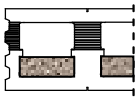
Step 1: measure gap to fill.



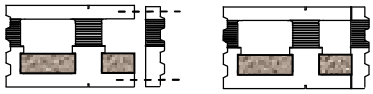
Step 2: cut off the end of the 'filler wallform'



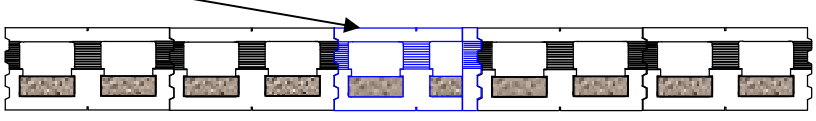
Step 3: Cut the wallform to the appropriate length(remove insert, cut separately)



Step 4: Re-attach the end of the wallform using 3.5" galvanized or ceramic coated screws:



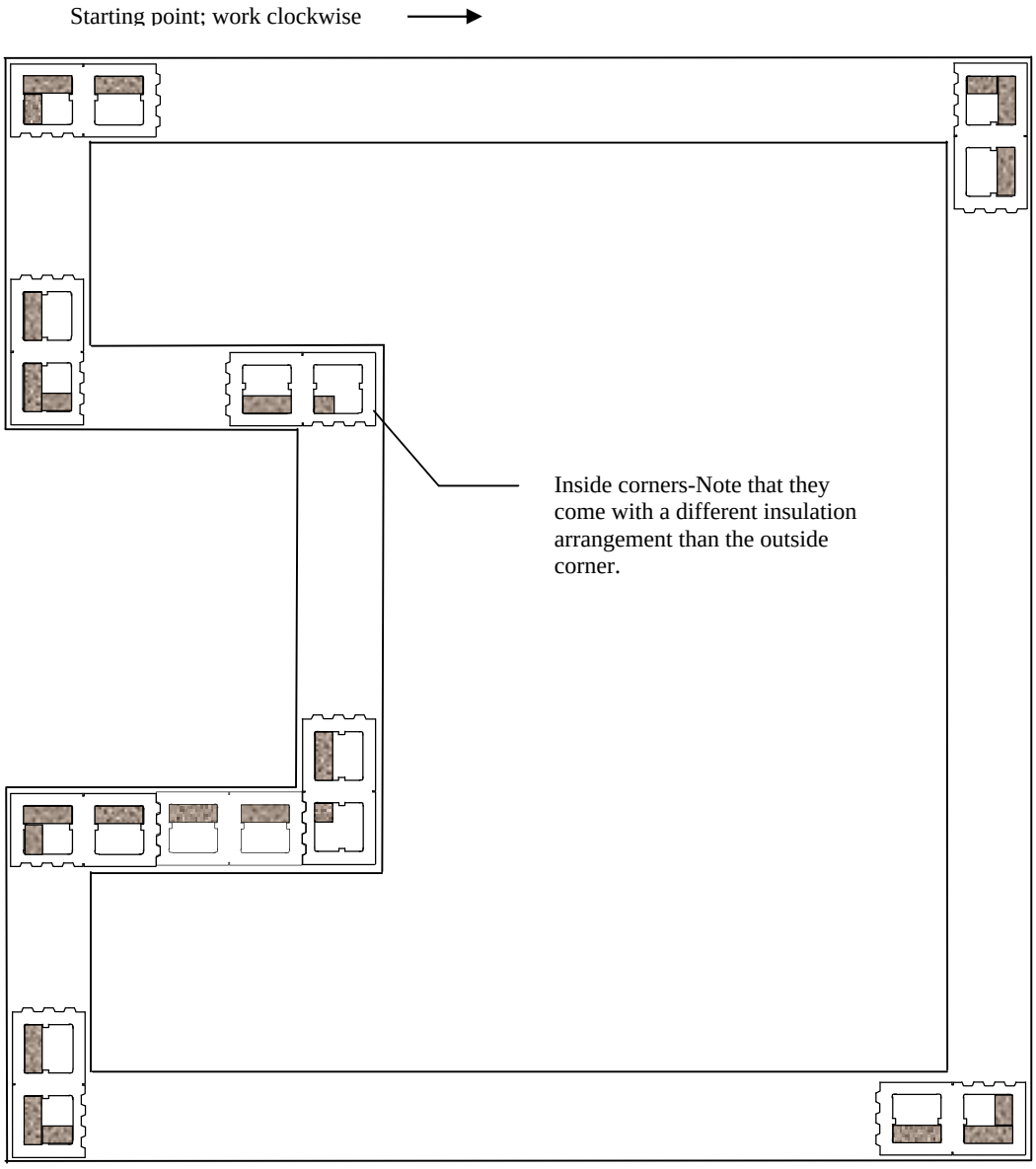
Step 5: Install in wall



4.8 Diagramming the First Three steps to start Wallform lay-up--Critical to orient the corners correctly!

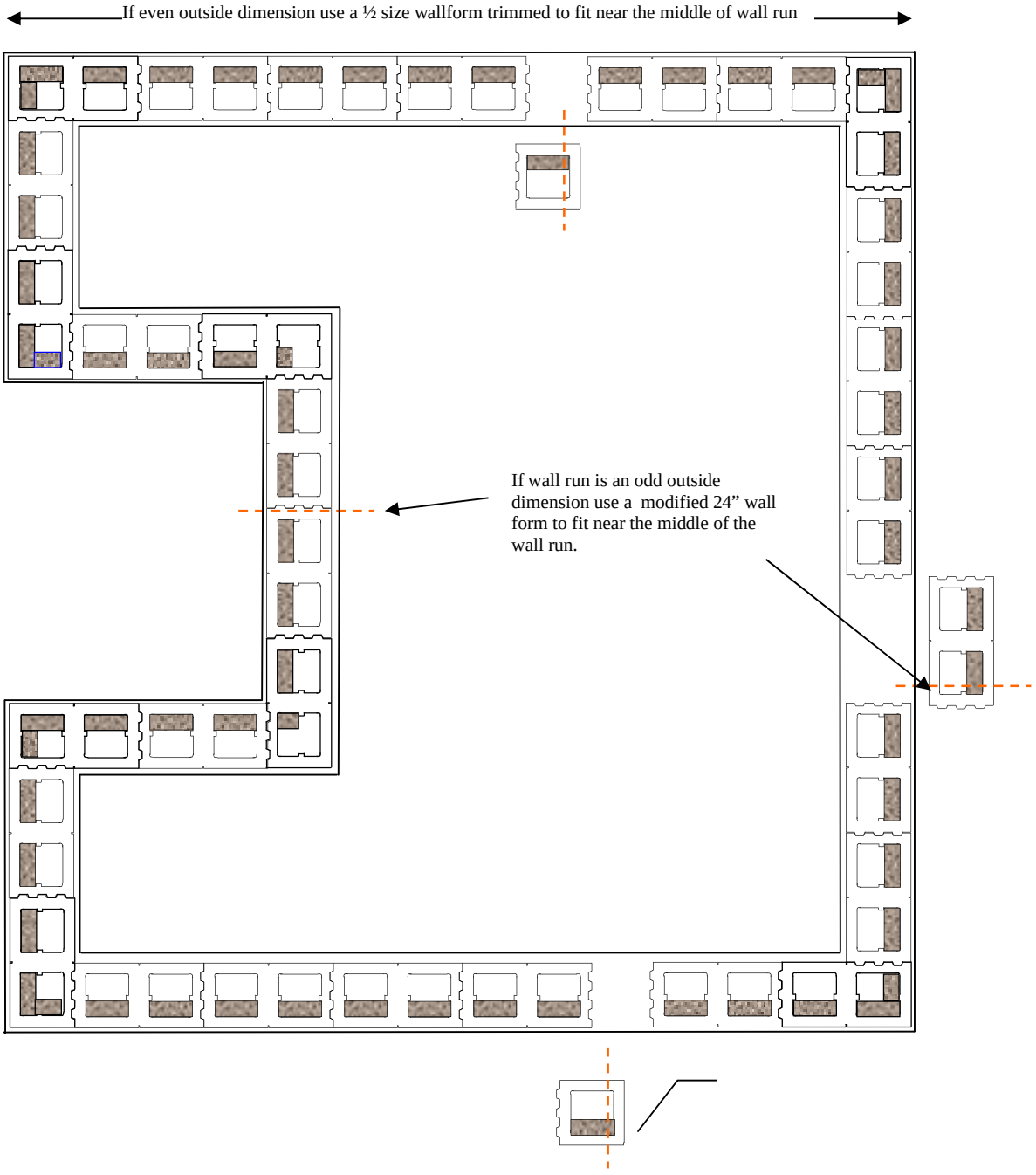
4.8.1 Step 1

Lay the corners first on the footing at exact locations. **Note the orientation of the corners on diagram!** This insures that the tongues and grooves mate properly on every course. It doesn't matter whether the process starts with the notched side up or down on the footing. Illustration shows notch down.



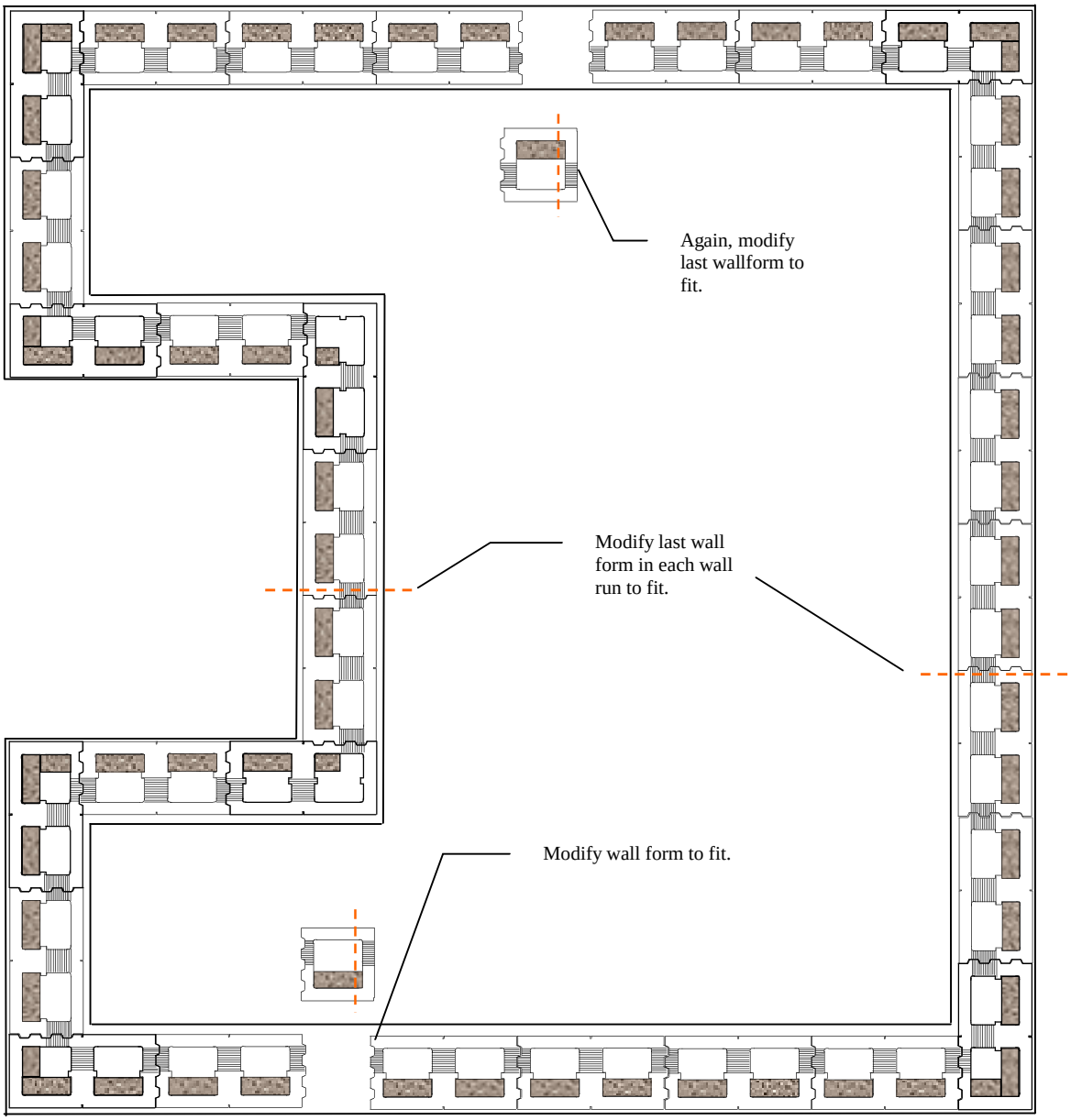
4.8.2 Step 2

Working from the corners, lay the first course and work towards the middle of each wall run. The last wall form placed in each wall run will need to be trimmed to fit. Orange color shows where field cutting is required. Rebar stubs have been cast into the footing and are protruding up. The first 2-3 courses of wall forms have to be lifted over the rebar to be set.



4.8.3 Step 3

After the first course has cured in its bed of mortar, subsequent courses can be dry stacked quite rapidly. Illustration shows the notched side up for this second course. Note that all of the corners overlap the previous corner. Tongue and grooves should all mate up around entire perimeter.



5.0 Instructions for Subsequent Courses and Openings

5.1 Recommended Stacking Protocol based on 1' x 8" module dimensions

NOTE: This is a different method than used for CMU construction! Think of the Faswall Wallforms more as a wood product than a cement product. It cuts very easily.

! As you have learned this recommended stacking method results in:

- least amount of waste
- fastest installation
- accurate alignment of the cells of the wall forms.
- Least amount of lumber (can be done without any permanent bucks)

= Corner wall form

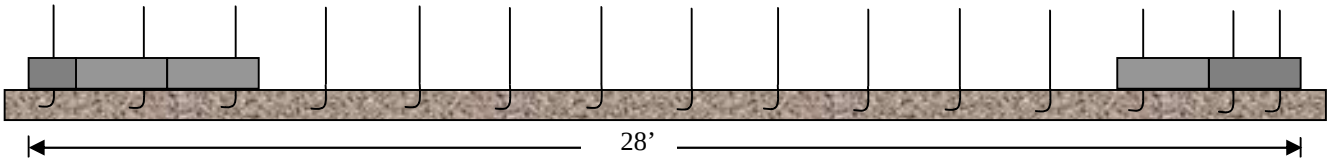
= Standard wall form

= End Block wall form

= custom cut WF

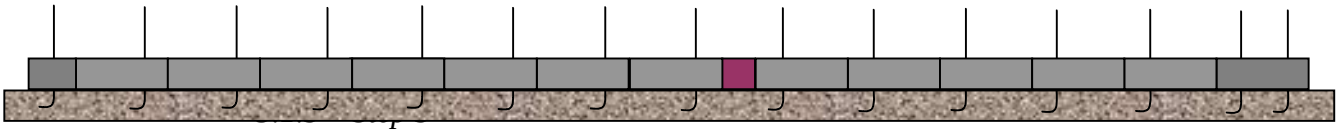
5.1.1 Step 1

Lay out the corners at exact outside dimension as per previous instructions. Start stacking to the center, threading Faswall® wall forms over rebar stubs. Shim wall forms to make **perfectly level**, or bed them into mortar.



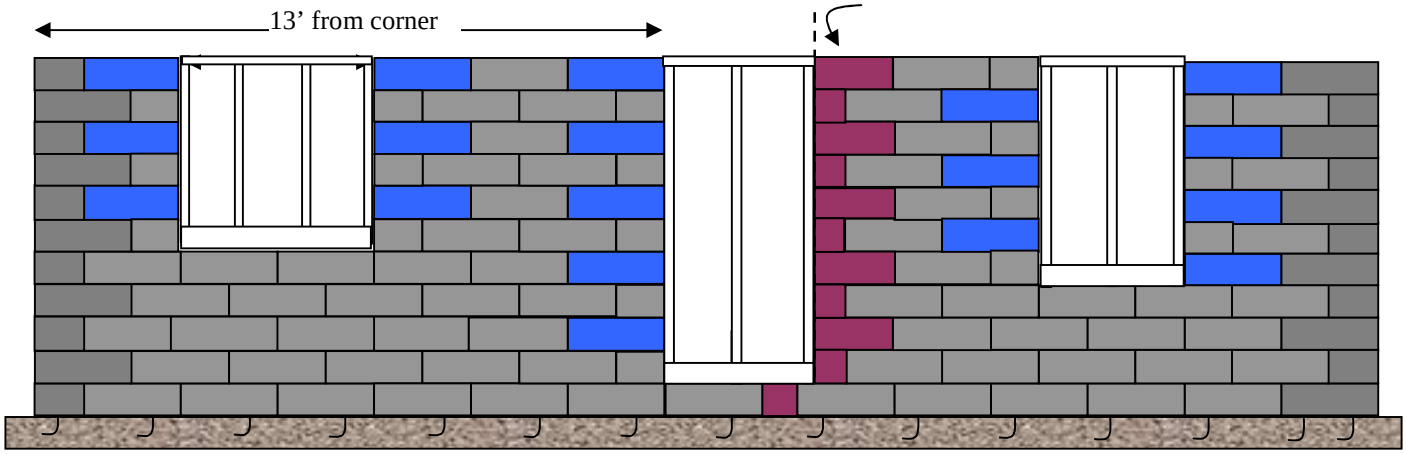
5.1.2 Step 2

Layout locations of windows and doors on first course or on footing. As discussed the last wall form in the course will be custom modified to fit (purple). TIP: layout design so custom cut block comes at a door way or window. This minimizes the number of block to cut.



Stack wall forms. When you reach a sill for an opening, form the **left** side of the opening using the End Block and half block (both have a smooth end-face), place the temporary buck in the opening and resume stacking on the opposite side of the buck.

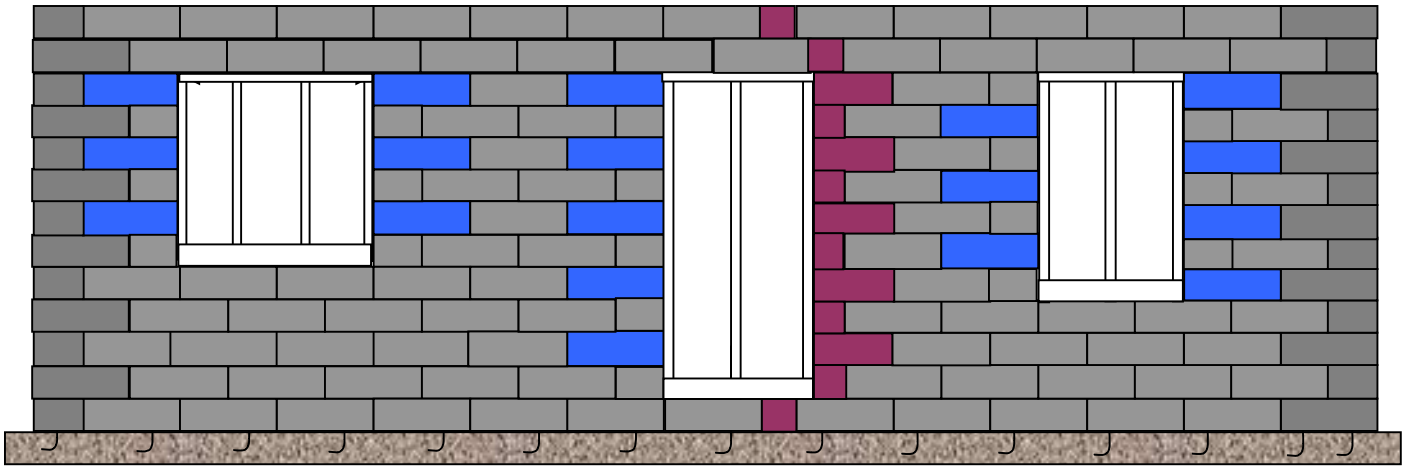
The illustration shows window openings that follow the 12"wide x 8" high module rule: 4' wide x 48" high on the left and 3' wide x 56" high on the right. The door opening will need to be treated differently since most standard doors' rough opening is not a 12" increment in width. Layout the door on a 1' increment from the corner as shown. This eliminates the need to cut any block on the left side. Then modify the right side Endblocks and half blocks as explained earlier. IMPORTANT: MODIFY THE SIDE ADJACENT TO THE OPENING. This preserves the proper alignment of vertical cells for optimum structural strength.



Alternative method for doors: Instead of screwing on the ends of the wallforms to make the shorter custom units you may cut the wallforms to the appropriate length then screw on a 12" wide piece of pressure treated plywood. The plywood remains in place after filling the wallforms with concrete and becomes the attachment point for the door frame.

5.1.4 Step 4

Resume stacking above the lintel course. Install vertical rebar with the proper overlap relative to the footing rebar. Then follow instructions to grout the cores. Lift heights will be between 4' and 9' depending on the complexity of the openings.

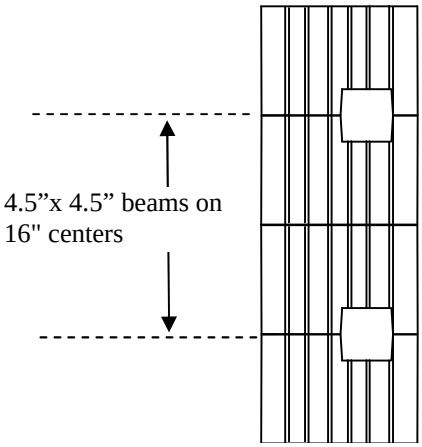


Picture sequence for setting a window buck and stacking to it.

5.2 Important Stacking Details

5.2.1 Flipping Wallforms over for every other course.

Ii is important that every other course of Wallforms needs to be inverted to form the horizontal cores properly. The notched side of the wallform needs to join to the notched side of the wallform on top of it. The flat side of the wallform needs to join to the flat side of the wallform on top of it. This creates the horizontal cores that are filled with concrete on 16" centers. Flipping the block also keeps the tongue and groove system on track around the perimeter of the building. The cores and subsequent concrete columns will be accurately aligned and fully formed. **REMBEMBER: "Stack notch to notch and flat to flat"**.



End view showing notched wallforms properly stacked

5.2.2 Corner Boards

Erect corner bracing at each corner to insure wallforms will be installed perfectly plumb. Use 2x8's screwed together or ¾" plywood. String lines can be used between the corners to keep the wall run straight and level. It is rare that shims need to be used in a wall to bring a wall back to level. The factory trimmed wallforms typically go up level and plumb.

5.2.3 Adjusting Walls prior to filling

After window and door bucks have been secured inside or against the Faswall® Wallforms check to assure that plumb and level are maintained before pouring concrete. If a wall run is out of plumb simply use vertical bracing ('strongbacks') and diagonally brace the wall in a plumb position prior to pouring. (similar to bringing a framed wall to plumb using diagonal bracing).

5.2.4 Rebar placement

The Faswall wall is reinforced with both horizontal and vertically placed rebar (steel or fiberglass). Typically for below grade applications rebar is place in every cell at 1' centerlines. Above grade applications rebar is typically placed in every other cell at 2' centerlines.

Horizontal rebar is typically used in every horizontal channel on 16" centerlines. The exact placement will depend on local code and specific engineering requirements for the structure. At times it is permissible for the horizontal rebar to lay in the bottom of the horizontal channel without being suspended by tying. However, check with local codes or an engineer is advised when in doubt. In certain jurisdictions it may be required to tie the horizontal rebar to the vertical rebar. The vertical rebar typically needs to be placed in the center third of the vertical columns. Engineering will dictate the size bar and the centerline placement to the anchoring systems at floors, roofs and footings. Anchoring systems at floors, roofs and footings must be located at vertical or horizontal channels and should not fall at a web.

TIP: cut 1" high slices of 1.5" PVC piping. Put these slices over the rebar stubs so they rest on the footing. After stacking the wall to a height of 6-8' insert the vertical rebar from the top of the stacked wall and insert the end of the rebar in the PVC pipe ring at the footing. This keeps the rebar centered in the core of the wallform.

NOTE: It may be necessary to tie the minimum 12" overlapping rebars to assure a flexible, monolithic post and beam structure in certain earthquake and hurricane resistance situations. This determination shall be made by the engineer of record.

5.2.5 Electrical, Plumbing, Vents

Proper planning for electrical, plumbing, and any penetrations is required since they will be set up prior to the concrete infill.

Gray colored PVC piping may be used as a chase through the walls. For small vent ducting use a hole saw through the wallform walls. Install stub prior to concrete infill.

Carefully plan and coordinate the placement of wiring conduit within the Wallforms as they are stacked. There are two methods for electrical wiring in the Wall forms. One is to install plastic conduit in the cores of the wallforms prior to concrete infill. The other method is to groove out the inside surface of the wallforms to embed wiring into the groove.

5.2.5.1 Conduit run in the wallforms

Typically flexible (blue) or gray conduit is used to link electrical boxes together. Use a reciprocating saw to cut out for electrical boxes. Secure the box in the opening with screws and/or non expanding urethane foam construction adhesive..

5.2.5.2 Surface installation of wiring in grooved wallforms

Conduit or wiring (code dependant) can also be placed within grooves routed into the wallform surface. This can be accomplished after the wallforms have been completely erected and filled with concrete. To rout grooves for surface installation of wiring, either within conduit or not, use an electric router fitted with a 5/8" x 2" carbide router bit or a chain saw fitted with a depth guide. Rout or cut the grooves as needed, making sure that the depth of the cut is adequate to lay the wiring out of reach of any fasteners (nails, screws, etc.) that might be used when finishing the wall or attaching fixtures. Wires are normally placed in conduit. After wiring is placed in the groove, use a quick-setting mortar to fill in the groove. Code sets the depth requirement for the wire from the surface of the wallforms.

5.3 Summary of Key Installation Procedures

The following summary of key installation procedures will serve as a cross check for proper Wallform installation:

1. Set the corner wall forms around the perimeter in the correct diagramed pattern.
2. Always lay wall-forms working from the corners toward the center point of the wall run.
3. Only one wall form will need trimming and modification in each course of a wall run.: choose a spot in the wall run that is close to the center of the wall and preferably at an opening where less trimmed wallforms will be needed. Each subsequent row will require a modified block and it will be advantageous to trim that one wall form near the same location in the wall run. (Section 4.8.2 Step 2 Diagram)

4. Use the guide groove located at the top center of each wall-form to keep vertical alignment of cells. Every two-foot long wall form has a guide groove at the midpoint. Be vigilant that this guide groove lines up with the joints of the wall forms in rows above and below the guide groove. This alignment ensures that the interior vertical column of concrete and rebar maintain plumb. If not plumb, the structural integrity of the wall is compromised. If the joints are not lined up with the guide groove the **wallforms must be cut to bring back in proper alignment.**
5. Every other row of wall forms must be flipped in order for the cut-out channel in the wall form to create a horizontal beam. Stack the wall forms flat surface to flat surface followed by notched surface to notched surface for the next course. **Remember "Flat to Flat, Notch to Notch".**
6. Use corner boards as a guide to keep the wall plumb and level.
7. Tap any protruding wallforms flush using a rubber mallet. Plumb wall sections using strongback bracing as necessary.
8. Prior to infilling wall forms with concrete prepare several patch kits for any places in the wall where a block may crack, allowing cement to ooze out from wall. Have plywood pieces (2'x 3' or 3' x 4' scraps) and 3" coarse threaded deck screws close for quick application against any weakened wall section.

6.0 Lintels

The wallform configuration is capable of performing as a self-contained lintel for a variety of window and door applications. A review of typical lintel applications is provided (Figures 5), but a design professional should be consulted for actual construction details.

Typical Lintel Load Capacity

CLEAR SPAN	CAPACITY: LBS/LIN.FT.		STEEL REBAR SIZE (QTY)	
FT. - IN.	ONE (OR 1-1/2) COURSE	TWO COURSES	ONE COURSE	TWO COURSES
UP TO 4' - 0"	700	1000	#4 (2)	#4 (3)
UP TO 6' - 0"	800	1300	#4 (2)	#5 (3)
UP TO 7' - 0"		800		#4 (4)
UP TO 8' - 0"		600		#5 (5)
UP TO 10' - 0"	250	500	#5 (5)	#5 (5)

FIGURE 6

7.0 Floor Attachment Systems

When an intermediate floor system is designed into the FASWALL® Wallforms structure, it is generally assumed to be of wood. Because these floors do not have components that can adequately support the dead weight of the subsequent wall assembly above it, the typical design criterion is to "hang" the floor from the inside of the wall structure. This technique involves the use of a perimeter rim joist that is secured to the vertical wall by a series of "hooked" 1/2" x 8" anchor bolts that are cast into the concrete core of the wall through the side of a Wallform (see Figure 7).

7.1 Rim Joists and Rim Joist Anchor Bolts

After the location of the rim joist for the floor is laid out on the wall, the locations of the anchor bolts are also marked on the surface of the Wallforms, on a vertical centerline visually above the top edge position of the rim joist. The rim joist is then held in position on the wall and the vertical centerlines of the anchor bolt locations projected and marked through the center of its width. At these points, 1/2" holes are drilled through the rim joist.

After the holes are drilled through the rim joist, the rim joist is again held in position on the wall and the holes used as templates to mark the precise locations of the anchor bolts on the Wallforms. Using a circular "hole-saw" mounted in a 1/2" drill, a 3" diameter hole is cut into the side of the wallform at each anchor bolt location. The 1/2" x 8" anchor bolts are then affixed, with nuts and washers through the 1/2" holes in the rim joist. They also may be tied to the rebar inside the cell.

The rim joist, with anchor bolts affixed, is then positioned on the wall with the "hooked" ends of the anchor bolts inserted into the 3" diameter holes in the Wallforms. While the rim joist is held in position, it is secured to the wall with 4" coarse-thread screws.

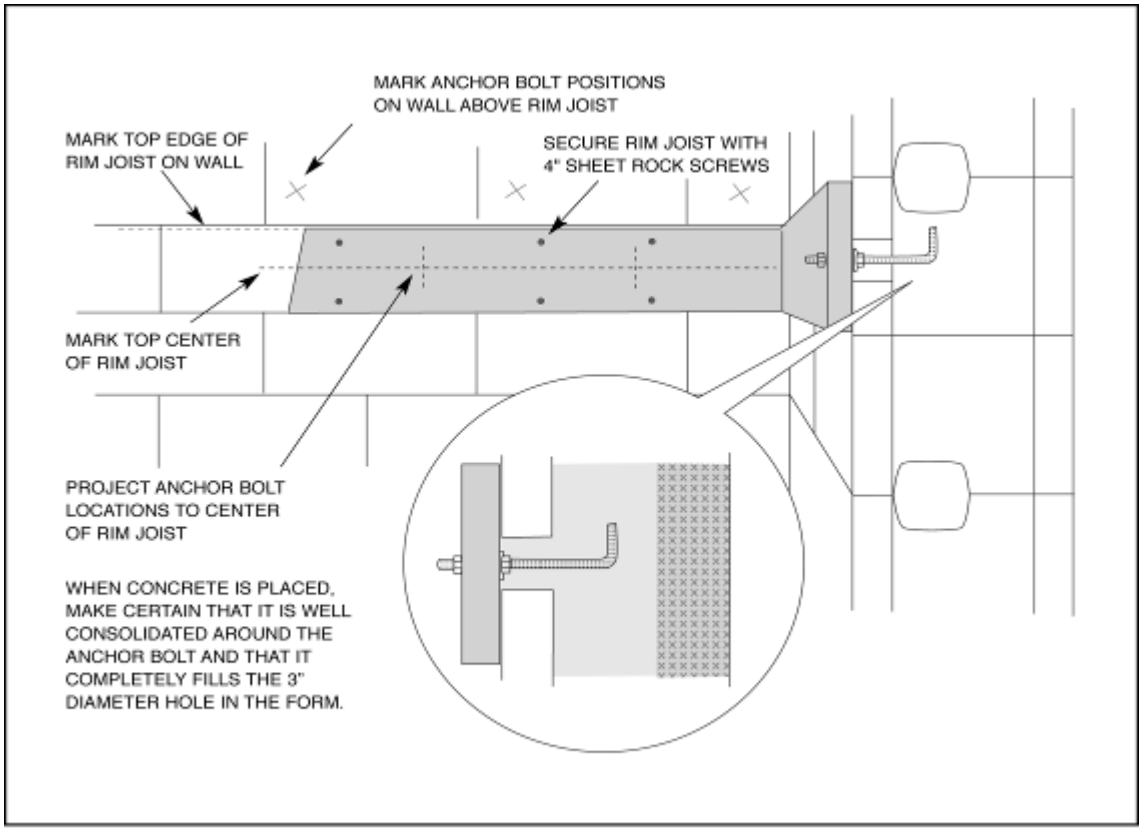


FIGURE 7

When the concrete is placed, great care should be taken to make sure it is well consolidated around anchor bolts and that it completely fills the 3" diameter holes in the Wallforms.

8.0 Filling Wallforms with Cement

8.1 Inspection

Call the building inspector and/or the licensed engineer to examine and approve the progress of the installation. NOTE: Local building officials may want special inspections at certain heights of the wall sections prior to filling.

8.2 Rebar

All rebar must be in place prior to the cement infilling process. Vertical rebar may be placed from the top of the wall down into the vertical cells typically being tied or coupled with the

preceding vertical rebar stubs below. Insure rebar is installed according to the plans. Rebar should extend out of the concrete a minimum of 12" on partial wall filling.

8.3 Cement Specifications

Use cement having minimum strength of 2500 psi or greater, as required by local code; the aggregate should be pea gravel no larger than 3/8" in diameter. Cement slump should be 6-7". Cement that is too stiff will not flow properly into the horizontal cavities and will cause incomplete beam formation. Cement mix that is too wet will reduce strength of the concrete and also create tremendous inertial pressures that could cause blowouts.

8.4 Concrete Pumps

A line pump is recommended with a 2" to maximum of 2.5" outlet for good control of the process. Pumps with boom arms may be used but can be more difficult to control. Minimize the fall height through the boom arm to reduce the out flowing concrete pressure. Too high pressure can damage and shift wallforms.

8.5 Spiral Pour Method

Concrete must be placed carefully so that equal pressures on the wall form are maintained. The optimum method for wall filling is to start at one corner and work around the entire perimeter of the building adding approximately 24" of concrete on each pass around the entire perimeter. This 'spiral pour' method insures proper filling without voiding. Do not allow the mouth of the pump hose to contact and possibly damage the Wallforms. Also, any extra length of hose should be kept away from the Wallforms as the weight of the concrete pushing laterally against unfilled Wallforms could cause slight shifting. Do not fill the wallforms to the top surface if this is not the final lift. To assure optimal strength and bonding of the concrete between the various pours/lifts within the overall wall, stop filling halfway up the topmost horizontal row of Wallforms (4 inches from the top).

8.6 Vibration

Following the instructions above insures proper filling. Properly mixed concrete at the required slump will flow very well throughout the cavities. Use a vibrator ("stinger") to consolidate the

concrete in each cell. When the concrete reaches 3-4' in depth dip the stinger in each cell for a few seconds. Where there is vertical rebar touching the stinger to the rod often vibrates the concrete sufficiently without dipping the stinger head into the cell.

8.7 Test Holes

Drill test holes in areas that the poured concrete may have more difficulty reaching.
Use a 2" dia. hole saw. Observe that concrete comes through the test holes during the pour.
Areas of concern are:
--Either side of openings that may have additional rebar.
--under openings.

NOTE: Although the concrete will mechanically set overnight and secure the positions of braced window and door openings, the bracing assemblies should not be disturbed for at least 12 days. In order to realize the true design strength of the wall assembly, ultimate loading should be avoided for at least 28 days. Additional Wallforms may be stacked the next day. All subsequent lifts and special structures such as lintels should be accomplished using the same techniques and conditions as described above.

9.0 Trusses

Determine the necessary layout pattern for the anchoring devices, insure that they are centered in the wallform cores. Anchor bolts or steel plates for the attachment of the roof structure must be deeply imbedded into the concrete fill while the mix is still workable (not more than 30 minutes after placing the concrete). Refer to the details in the plans for the building provided by the design/engineering team.

10.0 Fastening to the Wallforms.

Mechanical fasteners appropriate for the weight of the item to be attached should be anchored directly into the concrete core. For lighter loads coated #8 or #9 deck screws can be used if the depth of penetration into the wallform is maximized. Fastening screws at points where the wallform web is present is preferable as you can penetrate deep into the wallform at that point

using 3.5-4" screws. . Do not install fasteners with tight-torque tools that might "strip-out" the fastener hole.

Pneumatic nail guns have been used successfully to attach light weight dimensional lumber. The key concerns are that cement coated nails must be used, and that two nails are driven in at right angles to one another. This technique creates a locking design that sufficiently resists pullout. Light-weight objects can be successfully fastened directly to the Wallform.

11.0 Below Grade Surface Treatments of Faswall® Wallforms

Below grade wall surfaces outside of living space must be parge coated and waterproofed.
For some applications without living space inside, such as frost foundations, a parge coating is sufficient when used in conjunction with an adequate drainage system.
Equally important to the effectiveness of any waterproofing system is adequate drainage. There are several products available to provide "in-plane" drainage throughout the full height of the basement wall. These, coupled with properly designed footing drains, will take the water away before it has the chance to become a problem.

11.1 Recommended Below Grade Damp Proofing Protocol

The goal for below grade applications is to effectively stop water transmission but allow for water vapor permeability through the wall forms.

11.1.1 Steps

1. Apply a parge coat of 3 parts sand to one part Portland cement directly to wallforms to close any gaps between each.
2. Apply a waterproof coating over the parge coat (Ex; Thoroseal, Tamoseal, or Xypex)
3. Apply a dimple shield membrane (Ex; MiraDrain)

If not applying a dimple shield membrane then it is necessary to provide a bed of stone between the earth and the wall (16 inches minimum is recommended). In some soil conditions builders use both a dimple shield membrane and a crushed stone barrier.

12.0 Surface Treatment Options for Faswall® Wallforms Above Grade

Faswall must be coated or faced with a weatherable surface to keep liquid water from penetrating.

It is recommended that a design professional provide guidance specific to the site in order to ascertain an appropriate weather barrier with adequate flashing so that there is prevention of moisture penetration through the wall and into the interior.

12.1 Air Barrier and Vapor Permeable Materials and Faswall® Wallforms

When considering various surface finishes on the exterior of the Wallforms choose materials that will provide a good air barrier but ALLOW the passage of water vapor.

Air barrier products must be vapor permeable to allow for the free movement of water vapor though the hygroscopic Faswall® Wallform material. Air barriers need to be installed on both surfaces of the wall. Acceptable air barrier products are: a parge coat of sand and Portland cement, stucco, plaster, dry wall, felt paper, or building wrap membrane products with a high perm rating such as Tyvek®. Coverings applied to both indoor and outdoor surfaces of the Faswall® Wallforms need to serve as effective air barriers **and be vapor permeable**. It is recommended that all cracks over 1/8" be sealed prior to the application of the continuous air barrier.

12.2 Stucco/Plaster General Recommendations

The concrete infill in the Faswall® Wallform assembly needs to set and cure before stucco or plaster is applied to the Wallforms. Depending on climate and temperature, this process typically requires a minimum of 5-10 days, but may be as long as 28 days.

Metal lath may be used but is not necessary since the wood fiber-cement composite is a striated structure allowing stucco to key into the surface of the wall forms. If there is a concern regarding cracking, fiberglass mesh pressed into the base coat of stucco provides more protection against cracking. Where Faswall® Wallforms are joined with other materials such as wood, metal, plastic, for example, around window and door openings, metal lath or fiber mesh should be used for proper bonding of the stucco/plaster. Window and door openings should be waterproofed and properly caulked to prevent infiltration around windows and doors. To maintain the vapor permeable advantages of Faswall®Wallforms it is it is important to use vapor permeable stucco/plaster mixes.

12.3 Stucco

There are many stucco techniques that are compatible with Faswall. It is an excellent substrate for stucco to "key" into. However, it is very important that the stucco system chosen is VAPOR permeable. The hygroscopic quality of the Faswall material must be maintained allowing water vapor to travel through the walls.

The stucco materials that have these qualities are:

Cement based stucco

Cement based stucco with vapor permeable acrylic modified pigmented finish coat.

Lime based stucco

NOTE: Stucco has a tendency to crack. Hair line cracking is not detrimental to the Faswall material. It is a dynamic material that dries out readily if small quantities of water were to get into cracking.

12.3.1 Cost Effective Basic Cement Stucco Protocol

A basic scratch coat is applied on the Faswall® Wallform surface made on-site from 3-4 parts masonry sand to one part gray Portland cement. This may be either sprayed on (gunite type of equipment) or troweled directly onto the Faswall® Wallform surface. Depending on the surface smoothness desired, a second brown coat may need to be applied. A fiber additive in the cement preparation or applying a fiberglass mesh (EIFS, ¼" mesh) embedded into the scratch coat is a common method used to minimize cracking in the stucco. Commercial premixed fiber-added cement stuccos are also available on the market.

Applying the fiberglass mesh is added insurance against cracking. A common technique is to trowel on the scratch coat and lay the mesh into the coating pressing into the scratch coat until embedded. Alternatively, woven fiberglass mesh may be fixed to the Wallforms using stainless steel staples. Trowel on the scratch coat making sure the mesh gets embedded into the coating. This may be applied up to 3/8" thick. Stucco should be applied over slightly wet Faswall® Wallforms to avoid a fast drying action that may lead to cracking. It is important not to soak the Faswall®Wallform completely. After a few days (depending on climate conditions), fine hairline cracks develop which show that the wall is ready for the final stucco coat.

This first, basic coat requires up to 20% more stucco material than conventional concrete walls due to the porous surface of Faswall® Wallforms. The stucco penetrates into the wallform creating a monolithic bond to the Wallform surface. Subsequent stucco coats use the same amount of material as do conventional concrete wall systems. The wall should always be moistened first, but not soaked. Follow with a 3/8" top coat made from 3-4 parts masonry sand and one part white Portland cement. Top coat can be pigmented. Alternatively use the standard grey Portland cement brown coat topped by a mineral paint. These are silicate coatings that penetrate and chemically bond to their substrate rather than just coating it, and they last for more than a century without peeling or cracking. They are immune to damage by the sun's UV light and retain their colors. Buildings in Europe coated with this material still look pristine after one coat applied over 125 years ago. These paints are also fully breathable, in that they fully resist rainwater molecules from entering but fully allow smaller water vapor molecules to exit the wall, keeping it dry and free of mold. One company producing a mineral silicate surface coating is Keim Mineral Coatings of America, Inc. Charlotte, North Carolina; 866-906-5346.

These systems breathe and the materials are significantly less costly than synthetics. However, adding an acrylic to the stucco provides some flexibility to the top color coat that can reduce fine line cracking. Again, always choose coatings that are vapor permeable.

12.3.2 Portland cement scratch coat followed by brown coat and then acrylic modified pigmented top coat.

Apply a cement scratch coat with fiber additive directly against the Faswall® Wallform surface; a brown coat may be necessary depending on the finished look desired. Top it with pigmented acrylic modified stucco that is vapor permeable (check with manufacturers)

12.3.3 Lime based stucco.

This is the premium stucco method. It is very long lasting and provides excellent protection against moisture. It remains fully vapor permeable. It is the most costly method but is the most durable. This generally needs to be applied by a professional.

12.4 Siding

In a climate with heavy wind driven rain conditions, a drainage plane such as Dupont™ Tyvek DrainWrap™ can be attached with stainless steel staples directly against Faswall® Wallforms, followed by 2 inch wide furring strips which can be fastened directly onto the Faswall® Wallforms middle webbing with 2 ½ inch self tapping screws (zinc, galvanized, stainless steel, or ceramic coated). Lap siding, or board and batten siding using sheets of fiber cement board can then be installed directly against the furring strips and air gun nailed or screwed. In this protocol an air gap is created which allows any wall-penetrating moisture to quickly drain. Unless exposed to severe weather conditions, the furring strips can be eliminated from this protocol.

12.4.1 Wood siding.

For wood siding applications it is recommended to install a rain screen directly on the Wallforms and utilize furring strips to create an air gap between the back of the siding and the wall of the building. This ensures that condensation will not build behind the siding and cause decay in the siding (Faswall will be unaffected).

12.4.2 Fiber-Cement Siding

With Fiber Cement siding products, it is recommended to use a felt building paper or a stucco house wrap as a drainage plane. Whether installing furring strips or not with these products it is suggested that a draining house wrap product like Tyvek DrainWrap™ is used to allow for moisture to escape if the siding is compromised by driven rain. An alternative to building paper or house wrap products is to parge coat the outside of the wall, apply furring strips, then hang the siding.

13.0 Interior Finishes

For inside plaster application, follow the instructions of the manufacturer/supplier of the plaster mix. Where other materials join Faswall® Wallforms, and around doors and windows, a reinforcing fiber mesh should be applied. As in the stucco application, the base coat will require about 20% more material as used for conventional concrete walls.

If there any doubts or questions, it is important to contact Faswall® before you proceed.

13.1 Interior Finishing of Faswall® Wallforms With Gypsum/Drywall Products

Faswall® Wallforms present a solid surface to fasten to no matter what interior finish is selected for the interior surface of the wall. When applying drywall/Gypsum board, coarse threaded drywall screws are typically used to fasten to Faswall® Wallform. Different types of fasteners have correspondingly different pullout strengths. A #6 x 2" long coarse threaded drywall screw is adequate for hanging the board. The following caution and conditions need to be met when using standard #6 x 2" long coarse threaded drywall screws:

Throughout the body of the interior drywall board the maximum spacing for fasteners is 12".

Throughout the perimeter of the interior drywall board the maximum spacing for fasteners is 6".

Use of construction adhesive that is compatible with the cement-based nature of Faswall® Wallform should be applied at the corners and center of the drywall board. Over-drilling into the Faswall® Wallforms composite can strip out the hole; a clutch drill is recommended to avoid this action.