Utility Placement

FS · 6

An information series on residential concrete masonry technology

SUMMARY

The placement of utilities presents some unique considerations to designers and builders unfamiliar with concrete masonry wall construction. Three main factors affect utility placement in concrete masonry walls. They are

- ✓ the type of CMU wall construction (i.e., hollow, solid, grouted, or partially grouted);
- ✓ insulation (if present); and
- ✓ interior finish selection.

These factors are discussed herein as they affect utility installations. Refer to Fact Sheet 7 (FS•7) for more information on specific fasteners and tools.

The illustrations contained herein are "generic" and "typical" for many areas in the United States. However, certain areas of the country may impose more stringent requirements concerning utility installation. The designer or builder is advised to consult the local building code to determine if additional requirements exist beyond those discussed herein.

ELECTRICAL INSTALLATION

Electrical wiring and components may be installed within a concrete masonry wall or on the interior face of a concrete masonry wall.

Within CMU Wall

Although some builders install electrical wiring within concrete masonry walls, they are advised against doing so except in one-story construction for a variety of reasons, including the presence and placement of grouted or solid concrete masonry units, increased labor, and reduced thermal resistance in core-insulated walls.

Installing electrical lines within a concrete masonry wall may be most practical for one-story construction in a hollow concrete masonry home. Holes are punched in the wall for electrical boxes and the electrical wiring is run within conduit through the vertical core of hollow concrete masonry units to the top of the wall. The horizontal runs of electrical wiring are then installed in the attic space of the home. Conduit within the wall may be installed during or after wall construction. Either method increases the number of labor hours needed to install the electrical utility.

If the concrete masonry wall contains core insulation, electrical wiring placed either before or after the insulation requires more labor and coordination at the job site. In addition, a reduction in thermal resistance may occur if quality control at the job site is not adequate.

The horizontal runs of wiring may be placed in the wall if modified concrete masonry units are used in lieu of standard concrete masonry. These modified concrete masonry units, available from some manufacturers, have a cutout in the webs of the concrete block to allow for conduit insertion without requiring masonry field cutting.

Installing electrical wiring within a concrete masonry wall presents difficulties particularly in partially grouted or solid concrete masonry walls owing to the horizontal bond beams present at the top of each wall story as illustrated in Fact Sheets 1 through 3 (FS•1 through FS•3). Bond beams hinder vertical runs of electrical wiring. In addition, some vertical cores in a concrete masonry wall may be grouted solid to resist structural loads, limiting horizontal runs of electrical wiring. For labor efficiency and structural reasons, cutting or boring through solid or grouted beams and columns is not recommended.

On Interior Face of CMU Wall

For most residential homes built in the United States, installing electrical wiring and components on the interior face of concrete masonry walls is the preferred method of installation. This approach does not interfere with the wall's construction. It lends itself to easy installation and provides access to wiring and components.

Electrical wiring and components can be installed on the interior face of any concrete masonry wall whether the concrete masonry walls are hollow, partially or fully grouted, or solid. Electrical installation is typically conducted after the walls are constructed and prepared for interior finishes; therefore, coordination between the electrical contractor and the mason is limited to through-wall utility penetrations. For through-wall utility penetrations, the use of a sleeve is recommended. Typically a rigid plastic pipe, the sleeve is inserted into the wall by the mason during construction. After the wall is constructed, the utility line is simply inserted through the sleeve. While the use of a sleeve requires coordination between the electrical contractor and the mason during wall construction, it promotes ease of utility installation and expedites required maintenance. Refer to Figure 6-1, which illustrates the use of a sleeve for through-wall penetrations. When utility penetrations are below grade, care should be taken to prevent moisture seepage.

Lastly, the installation of electrical wiring and components on the interior face of a concrete masonry wall is faster and less costly than the installation of electrical wiring and components within a concrete masonry wall. Not

only may this approach reduce the number of labor hours required, but it also reduces material cost because conduit is not typically required. However, these costs must be balanced with potential savings when applying interior finishes directly to the masonry walls.

Figure 6-1: Utility Penetration through CMU Wall

The interior finish of a concrete masonry wall determines how electrical wiring and components are installed on the interior face of the wall. The interior finish selections may be grouped into three general categories as follows:

- ✓ interior surface of CMU wall exposed;
- ✓ interior finish installed on furring strips; and
- ✓ interior finish installed on rigid foam insulation.

If the interior face of the concrete masonry wall is left exposed, electrical boxes are mounted on the wall with face plates and the wiring run in conduit or hidden behind decorative molding attached to the wall surface.

Another alternative is to use electrical raceways. Commonly used in commercial buildings, electrical raceways are available for residential applications regardless of the interior finish desired. Electrical raceways are available in white or wood-laminate versions to blend with décor and typically mounted at the base of the wall to resemble traditional baseboards; refer to Figure 6-2.

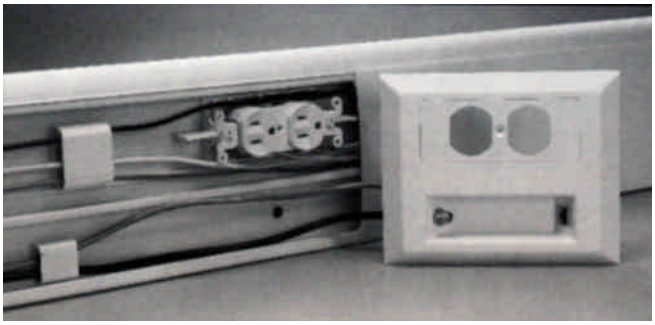

Figure 6-2: Electrical Raceway by the Wiremold Company

If the interior finish is installed on furring strips, as discussed in Fact Sheet 4 (FS•4), electrical boxes may be mounted on the concrete masonry wall by using shallow electrical boxes as shown in Figure 6-3; or a hole may be created in the wall to allow the use of standard electrical boxes as shown in Figure 6-4. Electrical wiring may be run without conduit through the furring strips and in the cavity between the furring strips. Metal plates are nailed to the furring strip over the notch in the furring strip where the wiring runs. The metal plate protects the wiring and holds it in place as in light-frame construction.

Figure 6-3: Shallow Electrical Box Installation

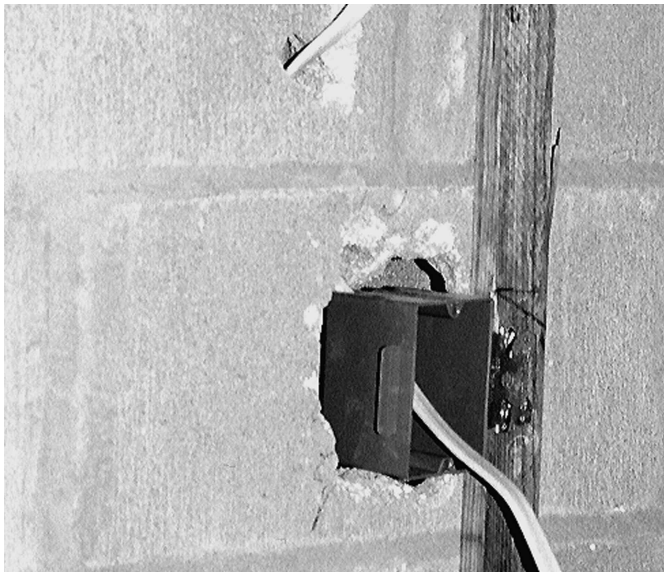

Figure 6-4: Standard Electrical Box Installation

If the interior finish is installed on rigid foam insulation, provisions are required to secure the wiring and components to the foam. Shallow or standard electrical boxes are installed in the same manner as in "furred" walls. If the insulation is particularly thick, the electrical boxes may be installed by cutting or routing out some of the foam

insulation. The electrical boxes are then inserted into the hole in the foam and secured with construction adhesive.

Electrical wiring may be run without conduit through the foam insulation by routing or cutting out channels in the foam. Care must be taken to ensure that the wiring is placed at the code-required depth. Refer to Figure 6-5, which illustrates electrical installation in rigid foam insulation.

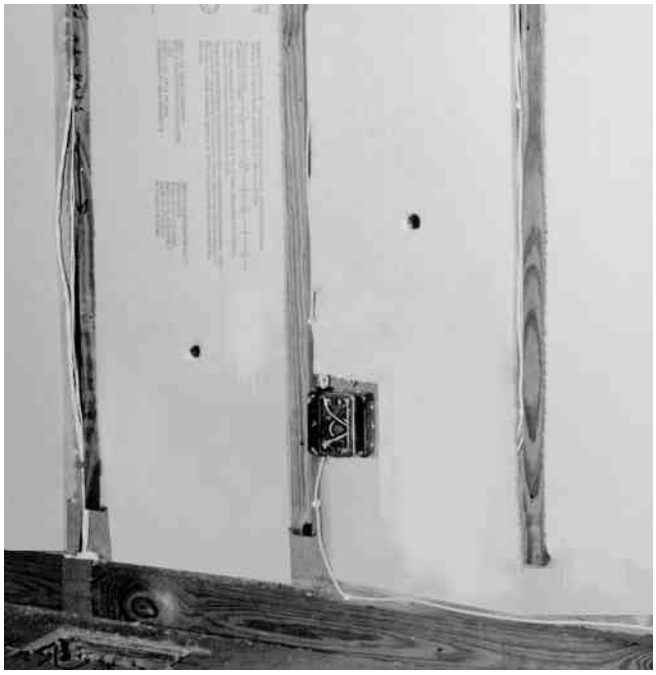

Figure 6-5: Electrical Installation in Insulated CMU Wall

Specialized tools, such as a hot knife or router, may be used to create the holes or channels in foam insulation; refer to Fact Sheet 7 (FS•7) for information on these tools.

If holes are created in concrete masonry walls to accommodate standard electrical boxes, insulation should be placed behind and around the boxes to prevent air infiltration and increases in heating and cooling loads. Expanding foam is typically used to seal any penetrations created in the wall.

Regardless of how the interior wall finish system is installed, the electrical panel box may be installed directly to the concrete masonry wall or to plywood that is fastened to the wall. Plywood is typically installed to facilitate the attachment of the panel box to the wall and to anchor any wiring exiting the box to the wall. Some electrical panel boxes have holes in which the wiring enters through the back of the box as opposed to the top, bottom, or sides of the box. If wiring is to enter the back of the panel box, the wall will need to be furred out to allow proper clearance for primary lines.

PLUMBING INSTALLATION

Plumbing may be installed on the interior face of a concrete masonry wall in a manner similar to electrical utility installation. Plumbing should not be installed in an exterior concrete masonry wall that is not protected by insulation or mechanical means (i.e., conductive heat tape) owing to the possibility of freezing, the presence of bond beams and filled vertical cores within the wall, and consideration of cost, coordination, and access issues. In addition, some local jurisdictions require hose bibs to be "frost-proof". Many of these concerns are also relevant to light-frame construction.

Although plumbing is not typically installed on exterior walls, plumbing may be installed on the interior face of exterior concrete masonry walls. In cold climates, attempts should be made to locate all plumbing within interior walls. The interior finish of a concrete masonry wall determines how plumbing is installed. Interior finish selections may be grouped into three general categories as follows:

- ✓ interior surface of CMU wall remains exposed;
- ✓ interior finish installed on furring strips; and
- ✓ interior finish installed on rigid foam insulation.

If the interior face of the concrete masonry wall is left exposed, plumbing is simply mounted on the wall with u-shaped brackets or strapping. This approach is typically acceptable in nonhabitable spaces.

If the interior finish is installed on furring strips and plans call for hiding the plumbing in the wall, larger furring strips or wall studs may be required for larger-diameter plumbing. Plumbing is then installed in a manner similar to light-frame construction; that is, vertical plumbing runs are placed between studs and horizontal plumbing runs are cut through studs. Refer to Figure 6-6, which illustrates the installation of plumbing for a kitchen sink on an exterior CMU wall.

Figure 6-6: Plumbing Rough-In on Exterior CMU Wall

If the interior finish is installed on rigid foam insulation, the installation of plumbing is similar to electrical utility installation because plumbing pipes are similar in diameter to electrical conduit. For larger-diameter plumbing, chases may be constructed, or thicker furring strips may be used.

If holes are created in concrete masonry walls for through-wall penetrations, insulation or sealant should be placed around the penetration to prevent air infiltration and loss of heating and cooling. Similarly, channels cut into foam insulation for plumbing should be insulated to provide the same insulation thickness as the undisturbed

surrounding insulation area. When plumbing penetrations are below grade, care should be taken to seal around the plumbing to prevent moisture seepage.

For through-wall plumbing penetrations, the use of a sleeve may be used. Typically a rigid plastic pipe, a sleeve is inserted into the wall by the mason during construction. After the wall is constructed, the utility line is simply inserted through the sleeve. The use of a sleeve requires coordination between the plumbing contractor and the mason during wall construction. For through-wall plumbing penetrations where a sleeve is not used, the plumber simply cuts a hole in the wall where needed. Refer to Figure 6-1, which illustrates the use of a sleeve for through-wall penetrations.

HVAC INSTALLATION

The installation of HVAC (heating, ventilating, and air conditioning) ductwork is similar to that in light-frame construction. Vertical ductwork is typically placed near the center of the home to shorten duct runs and to reduce labor and material costs. If ductwork must be run along an exterior concrete masonry wall, a chase or other enclosure is typically constructed to keep the duct hidden and, if needed, insulated. For freon and other related lines that may penetrate a concrete masonry wall, refer to the discussion of through-wall penetrations and the use of sleeves in the previous sections.

INSULATING CONCRETE MASONRY UNIT

The placement of utilities in insulating concrete masonry units generally follows the methods described above for standard concrete masonry units. Consult the manufacturer for detailed installation guidelines.

CONCLUSIONS

Utility placement is different than in light-frame construction. Some of the unique considerations are presented herein and can be easily followed during construction. With increased exposure to concrete masonry construction, differences will become less of an issue.

RESOURCES

NAHB Research Center, Inc.
400 Prince George's Boulevard
Upper Marlboro, Maryland 20774-8731
☎ 800.638.8556
💻 http://www.nahbrc.org

National Concrete Masonry Association (NCMA)
2302 Horse Pen Road
Herndon, Virginia 20171-3499
☎ 703.713.1900
💻 http://www.ncma.org

Portland Cement Association (PCA)
5420 Old Orchard Road
Skokie, Illinois 60077-1083
☎ 847.966.6200
💻 http://www.portcement.org

U.S. Department of Housing and Urban Development (HUD)
451 Seventh Street S.W.
Washington, DC 20410
☎ 202.708.4370
💻 http://www.hud.gov
Publications
☎ 800.245.2691
💻 http://www.huduser.org

The Wiremold Company
60 Woodlawn Street
West Hartford, Connecticut 06133-2500
☎ 800.621.0049

Tools and Fasteners

FS · 7

An information series on residential concrete masonry technology

SUMMARY

Many fasteners and tools, such as trowels, levels, etc., are used in concrete masonry construction. However, this fact sheet focuses on tools and fasteners used to attach plumbing, mechanical and electrical utilities, and finishes to concrete masonry walls. The two different fastening methods are as follows:

- ✓ adhesives; and
- ✓ mechanical fasteners.

A general description of fasteners and tools follows. The fastening methods are applicable to a variety of fastening needs; refer to applications described in Table 7-1. For more specific information about individual fasteners and tools, refer to Tables 7-2 and 7-3 contained herein. This fact sheet does not include all possible methods; consult manufacturers' data.

The examples contained herein are intended for illustrative purposes only. Some fasteners and tools are manufactured by more than one manufacturer and some products are proprietary. The intent is simply to illustrate the general appearance of items; it is not to endorse specific products or manufacturers. Consult tool and fastener manufacturers to determine whether they manufacture a specific product.

ADHESIVES

Adhesives are either used alone or with a mechanical fastener. Adhesives used alone are generally known as construction adhesives; however, construction adhesives may also be used in conjunction with mechanical fasteners.

For example, construction adhesives may be used to adhere drywall to a concrete masonry wall; however, a mechanical fastener may be used to attach the top of the drywall to the sill plate while the adhesive sets.

Adhesives used solely in combination with mechanical anchors are generally known as epoxy anchors. Epoxy anchors are composed of two or more components that, when mixed together, react to create a chemical bonding agent that sets in a given period; epoxy is available in prepackaged capsules and cartridges. Epoxy is inserted into the hole before fastener insertion and then gels or sets to create a strong bond between the interior surface of the hole and the fastener. There are a wide variety of anchors; however, they are typically used for "heavy-duty" connections.

MECHANICAL FASTENERS

Several mechanical fasteners are available for concrete masonry construction. Each type of fastener is used for a specific application or type of base material. Fasteners may need a predrilled hole for installation or may be driven directly into place. Of course, some fasteners may be placed in grout before it sets. Refer to the tables contained herein for more information.

TOOLS

Depending on the scope of work and the work environment, a variety of tools are available for concrete masonry construction. Table 7-3 highlights those tools specifically designed for use with concrete masonry. Refer to Table 7-3 for a discussion of each tool, including typical applications.

Table 7-1: Fastening Methods by Application

Fact Sheet Reference	Interfacing Item	Fastener	Application
STRUCTURAL APPLICATIONS:			
FS•2	Sill Plate	J-Bolt Anchor	Cast into grouted core.
		Strap Anchor	Placed in mortar joint during wall construction.
		Sill Plate Anchor	Cast into grouted core.
		Epoxy Set Anchor	Installed after grouted core cures.

Table 7-1: Fastening Methods by Application (cont'd.)

Fact Sheet Reference	Interfacing Item	Fastener	Application
FS•2	Sill Plate	Expansion Anchor	Installed after grouted core cures.
FS•2, FS•3	Direct-Bearing Joist Hanger	J-Bolt Epoxy Set Anchor Expansion Anchor	Cast into grouted core. Installed after grouted core cures. Installed after grouted core cures.
FS•2, FS•3	Ledger Board or Steel Ledger Angle	J-Bolt Anchor Epoxy Set Anchor Expansion Anchor	Cast into grouted core. Installed after grouted core cures. Installed after grouted core cures.
FS•2, FS•3	Clip Angle for Steel Framing	J-Bolt Anchor Epoxy Set Anchor Expansion Anchor	Cast into grouted core. Installed after grouted core cures. Installed after grouted core cures.
FS•3	Top Plate	J-Bolt Anchor Top Plate Anchor	Cast into grouted core. Cast into grouted core.
FS•3	Roof System	Truss or Rafter Anchor	Cast into grouted core.
FINISH APPLICATIONS:			
FS•4	Brick Veneer	Wall Tie (Corrugated Brick Tie)	Placed in mortar joint during wall construction.
FS•4	NovaBrik™ by Allan Block Corporation	Consult Manufacturer	Installed in accordance with the manufacturer's instructions.
FS•4	Brick Veneer Backer Board	Consult Manufacturer	Installed in accordance with the manufacturer's instructions.
FS•4	Stone Veneer	Stone Anchor	Placed in mortar joint.
FS•4	Cultured Stone Veneer	Mortar	Applied to wall surface.
FS•4	Wood Furring Strips	Powder-Actuated Fastener Hard Cut Masonry Nail Fluted Masonry Nail	Driven into wall face. Driven into wall face. Driven into wall face.
FS•4	Cold-Formed Metal Furring Strips (Hat or Z Channels)	Powder-Actuated Fasteners Fluted Masonry Nail	Driven into wall face. Driven into wall face.
FS•4	Stucco and Decorative Masonry Finish	Not Applicable	Finish system is applied to wall face.
FS•4	Exterior Insulated Finish System	Consult Manufacturer.	Installed in accordance with the manufacturer's instructions.
FS•4	Gypsum Board	Construction Adhesive	Applied to wall face.
FS•4	Laminate Insulation-Gypsum Board	Construction Adhesive	Applied to wall face.
FS•4	Wallpaper	Manufacturer's Adhesive	Applied to wall face.
INSULATION APPLICATIONS:			
FS•5	Surface Insulation	Construction Adhesive Insulation Fastener	Applied to wall face. Driven into wall face.
UTILITY APPLICATIONS:			
FS•6	Electrical Box	Nail Anchor	Installed in hollow or solid wall.
FS•6	Electrical Conduit	U-Shaped Brackets with self-tapping screws	Installed in hollow or solid wall.

CONCLUSIONS

Few things make a job more difficult than not having the correct tools and fasteners. It is important when selecting the correct tools and fasteners to consider anchorage capacity and the base material. In addition, some fasteners require the fixture be in place at time of insertion; such a requirement should also be taken into account when selecting fasteners.

Many tools are designed to accomplish a particular task. A few "generic" examples are discussed herein; however, each tool and fastener manufacturer produces its own variations. Many tool and fastener manufacturers have their own patented products designed specifically for use with concrete masonry construction. Other products are designed for use with concrete. These latter fasteners may also work well when used with grouted concrete masonry.

The apparent lack of a fastener that will "work" for a specific application should rarely be a factor. If this seems to be the case, confer with local supplier or manufacturer representatives and data to identify alternatives that will achieve the desired result.

RESOURCES

Avalon Concepts, Corporation
1055 Leisz's Bridge Road
Leesport, Pennsylvania 19533
☎800.636.8864
http://www.avalonconcepts.com

Hilti, International
5400 South 122nd East Avenue
Tulsa, Oklahoma 74146
☎800.879.8000
http://www.hilti.com

Illinois Products, Corporation
1030 Atlantic Drive
West Chicago, Illinois 60185
☎800.383.8183

Industrial Fasteners Institute (IFI)
1717 East Ninth Street, Suite 1105
Cleveland, Ohio 44114-2879
☎216.241.1482
http://www.ifi-fasteners.org

NAHB Research Center, Inc.
400 Prince George's Boulevard
Upper Marlboro, Maryland 20774-8731
☎800.638.8556
http://www.nahbrc.org

National Concrete Masonry Association (NCMA)
2302 Horse Pen Road
Herndon, Virginia 20171-3499
☎ 703.713.1900
http://www.ncma.org

PaslodeÒ, an Illinois Tool Works Company
888 Forest Edge Drive
Vernon Hills, Illinois 60061
☎ 800.682.3428
http://www.paslode.com

Portland Cement Association (PCA)
5420 Old Orchard Road
Skokie, Illinois 60077-1083
☎ 847.966.6200
http://www.portcement.org

Power Tool Institute (PTI)
1300 Sumner Avenue
Cleveland, Ohio 44115
☎ 216.241.7333
http://www.taol.com/pti

Quickpoint™, Inc.
23B Bradford Street
Concord, Massachusetts 01742
☎ 800.368.2292
http://www.tiac.net/users/quikpnt

Simpson Strong-Tie
4637 Chabot Drive, Suite 200
Pleasanton, California 94588
☎ 800.999.5099
http://www.strongtie.com

U.S. Department of Housing and Urban Development (HUD)
451 Seventh Street, S.W., Suite 8132
Washington, DC 20410
☎ 202.708.4370
http://www.hud.gov
Publications
☎ 800.245.2691
http://www.huduser.org