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CIRCULAR SERIES

INDEX NUMBER **F17.2**



# BRICK and CONCRETE MASONRY

ISSUED BY THE  
**SMALL HOMES COUNCIL - BUILDING RESEARCH COUNCIL**

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**MATERIAL IN THIS CIRCULAR BY DONALD E. BROTHERRSON  
SMALL HOMES COUNCIL - BUILDING RESEARCH COUNCIL**

Architectural Consultants: Frank M. Lescher, Rudard A. Jones, A.I.A.

Editor: Mary Glöckner

Illustrator: Carmen Gilman

BRICK AND CONCRETE MASONRY  
SMALL HOMES COUNCIL  
**F17.2**



# BRICK AND CONCRETE MASONRY

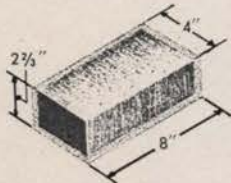
Masonry construction offers the homeowner one of the most durable and easily-maintained walls he can buy. Properly constructed with sound materials, masonry will give almost unlimited service with a minimum of maintenance. However, though strong and durable, a masonry wall still requires insulation to minimize heat losses, and, being heavier than frame construction, may require a larger or stronger foundation. An improperly-constructed masonry wall may allow rain penetration, and subsequent damage due to freezing of the water inside the wall or staining of the wall surface can be expensive to repair. In making a choice between masonry or frame construction, the prospective homeowner should weigh the advantages and disadvantages of each system to determine which would better fit his particular requirements.

This circular will describe the various materials used in brick and concrete masonry construction, some of the more common masonry systems, and the details that go into making masonry walls strong, durable and weather-resistant.

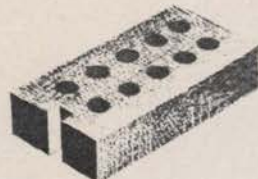
## BRICK UNITS



STANDARD BRICK  
2 1/4" x 3 3/4" x 8"



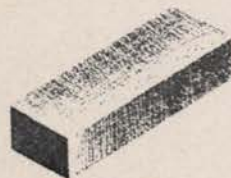
MODULAR BRICK



SCR brick†  
2 3/8" x 6" x 12" mod.



ROMAN BRICK  
1 1/2" x 3 3/4" x 12" std.  
2" x 4" x 12" mod.



NORMAN BRICK  
2 3/4" x 3 3/4" x 12" std.  
2 3/8" x 4" x 12" mod.

Brick is one of the oldest of the manufactured building materials. A small building unit usually rectangular in shape, it is made from clay or shale and hardened by heat, and may be either solid or cored (so long as the coring does not exceed 25% of the volume of the brick).

**Types:** Two types of brick are generally used in residential construction: 1) building brick (very often referred to as common brick), and 2) face brick, made especially for facing purposes and often treated to produce a variety of surface colors and textures.

Fire brick is a special type of brick made of a refractory ceramic material which has a high resistance to heat. It is used chiefly in the construction of fireplace linings and hearths.\*

**Grades:** Both building brick and face brick are graded on the basis of their resistance to weather, especially on their resistance to the effects of freezing when permeated with water. Face brick is also graded on the basis of the appearance of the finished wall, each grade of brick specifying the variations in color, size and texture permitted and the degree of mechanical perfection required.

**Sizes:** At the present time, brick is available in both standard and modular sizes.\*\* In some areas both types are available, but in others only the standard brick is manufactured. Some of the more popular sizes are shown at the left.

Standard brick is specified by its *actual* size. Modular brick is specified by its *nominal* size — that is, the actual dimension of the brick plus an allowance for the mortar joint. For instance, a brick nominally 12 inches long would actually measure only 11 1/2 inches long if it were designed to be used with 1/2-inch mortar joints. If designed for use with 3/8-inch mortar joints, then it would actually measure 11 3/8 inches long. (Building brick is generally designed for 1/2-inch joints, face brick for 1/2-inch, 3/8-inch, or 1/4-inch joints.)

\* See Small Homes Council circular, F7.0 — "Chimneys and Fireplaces."

\*\* Modular bricks are sized so that when made up into a wall they will form increments of 4 inches or 8 inches.

† TM Reg. U.S. Pat. Off. Pat. Pend. SCPRF



BAT



SOLDIER



HEADER



Although it appears that one would get more square feet of brick wall by using standard brick (since they are dimensionally larger), the use of modular units actually results in greater economies and less cutting and waste when used in combination with other modular components such as windows, doors and concrete masonry units.

**Color and Texture:** Nearly 99% of the brick manufactured today is in the range of the reds, buffs and creams. The actual color varies with the chemical content of the clay, which, in turn, depends upon the source of the clay and the additives used in the manufacturing process. Color is also affected by the method of manufacture and the length of time the brick is left in the kiln. Texture is produced by the addition of various chemicals and in the method of molding and cutting the brick. The variety of colors and textures available is limited only by the imagination of the designer.

## CONCRETE UNITS

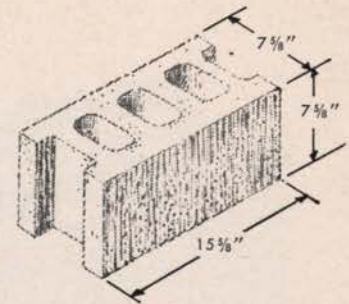
Concrete masonry units account for a major share of the masonry construction being built today. They are used for both load-bearing and non-load-bearing walls and partitions, retaining walls and foundation walls. They also are used as back-up for brick, stone, stucco and other facings, and for fireplaces and chimneys, decorative grills and screens, and outdoor paving.

**Types:** Concrete masonry units are generally classified as being either hollow or solid, and either load-bearing or non-load-bearing. These units may be either heavyweight or lightweight. Heavyweight units are made with aggregates such as sand, gravel, crushed stone and air-cooled slag. Lightweight units are made with coal cinders, expanded shale, clay or slag, and natural light-weight materials such as volcanic cinders and pumice. The type of aggregate used in the block will affect its texture, porosity, weight, insulative and acoustical value.

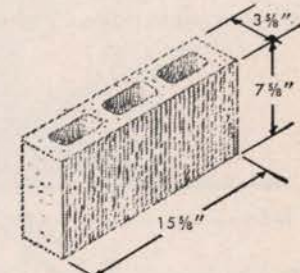
**Sizes:** Most concrete masonry units are specified by their nominal dimensions. The most popular unit is the 8 x 8 x 16 (which actually measures 7 $\frac{3}{8}$ " x 7 $\frac{3}{8}$ " x 15 $\frac{3}{8}$ ", thus allowing for a  $\frac{3}{8}$ -inch mortar joint). Among other sizes available are the 8 x 4 x 16, the 10 x 8 x 16 and the 12 x 8 x 16 (all nominal sizes), and a variety of special shapes such as jamb units, chimney units, bullnoses and corner units.

Split block and slump block are both special concrete units used where a rough, stone-like effect is desired. Split block is made by splitting a solid concrete unit length-wise and exposing the "split" side. Slump block is made from concrete especially mixed to sag when the mold is removed instead of taking the exact shape of the mold. The resulting blocks vary in height, texture and general appearance.

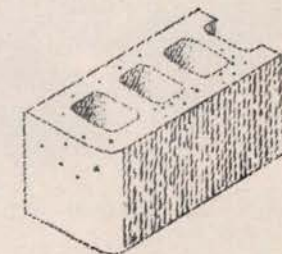
Concrete brick is available in sizes similar to those of clay brick.



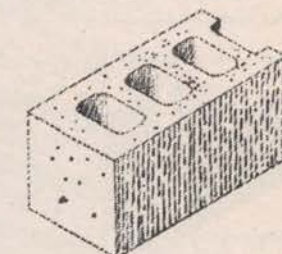
STRETCHER BLOCK



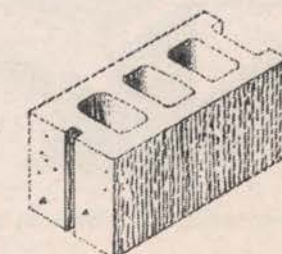
BACK-UP OR PARTITION BLOCK



BULLNOSE BLOCK



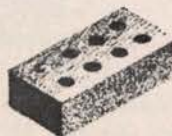
CORNER BLOCK



METAL SASH BLOCK



STRETCHER



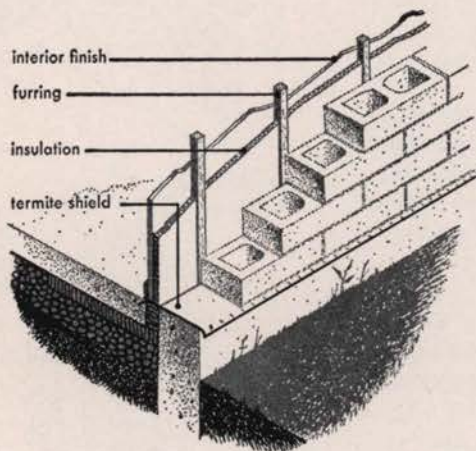
CORED BRICK



# TYPES OF MASONRY WALLS

## Solid Masonry Walls

Solid masonry walls may be constructed in two ways: either as a wall one-unit thick or as a wall two or more units thick. The most common single-

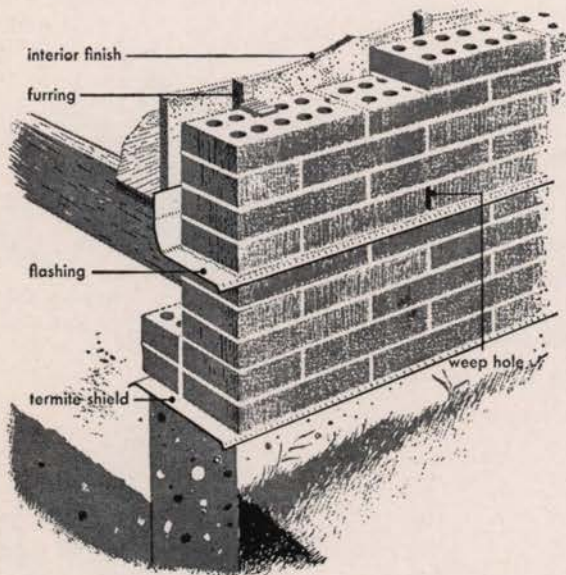


SINGLE-UNIT SOLID MASONRY WALL BUILT WITH 8 X 4 X 16 CONCRETE BLOCK

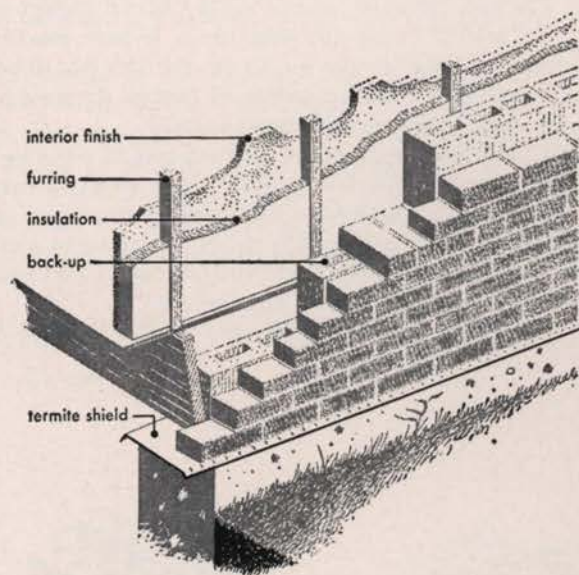
unit-thick type of wall as made of 8-inch concrete block, and may be used either as an interior or exterior wall.

It is also possible to build a single-unit-thick solid masonry wall of clay masonry by using "SCR brick." This is a special clay brick unit 6 inches thick developed by the Structural Clay Products Research Foundation especially for one-story residential work. The standard details of the wall include furring, which forms an air space that acts as an insulator and as a barrier to moisture penetration; weep holes, to allow the escape of any moisture that does penetrate; and flashing.

Multiple-unit solid masonry, once the most common type of masonry wall, is still required by some local building codes. The walls may be composed of either clay or concrete units or a combination of the two. Normally, a higher-grade unit is used as the facing and a less-expensive unit as the back-up. Masonry headers or metal ties are used to tie the face units to the back-up units. (A masonry header is a brick laid across two thicknesses of the wall.)



SINGLE-UNIT SOLID MASONRY WALL BUILT WITH "SCR brick"



DOUBLE-UNIT SOLID MASONRY WALL BUILT WITH FACE BRICK AND CONCRETE BACK-UP BLOCKS



## CAVITY WALL WITH COMMON BRICK INTERIOR AND FACE BRICK EXTERIOR

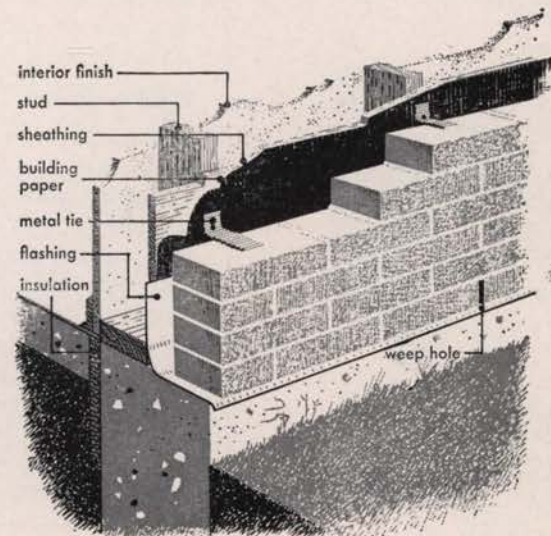
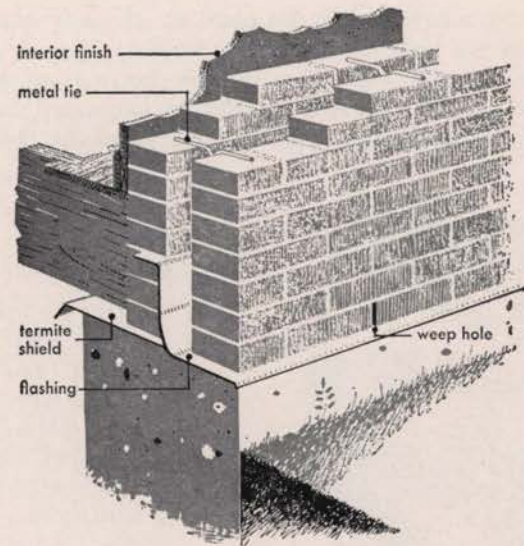
### Cavity Walls

A cavity wall consists of two masonry walls — each at least 4 inches thick — separated by a continuous air space and tied together by rigid metal ties embedded in the mortar joints of both walls. The air space, generally 2 to 3 inches wide, acts as a barrier to moisture penetration and increases the insulative value of the wall.

Weep holes and flashing are provided at the base of the wall to allow water or moisture that does penetrate the outside face to escape. Furring of the inside face is not necessary. The inside face can be left exposed as a decorative element or plastered directly.

### Veneer Walls

A veneer wall is technically not a masonry wall at all, but a frame wall with masonry used in place of the siding. In this type of wall, the masonry (which may be clay brick, concrete brick, split-block or stone) serves no structural purpose aside from supporting its own weight, and acts only as a finished surface for the frame wall. The masonry is only one unit thick, and is tied to the frame wall by galvanized metal ties spaced so there is one tie for each 2 square feet of wall area. A  $\frac{3}{4}$ -inch air space is provided between the veneer and the sheathing. Water or moisture that penetrates the veneer is allowed to escape through weep holes at the base of the wall.



VENEER WALL WITH FACE BRICK

## FASTENING MATERIALS TO MASONRY WALLS

Fastening of materials such as wood trim and fixtures to masonry walls is relatively simple if planned and provided for during construction of the walls.

Wood trim can be nailed into metal nailing plugs or soft wood blocks placed in the vertical joints of the wall. Metal plugs are available with or without fiber inserts, and are superior to the wood blocks. If blocks are used, they should be well-seasoned and treated to prevent rot and shrinkage.

Cabinets, shelves or other fixtures can be fas-

tened to hollow units with toggle bolts of various types. Wood or fiber plugs or metal expansion shields may be used in either solid or hollow masonry units. Holes for these plugs are usually drilled into the mortar joints with carbide-tipped drills.

Furring is attached to walls either by using case-hardened nails driven into the mortar joints, metal or wood nailing plugs placed in the wall during construction, or some of the newer adhesives which set without heat or pressure.

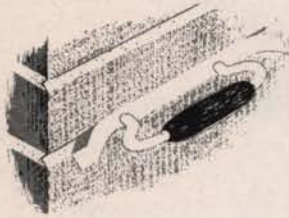


# ESSENTIALS OF WEATHER-TIGHT CONSTRUCTION

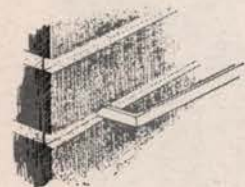
Because masonry walls are made up of many small units, it is essential that careful attention be given to the factors contributing to the weather-tightness of the wall. Moisture problems may result either from penetration of water from the exterior or from the condensation of water vapor from the interior.\* Exterior moisture penetration can be minimized by attention to the construction details discussed below. Moisture penetration from the interior of the building is discussed later under *Insulation*.



CONCAVE JOINT



V-JOINT



RAKED JOINT



FLUSH JOINT

## Mortar

Mortar, the material used to bind the masonry units together, is a mixture of portland cement, lime and sand, or a mixture of masonry cement and sand. The quality of the mortar and the way it is mixed can determine to a large extent the strength and water-tightness of a masonry wall. A good mortar must have the ability to retain water (otherwise it loses its plasticity too quickly and becomes stiff and unworkable), and must also be able to retain its compressive and tensile strength when subjected to varying weather conditions. The proportions of the ingredients in the mortar can be changed to meet different requirements for workability and strength.

## Workmanship

The quality of a masonry wall depends to a great degree upon the skill of the mason. Unless especially treated, high-absorption clay bricks must be wetted prior to laying so they do not absorb water too rapidly from the mortar. All vertical and horizontal joints must be completely filled with mortar, since any channels or pockets left in the joints provide an entry for water. When the mortar in the joints has partially stiffened, it should be pressed tight against the brick with a special tool. This tooling not only compresses the mortar and creates a firm bond, but also helps protect the joint against the entrance of water. Concave joints and V-joints are recommended for exterior masonry. Raked joints form ledges that can hold water and may produce leaks. Flush joints are not considered as desirable as concave or V-joints because the mortar is not compressed when the joints are formed.

\* See Small Homes Council circular F6.2 — "Moisture Condensation."

## Efflorescence

One of the most common problems occurring with masonry walls is efflorescence — a deposit of water-soluble salts which appears on the outside surface of the wall or in the pores of the masonry. Although the deposit is usually white in color, certain salts result in a green deposit commonly called "green stain." Three conditions are necessary to produce efflorescence: 1) presence of the salts in the wall; 2) contact of water with the salts; and 3) path through which the water can reach the surface of the wall. Since soluble salts are found in all masonry units and mortars to some degree, the best preventative measure for efflorescence is to keep water penetration into the wall to a minimum.

As discussed previously, proper flashing, full mortar joints, attention to details at vulnerable areas, and the caulking of exterior door and window frames will reduce water penetration. In areas where high wind-driven rain can be expected, coating the inside face of the facing units with a portland cement mixture has proved an effective water barrier.



## Flashing

Under severe weather conditions, some water penetration will occur in most masonry walls, no matter how well-constructed they are. To conduct this moisture safely to the exterior of the wall, flashing is installed at these vulnerable points: 1) the grade line; 2) the sills and heads of openings; and 3) intersections of vertical masonry construction with horizontal surfaces.

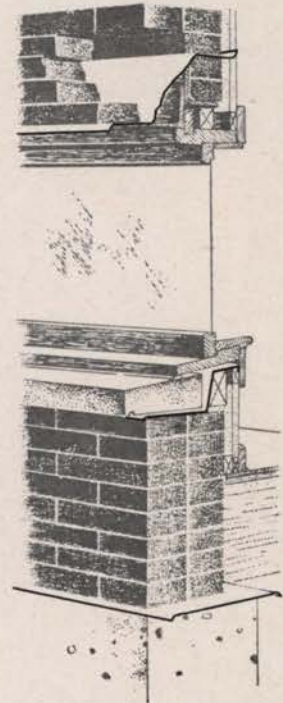
Flashing must be selected and installed with care. Although the choice of flashing is largely determined by cost, it should be remembered that the cost of replacing deteriorated or defective flashing can easily exceed any initial savings made by selecting less-expensive materials of inferior quality. Improper installation can also result in serious damage to the structure.

Flashings are usually formed of sheet metal (generally lead, zinc or copper), bituminous membrane material, or a combination of both. Generally, the sheet metals are more permanent, followed in order by the combination materials and the bituminous membranes. Combination flashings are made by laminating a light copper sheet between two sheets of bituminous-saturated (such as asphalt) fabric sheets.

External flashing is used to make a weathertight joint at intersections of vertical masonry construction with a relatively flat surface (a roof and chimney, for instance), and consists of two parts: the *base flashing* which covers the flat surface and is turned up against the vertical surface; and the *cap or counter flashing*, built into the vertical surface and turned down over the base flashing.

Internal flashings are built into the wall to direct any moisture which penetrates the wall to the exterior surface. When possible, the front of the flashing should extend through the wall and form a drip. Water caught by the flashing should be drained by weep holes spaced along the mortar joint in which the flashing is placed, or by wicks formed of cotton rope or glass fiber.

Projecting trim such as window sills should be designed with a "V" slot on the underside to let the water drip free of the wall rather than run back along the undersurface of the sill and down the face of the wall. The concentration of large amounts of water under sills or other protruding elements without drips not only causes efflorescence but also may deposit large amounts of dirt on the face of the wall under the projecting element.



WINDOW SECTION SHOWING HEAD FLASHING, SILL FLASHING, AND BASE FLASHING

## Surface Treatments

Masonry walls above grade actually need no additional exterior treatment when properly constructed. However, surface treatments can be used, either to change the appearance of the wall or make it more water-repellant.

Paint films retard evaporation of any moisture which has penetrated the wall, causing the moisture to remain in the wall for a longer period of time. (In cold weather this moisture may freeze in the wall.) *For this reason, the best surface treatments for both brick and concrete walls are those which allow water vapor to escape through them, such as the portland cement base paints and some of the newer synthetic resin paints.* Concrete masonry also serves as an excellent base for stucco, which is applied in much the same way as plaster.

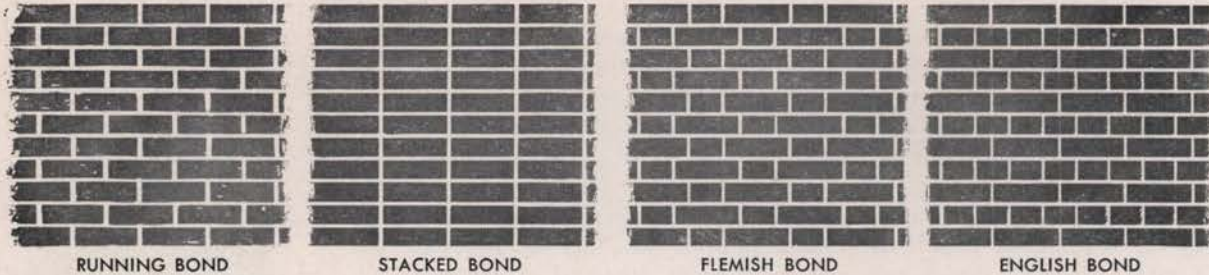
Transparent surface treatments such as silicones are effective in making masonry walls more water-repellant, and will seal hairline cracks. They will *not* correct defective flashings, bad mortar joints or poor grades of brick.



## PATTERNS IN MASONRY WALLS

The pattern in a masonry wall is formed by the way in which the individual units are arranged. Many of the patterns were developed as a direct result of the method used to tie or bond the thicknesses of the wall together. Some of the more popular patterns are running bond, stacked bond, English bond, and

Flemish bond. Special decorative effects, such as a herring-bone pattern or a mosaic appearance, may be achieved by carefully selecting the units as they are placed in the wall or by setting units forward or depressing them into the surface of the wall to form the pattern.



## INSULATING MASONRY WALLS

Requirements for insulation in masonry walls depend upon the severity of the weather, the comfort desired and the savings which can be gained in heating and cooling operations.

Solid masonry walls can be insulated by applying furring strips to the inside wall, thereby creating an air space in which the insulation can be placed, or by applying expanded (foamed) glass or plastic insulation in board form to the wall. This board is then used as a plaster base.

Cavity walls can be insulated with a water-repellent pouring-type vermiculite or glass fibers especially developed for use in masonry walls. (This

insulating masonry fill can also be used to fill the cores of concrete masonry units.) Insulation in the form of expanded glass or plastic can also be applied in the cavity.

Brick veneer walls are insulated in the same way as other frame walls — with flexible-type insulation, reflective foil, or insulating board.

Vapor barriers should always be provided as near to the warm surface of the wall as possible. When the wall is furred, the vapor barrier is applied in the same manner as in frame construction. Recent research indicates that vapor barriers are not needed for cavity walls except in special cases.

### HEAT TRANSMISSION COEFFICIENTS (U)<sup>†</sup>

|  | No Insulation<br>3/8" Sand Plaster | Cores or<br>Cavity Filled<br>3/8" Sand Plaster | 3/4" Furring<br>Foil-back Lath<br>1/2" Sand Plaster | 3/4" Furring<br>1" Insulation<br>3/8" Gypsum Lath<br>1/2" Sand Plaster | 1 3/8" Furring<br>1 1/2" Insulation<br>3/8" Gypsum Lath<br>1/2" Sand Plaster | 1" Applied<br>Expanded<br>Polystyrene in 1/4"<br>Cement Mortar<br>3/8" Sand Plaster |
|--|------------------------------------|--|---|--|--|---|
| <b>SOLID MASONRY</b>                               |                                    |  |   |  |  |   |
| A 6" Face Brick*                                   | 0.64                               | ....   | 0.19  | 0.18   | 0.13   | 0.19  |
| B 4" Face Brick<br>4" Building Brick               | 0.45                               | ....   | 0.17  | 0.16   | 0.12   | 0.17  |
| C 8" Concrete Block<br>Stucco                      | 0.46                               | 0.35   | 0.17  | 0.16   | 0.12   | 0.16  |
| D 8" Light Weight<br>Block<br>Painted              | 0.34                               | 0.18   | ....  | ....   | ....   | 0.15  |
| <b>CAVITY WALLS</b>                                |                                    |  |   |  |  |   |
| E 4" Face Brick<br>2 1/2" Air<br>4" Face Brick     | 0.37**                             | 0.14**   | ....  | ....   | ....   | 0.16***   |
| F 4" Face Brick<br>2 1/2" Air<br>4" Building Brick | 0.32                               | 0.14   | ....  | ....   | ....   | 0.15***   |
| G 4" Face Brick<br>2 1/2" Air<br>4" Concrete Block | 0.33                               | 0.12   | ....  | ....   | ....   | 0.15***   |

<sup>†</sup> Expressed in Btu per hour per square foot per degree Fahrenheit temperature difference

\* "SCR brick"

\*\* Plaster omitted

\*\*\* Applied in cavity