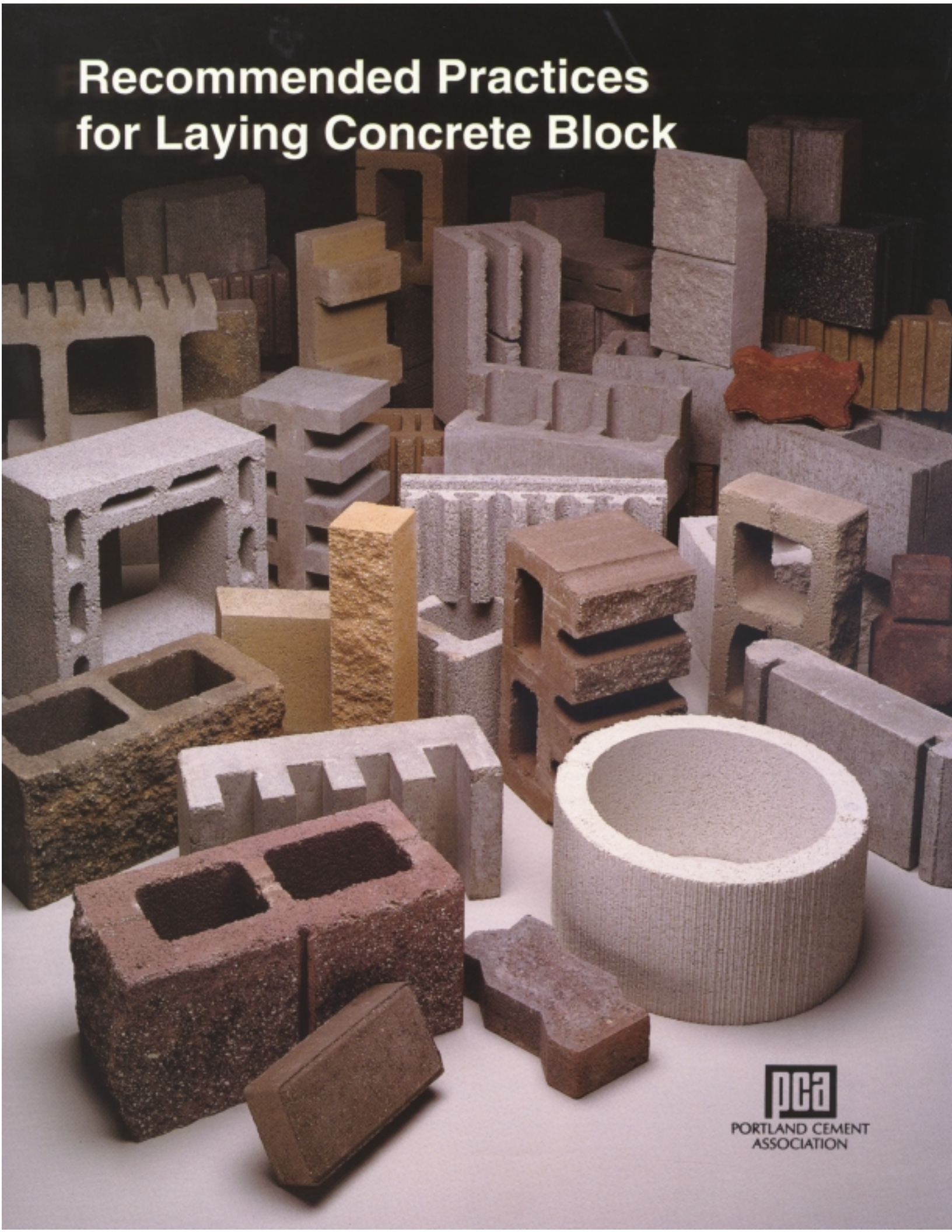
Recommended Practices for Laying Concrete Block



PORTLAND CEMENT ASSOCIATION

Recommended Practices for Laying Concrete Block

FIFTH EDITION

PORTLAND CEMENT ASSOCIATION
5420 Old Orchard Road, Skokie, Illinois 60077-1083

An organization of cement manufacturers to improve and extend the uses of portland cement and concrete through market development, engineering, research, education, and public affairs work.

Author: This text was revised by William C. Panarese, manager, Construction Information Services, Portland Cement Association.

On the cover: Concrete masonry units are manufactured in a wide variety of sizes, shapes, colors, and textures. Consult local producers for availability. Photo courtesy of Besser.

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CAUTION: Contact with wet (unhardened) concrete, mortar, cement, or cement mixtures can cause SKIN IRRITATION, SEVERE CHEMICAL BURNS, or SERIOUS EYE DAMAGE. Wear waterproof gloves, a long-sleeved shirt, full-length trousers, and proper eye protection when working with these materials. If you have to stand in wet concrete, use waterproof boots that are high enough to keep concrete from flowing into them. Wash wet concrete, mortar, cement or cement mixtures from your skin immediately. Flush eyes with clean water immediately after contact. Indirect contact through clothing can be as serious as direct contact, so promptly rinse out wet concrete, mortar, cement, or cement mixtures from clothing. Seek immediate medical attention if you have persistent or severe discomfort.

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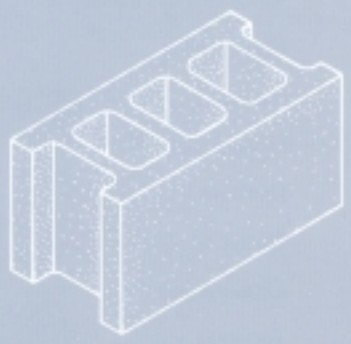
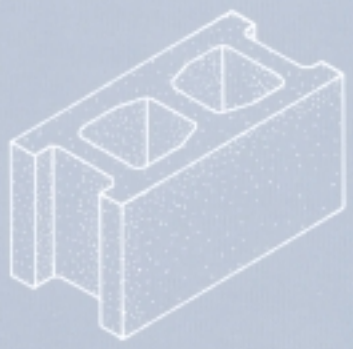
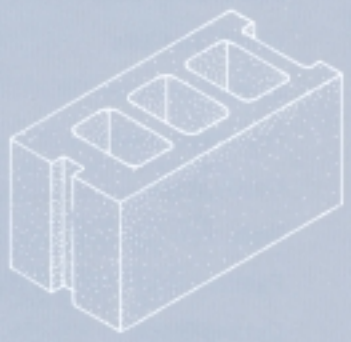


Stretcher (3 core)

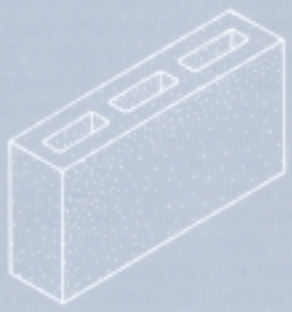


Stretcher (2 core)

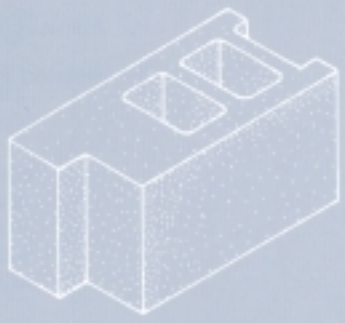


Sash

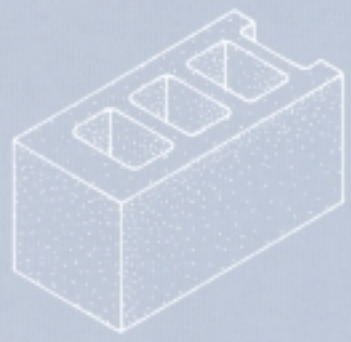
Ribbed, split-face



Partition



Jamb



Corner

Foreword

Concrete masonry has experienced one of the most remarkable growths of any modern building material. Concrete masonry makes up more than two-thirds of the masonry in walls being built today.

This popularity is a result of its adaptability to all types of buildings. From its modest beginning, when concrete masonry was generally restricted to simple and unassuming structures, it is now used in apartment buildings, schools, churches, office commercial and industrial buildings, warehouses, and wherever beauty, firesafety, economy, and durability are essential.

The use of exposed concrete masonry for finer types of buildings has opened up new fields of construction to the masonry craft. Masons are quick to recognize the opportunities offered by working with this modern building material. Largely responsible for the popularity of concrete block construction is the careful attention given to good workmanship in building structurally sound, clean, straight walls.

This text illustrates and describes some of the practices of building a concrete block wall that result in the highest type of workmanship. Adherence to these recommended practices will result in even greater acceptance and use of concrete masonry construction.

Concrete masonry units are made with aggregate such as sand, gravel, crushed stone, air-cooled slag, coal cinders, expanded shale or clay, expanded slag, volcanic cinders, pumice, and scoria. In some localities, the term "concrete block" has been used to designate only those units made with sand and gravel or crushed stone aggregates. Generally speaking, however, concrete block refers to hollow concrete masonry units, usually of 8x8x16-in. (200x200x400-mm) dimensions, made with the aggregates mentioned.

Some concrete masonry units illustrated in this publication may not be available in all areas. *Local block producers should be consulted as to sizes, shapes, colors, and textures available.* To obtain a list of local producers, consult the yellow pages of the telephone directory and contact the National Concrete Masonry Association, 2303 Horse Pen Road, P. O. Box 781, Herndon, Virginia 22070-0781, phone: 703-435-4900, fax: 703-435-9480.

Although many of the illustrations show the first course of concrete block being laid on a concrete footing, the procedures are the same whether the first course is laid on a footing, a foundation wall, or a concrete floor.

As specifications limit the moisture content of concrete block, care must be taken to keep the block dry at the jobsite. It should be stockpiled on pallets or other supports free from contact with the ground and covered for protection against wetness [**1**]. *Concrete block must never be wetted before or during laying a wall* [**2**].

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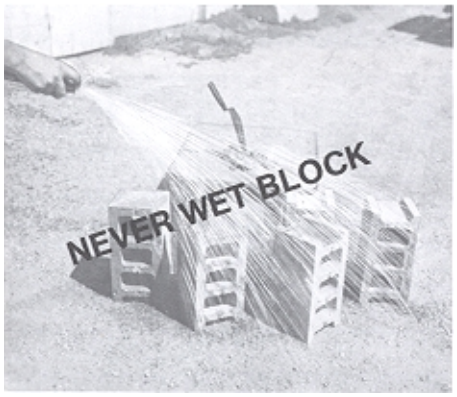

Mortar

Good mortar is necessary to good workmanship and good end-product performance. It must bond the masonry units into a strong, well-knit whole. The strength of the bond is affected by various factors—type and quantity of cementing material, workability or plasticity of the mortar, surface texture of the mortar-bedding areas, rate of suction of the masonry units, water retentivity of the mortar, and *always* the quality of workmanship in laying up the units.

Masonry walls subjected to severe frost action or severe stresses require mortars that are stronger and more durable than walls that have less severe exposure. The standard mortar mixes are shown here in the table. Strength of the mortar increases toward the top of the table, while the workability increases toward the bottom. Type N is the most commonly used mortar because of its blend of strength and workability.

Mortar should be mixed in a power mixer except for very small jobs where it can be mixed by hand. Mortar is proportioned by volume [**3**]. Cements come in 1-cu-ft bags. Lime is packaged 1¼ cu ft per sack. In Canada, a bag of portland cement, masonry cement, or lime is 0.028 m³. It is difficult to estimate the volume of sand on a shovel, so the volume should be checked once or twice a day against a measuring box or pail to determine how many shovels of sand make a unit volume [**4**].

Proportion Specifications for Mortar

United States

Mortar specification	Mortar type	Parts by volume*				
		Portland cement or blended cement	Masonry cement type			Hydrated lime or lime putty
			M	S	N	
ASTM C270	M	1	—	—	1	—
		—	1	—	—	—
		1	—	—	—	¼
	S	½	—	—	1	—
		—	—	1	—	—
		1	—	—	—	Over ¼ to ½
	N	—	—	—	1	—
		1	—	—	—	Over ½ to 1¼
	O	—	—	—	1	—
		1	—	—	—	Over 1¼ to 2½

Canada

Mortar specification	Mortar type	Parts by volume			
		Portland cement	Masonry cement (formerly Type H)	Hydrated lime or lime putty	Aggregate**
CSA A179M	M	1	1	—	6
		1	—	¼	3½
	S	½	1	—	4½
		1	—	½	4½
	N	—	1	—	3
		1	—	1	6
	O	—	1	—	3
		1	—	2	9
	K	1	—	3	12
		—	—	1	3

*Aggregate ratio: Under the proportion specifications, the total aggregate shall be equal to not less than 2¼ and not more than 3 times the sum of the volumes of the cement and lime used.

**The amount of aggregate may be decreased to not less than 2¼ times the sum of the cement and lime used.

Notes:
1. Under ASTM C270, Standard Specification for Mortar for Unit Masonry, aggregate is measured in a damp, loose condition and 1 cu ft of masonry sand by damp, loose volume is considered equal to 80 lb of dry sand.
2. Under CSA A179M, Mortar and Grout for Unit Masonry, aggregate is proportioned on a dry basis and adjusted for bulking.
3. Mortar should not contain more than one air-entraining material.

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The looseness of the sand can be judged from a footprint [**5**]. If the sand is very loose, more shovelfuls are required than if it is compact.

Mortar should be mixed for 3 to 5 minutes after all ingredients have been placed in the mixer. The wheelbarrow should be wetted [**6**] before fresh mortar is placed in it [**7**].

Mortar that has stiffened on the mortar board because of evaporation can be retempered to restore its workability by thoroughly remixing it and by adding water as required [**8**]. Mortar stiffened by hydration (setting) should be discarded.

Since it is difficult to distinguish between these two causes of stiffening, the practical method of determining suitability of mortar is on the basis of time elapsed after initial mixing. Mortar should be used within 1½ hours after original mixing when the air temperature is 80°F (27°C) or higher, and within 2 hours when the air temperature is below 80°F (27°C). Mortar not used within these time limits should be discarded.

Mortar also must be sticky [**9**] so that it will adhere to the concrete block when it is laid for the wall. When taking a trowel full of mortar from the mortar board, the mason can shake the trowel with a quick vertical snap of the wrist to make the mortar stick to the trowel [**10**]. This keeps mortar from falling off the trowel when it is applied to the edges of the block.

Block and mortar should be placed on the scaffold near its final position to minimize the mason's movements [**11**].

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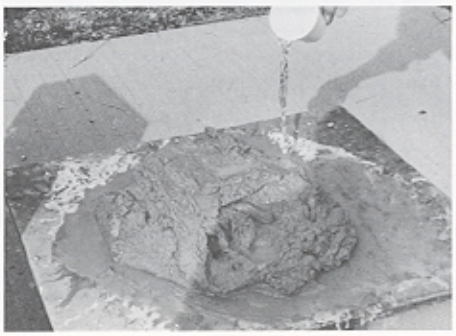

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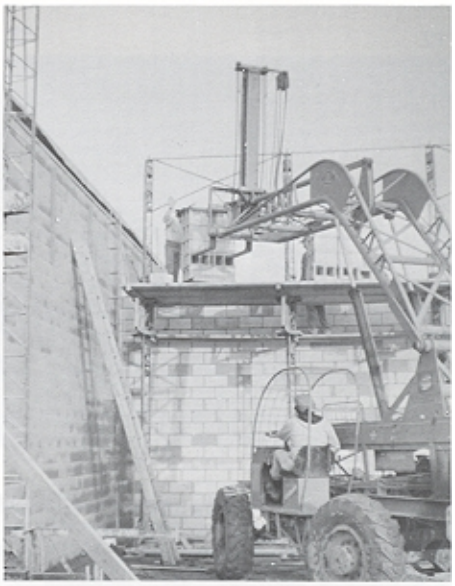

First Course

The mason, after locating the corners, can string out the block for the first course without mortar, in order to check the layout and eliminate unnecessary cutting of units [**12**]. A chalked snapline is sometimes used to mark the footing and help align the block. Another way is to stretch a line between corners and tie it to a batterboard or a stake. A full mortar bed can then be spread and furrowed with a trowel to ensure plenty of mortar along the bottom edges of the block for the first course [**13**]. The corner block should be laid first and carefully positioned [**14**].

Block should be laid with the thick end of the face shell up to provide a larger mortar-bedding area. For vertical joints, only the ends of the face shells need be coated with mortar (buttered). By placing several blocks on end, the mason can butter the ends of the face shells of three or four blocks in one operation [**15**]. Each block is then brought over its final position and pushed down into the mortar bed and against the previously laid block, thereby producing a well-filled vertical mortar joint [**16**].

After three or four blocks have been laid, a mason's level is used as a straightedge to assure their being in correct alignment [**17**]. They are then carefully checked with the level and brought to proper grade [**18**] and made plumb [**19**] by tapping with the trowel handle. The first course of concrete masonry should be laid with great care and properly aligned, leveled, and plumbed. This will make easier the laying of succeeding courses and the building of a straight, true wall.

Corners

After the first course is laid, mortar is usually applied only to the top edges of

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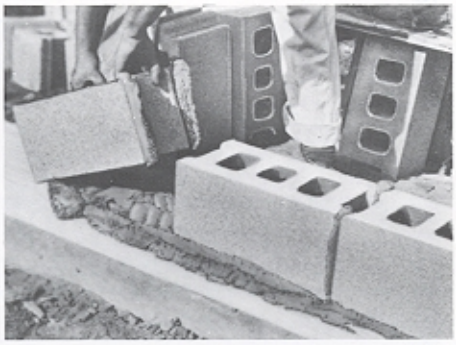

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the face shells. This is called face-shell mortar bedding [**20**]. Mortar for the vertical joints (head joints) can be applied to the face shells of the block to be placed (preferred), or to the vertical edges of the block previously laid. Some masons butter the face shells of the block previously laid, as well as the block to be laid, to ensure well-filled head joints.

The corners of the wall are generally built first, usually four to six courses high. As each course is laid at the corner, it is checked with a level for alignment [**21**], for level [**22**], and for plumb [**23**]. Each block is carefully checked with a level or straightedge to make certain that the faces of the block are all in the same plane [**24**]. This is necessary to ensure true, straight walls.

The use of a story- or course-pole (a stick with markings 8 in. [200 mm] apart) provides an accurate method of finding the top of each course [**25**]. Mortar joints for concrete masonry should be ⅜ in. (10 mm) thick. Each course of the corners is stepped back a half block and the mason should check the horizontal spacing of each block by placing the level diagonally across the corners of the blocks [**26**].

In some localities, a full mortar bed may be specified on all concrete block construction. This requires mortar on the cross webs as well as on the face shells [**27**].

Do not move or straighten the block in any manner once the mortar has stiffened, or even partly stiffened. Final positioning of the block must be done while the mortar is soft and plastic. Any attempt to move or shift the block after the mortar has stiffened will break the mortar bond and allow rain to penetrate.

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Between Corners

When filling in the wall between the corners, a mason's line should be stretched [**28, 29**] from corner to corner for each course, and the top outside edge of each block can then be laid to this line.

Different devices can be used to fasten the line, such as a corner block [**30**] held in place at the corner by tension on the line; a line pin [**31**] driven into a mortar joint that has set; a line twig [**32**] held by a brick and used to eliminate the sag in the line; a line stretcher [**33**] fitted over the top of the wall at any convenient place.

The manner of handling or gripping the blocks is important. Practice will determine the best way for each individual [**34**]. Tipping the block slightly toward himself allows the mason to see the upper edge of the course below so he can place the lower edge of the block directly over the course below [**35**].

By rolling the block slightly to a vertical position and shoving it against the adjacent block, it can be laid to the mason's line with minimum adjustment. *All adjustments to final position must be made while the mortar is soft and plastic.*

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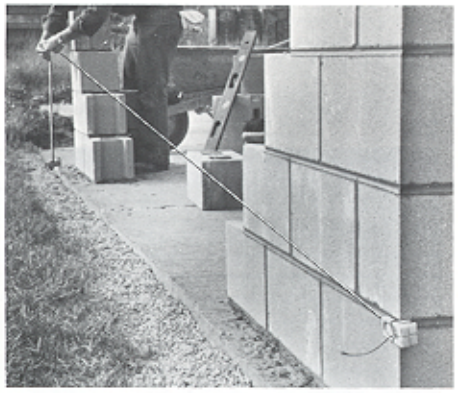

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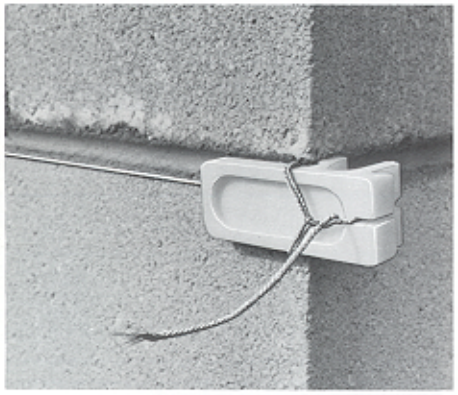

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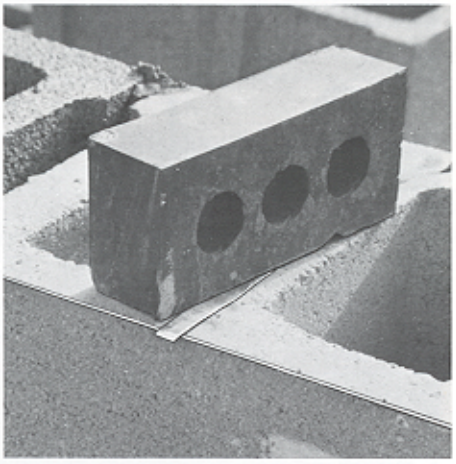

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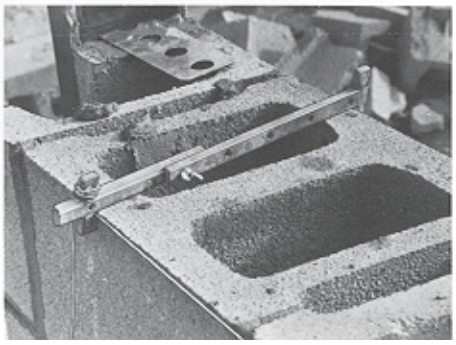

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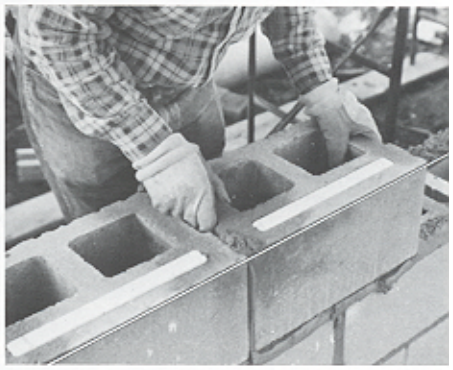

Any adjustments made after the mortar has stiffened will break the mortar bond. By tapping lightly with the trowel handle, it is possible to level and align each block to the mason's line [**36**]. The use of the mason's level between corners is limited to checking the face of each block to keep it lined up with the face of the wall.

To assure good bond, mortar should not be spread too far ahead of actual laying of block or it will lose its plasticity.

When steel joint reinforcement is required, it is laid on top of the block and mortar is troweled over it [**37**].

As each block is laid, excess mortar extruded from the joints must be cut off with the trowel [**38**]. It may be thrown back on the mortarboard and reworked into the fresh mortar. If the work is progressing rapidly, the extruded mortar cut from the joints can be applied to the face shells of the block just laid [**39**]. But should there be any delay long enough for the mortar to stiffen on the block, the mortar must be removed and returned to the mortarboard and reworked. The application of mortar to the face shell of the block already in the wall and to the block being set ensures well-filled joints [**40**]. Mortar that has been dropped onto the scaffold or floor should be discarded.

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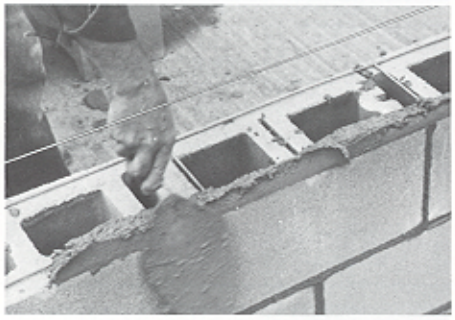

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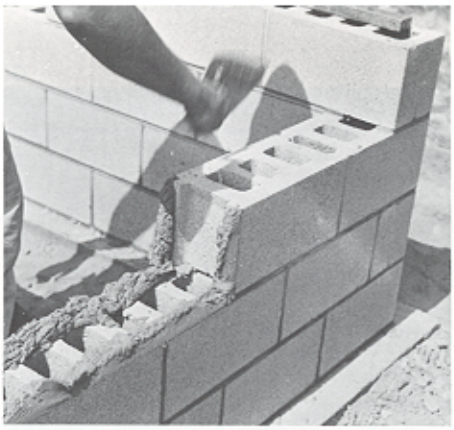

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Closure Block

When installing the last or closure block in each course, all edges of the opening and all four vertical edges of the closure block should be buttered with mortar [**41**] and the closure block carefully lowered into place [**42**].

The mortar joint should then be dressed with the point of the trowel [**43**]. If any of the mortar falls out, leaving an opening in the joint, the closure block must be removed, fresh mortar applied, and the operation repeated.

Tooling

Weathertight joints and neat appearance of concrete block walls are dependent on proper tooling; that is, compressing and shaping the face of the mortar joint. The mortar joints should be tooled when the mortar in the section of wall just laid is hard enough so a thumbprint barely shows [**44**]. Tooling compacts the mortar and forces it tightly against the masonry unit on each side of the joint. Proper tooling will produce joints of uniform appearance with sharp, clean lines. Unless otherwise specified, all joints should be tooled either in a concave shape or a V-shape.

The jointer (sometimes called a sled runner) for tooling horizontal joints should be longer than a masonry unit and turned up at one end to prevent gouging the mortar [**45** and **46**]. Tooling the horizontal joints should be done first, followed by striking the vertical joints with a small S-shaped jointer [**47**]. After the joints have been tooled, any mortar burrs should be trimmed off flush with the face of the wall with a trowel [**48**] and then dressed with a burlap bag or a brush [**49**].

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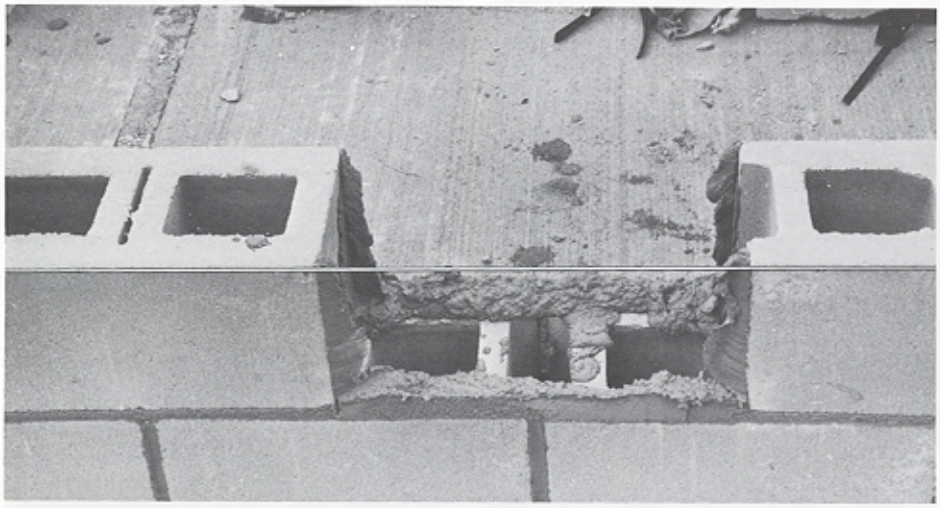

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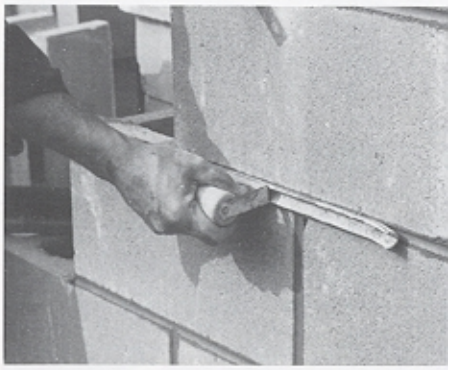

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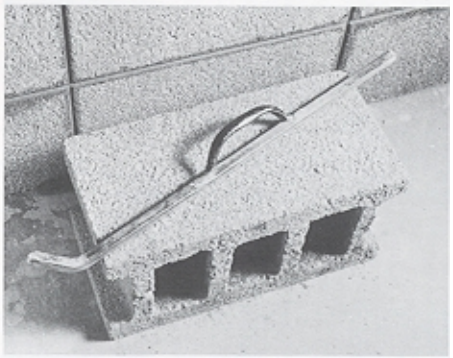

Anchor Bolts

In construction of concrete masonry with wood framing, wood plates are fastened to the tops of concrete block walls by anchor bolts ½ in. (12 mm) in diameter, 18 in. (450 mm) long, and spaced not more than 4 ft (1.2 m) apart. The bolts are placed in the cores of the top two courses of block and the cores then filled with concrete, grout, or mortar. Pieces of metal lath are placed in the second horizontal mortar joint from the top of the wall and under the cores that will be filled to hold the concrete, grout or mortar filling in place. The threaded end of the bolt should extend about 3 in. (75 mm) above the top of the wall; and when the filling has hardened, a wood plate can be securely fastened to the wall [**50**].

Control Joints

Control joints are continuous vertical joints built into concrete masonry walls to control masonry cracking from shrinkage and temperature stresses. Shrinkage cracking will occur at the joint even though the mortar is the full thickness of the face shell or flange, because such a head joint is horizontally weaker in tension than the block. To keep control joints as inconspicuous as possible, care must be taken to build them plumb and of the same thickness as the other mortar joints. If the control joint will be exposed to weather, it should be sealed with a calking compound.

All control joints should be laid up in mortar the same as the other vertical joints. If the control joint is to be calked, a recess should be provided for the calking material by raking out the mortar to a depth of about ¾ in. (19 mm) after the mortar has become quite stiff [**51**].

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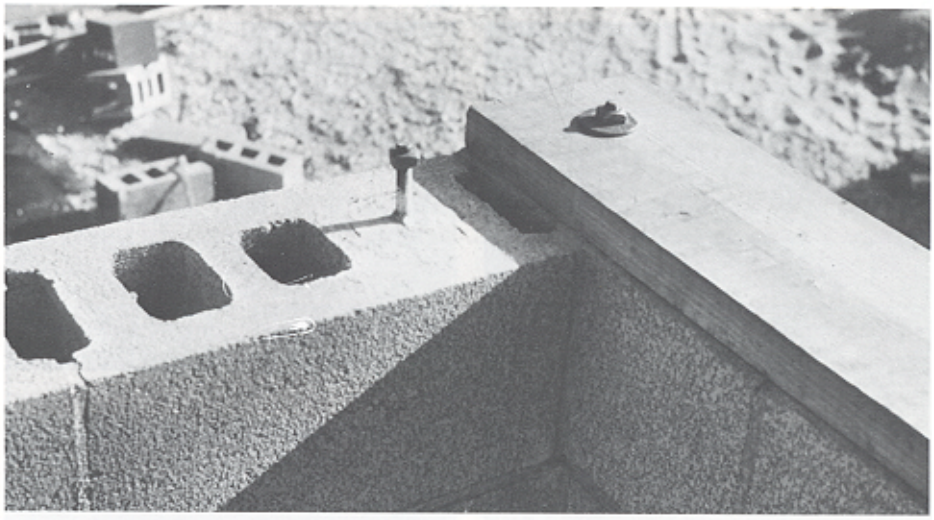

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Control Joints, continued

Edges of the masonry in the control joint may have to be primed before calking to prevent the dry masonry from absorbing oils from the compound. Recommendations of manufacturers of calking materials regarding priming should be followed. A thin, flat calking trowel or calking gun is used to force the calking compound into the joint [**52**].

One type of control joint is made with a plastic strip shaped like a cross [**53**]. The strip is fitted between sash units as they are laid [**54**]. The spacing of the blocks should be checked with a rule [**55**].

To form a continuous vertical control joint, full- and half-length blocks are used. Sometimes offset jamb blocks are used at control joints, with a noncorroding metal tie bent in the form of an open Z laid across the joint [**56**]. Another type can be constructed by inserting building paper or roofing felt in the end core of the block and then filling the core with mortar for lateral support [**57**]. The paper or felt prevents the mortar from bonding on one side of the joint, thus permitting the control joint to function.

A control joint block available in some areas provides lateral support by means of a tongue-and-groove shape at the ends of the blocks [**58**]. Control joint blocks are made in full- and half-length units [**59**].

Intersecting Walls

Many intersecting walls could be built without any connection; but if no instructions are given otherwise, connections should be used. Where one or both of the walls need lateral support, a metal

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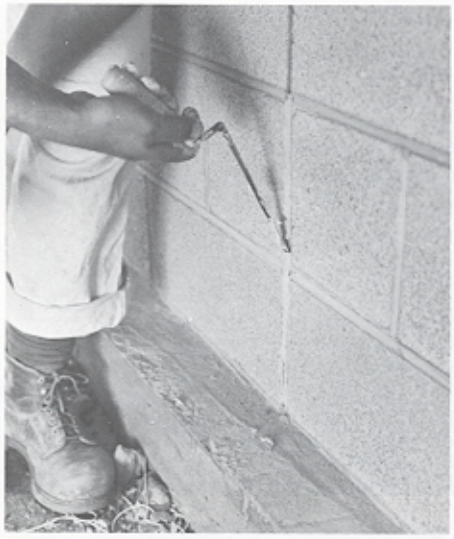

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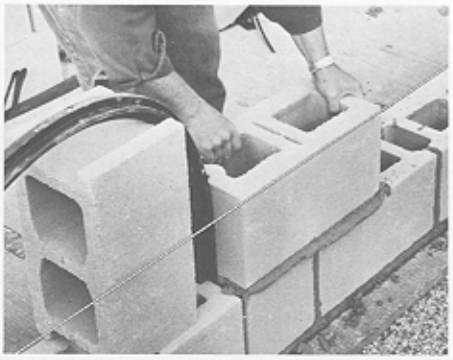

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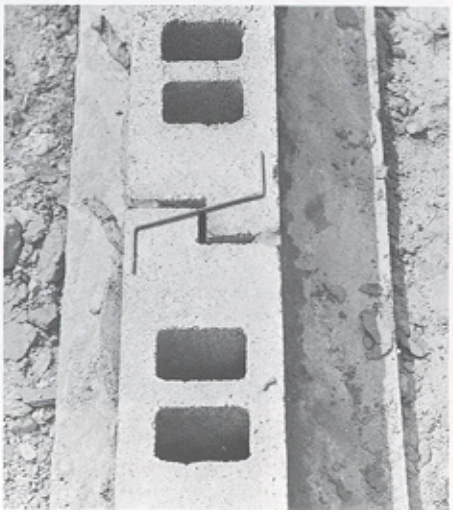

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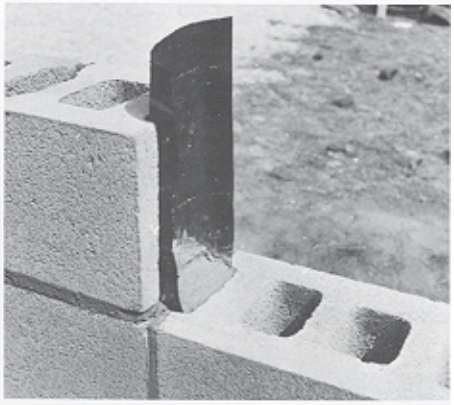

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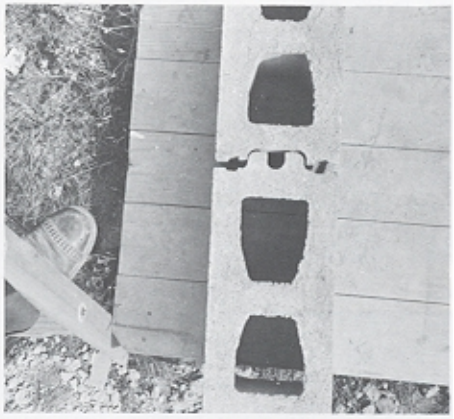

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tie is usually provided. For bearing walls, a metal tie bar can be installed in the joints at about every sixth course [**60**]. For nonbearing walls, metal lath or hardware cloth is placed across the joint in alternate courses [**61**]. Intersecting walls can be tied together in a masonry bond instead of using metal ties or bars.

Lintels and Sills

Precast concrete lintels are available for door and window openings [**62**]. These are made in a variety of shapes and types to suit the wall or load they must carry. A basic type is the solid precast lintel [**63**]; another is the U-shape lintel or lintel block [**64**]. They are for either metal or wood doors.

A noncorroding metal plate placed under the ends of the lintel where control joints occur will permit the lintel to slip and the control joints to function properly [**65**]. A full bed of mortar should be placed over the metal plate to uniformly distribute the lintel load.

After the mortar in the control joint, at the end of and under the lintel, has hardened sufficiently, it should be raked out to a depth of ¾ in. (19 mm) and then filled with a calking compound [**66**].

Precast concrete sills are usually set in a bed of mortar after the masonry walls have been built [**67**]. Joints at the ends of sills should be tightly filled with mortar or raked and filled with a calking compound. Concrete masonry sill units are sometimes available in a nominal length of 8 in. (200 mm). To ensure a watertight sill with these units, the course below should be filled solid or flashing should be provided under the units.

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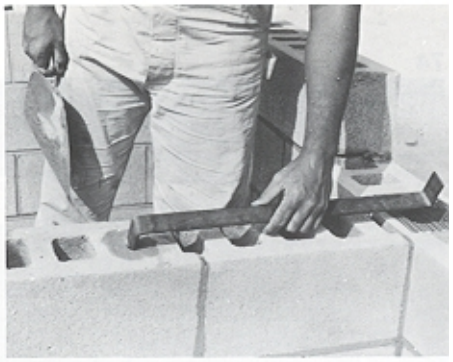

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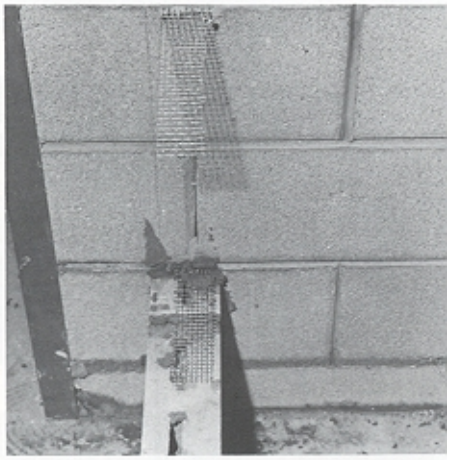

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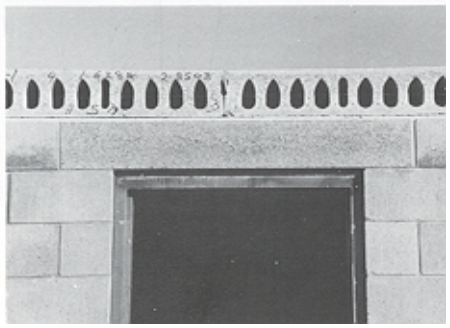

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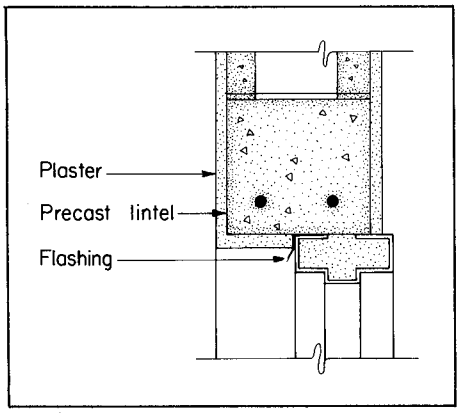

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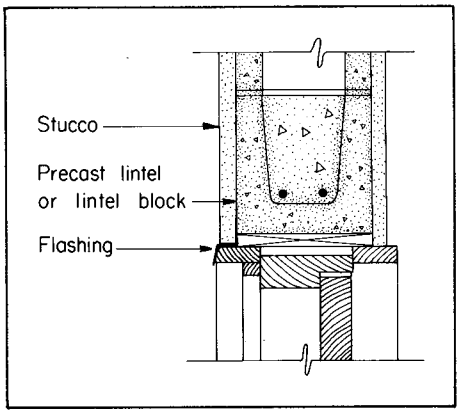

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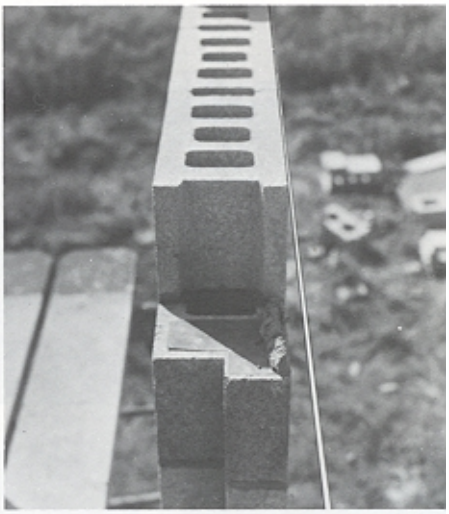

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Special Corners

Where L-shape corner blocks are available for walls thicker than 8 in. (200 mm), they should be used in constructing the corners [**68**]. Where they are not available, the corner can usually be laid up with an 8x8x16-in. (200x200x400-mm) corner block on the outside and a concrete brick on the inside [**69**]. The brick, well buttered with mortar, can be laid to complete the corner detail [**70**].

Foundation Walls

Foundation walls of hollow concrete blocks should be capped with a course of solid masonry to help distribute the loads from floor joists and to act as a termite barrier. Solid top blocks, which have 4 in. (100 mm) of solid concrete at the top, are available in some areas [**71**]. Stretcher blocks are used, particularly when anchor bolts are required. A strip of metal lath wide enough to cover the core spaces is placed in the mortar joints under the top course [**72**]. The cores are then entirely filled with concrete or mortar and troweled smooth [**73**].

Sometimes 4-in. (100-mm) solid units are used to cap concrete block foundation walls [**74**]. All vertical joints must be completely filled, and slushing of joints should not be permitted. Slushing is the placing of a unit with a small amount of mortar and then throwing mortar into the open space of the head joint with a trowel. This can leave voids where the mortar is not compact and does not bond, so that water can leak through the wall.

Another scheme is to use a continuous bond beam and lintel course capped with 2-in. (50-mm) units [**75**] that will support a precast floor [**76**].

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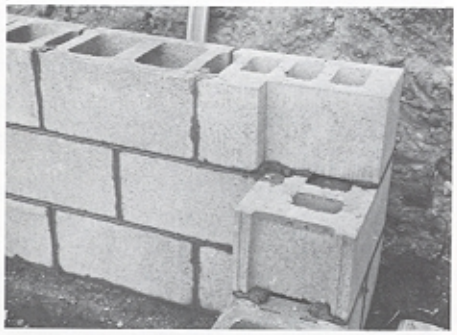

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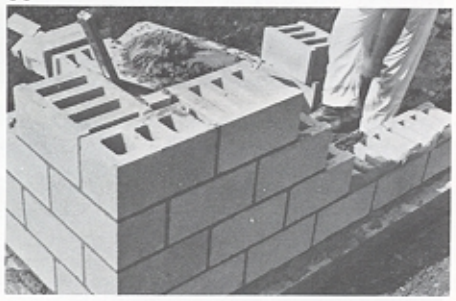

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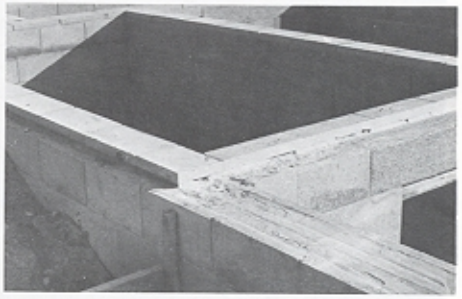

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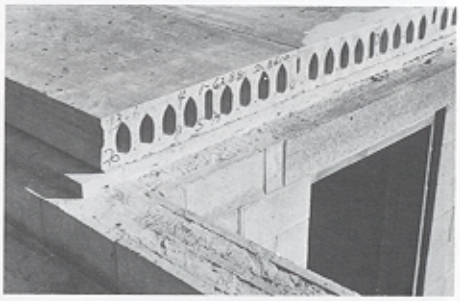

Cavity Walls

A cavity wall consists of two walls separated by a continuous air space 2 to 4½ in. (50 to 114 mm) wide, securely tied together [**77**]. The outside wythe (thickness or section of the wall) can be block or brick. Noncorroding metal ties are embedded in the mortar to tie the sections of wall together. Unit ties are usually placed at every other block horizontally and in every other horizontal joint [**78**]. Continuous metal ties (joint reinforcement) serve the same purpose [**79**].

Cavity walls are preferred for rain resistance but they cannot perform this function unless they are carefully constructed. Particular attention should be given to three items:

1. Weep holes are required at the bottom to shed any rain that penetrates the wall and runs down the inner face of the outer wythe. They should be located in the bottom course at about every second or third head joint in the outside wythe. Cotton sashcord, permanently encased in mortar, makes a good weep hole [**80**].

2. Flashing [**81**] is required in the bottom portion of the cavity wall to direct any water to the weep holes.

3. The cavity must be kept free of mortar droppings that could form a bridge for moisture to pass across to the interior wythe. A simple method of keeping the cavity clear is by catching mortar droppings on a board laid in the cavity across a tier of ties [**82**]. When the masonry reaches the next level for ties, the board is raised, cleaned, and repositioned [**83**].

Keeping mortar from dropping into the cavity can also be avoided by spreading the mortar bed so that it is back about ½ in. (12 mm) from the edge on the cavity. When the next masonry units are laid, the mortar will spread to the edge of the unit without squeezing over into the cavity. Another method is to spread the mortar and then draw the trowel over the mortar in an upward and outward direction away from the cavity, forming a beveled mortar bed. When units are laid on such a beveled bed, the mortar will spread only to the cavity edge.

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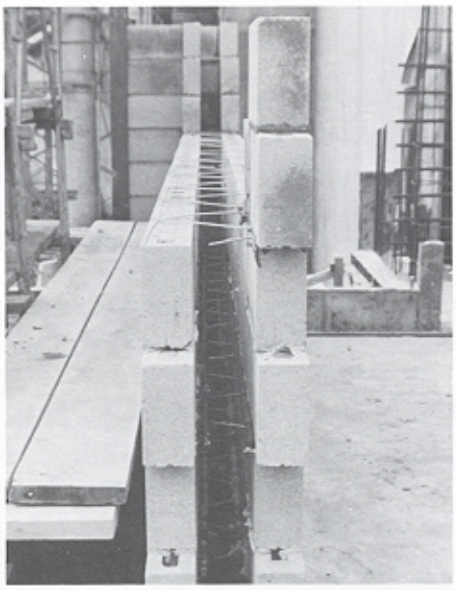

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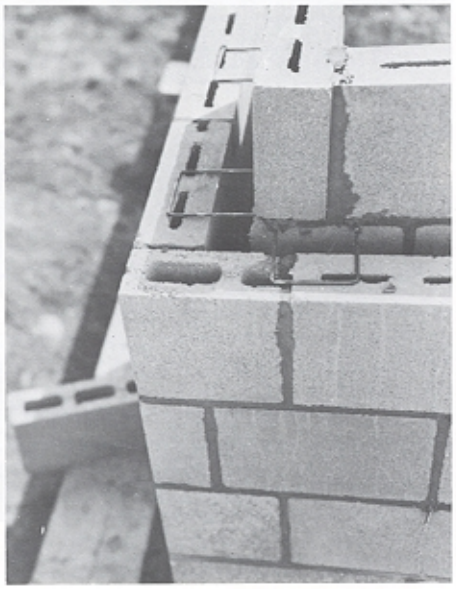

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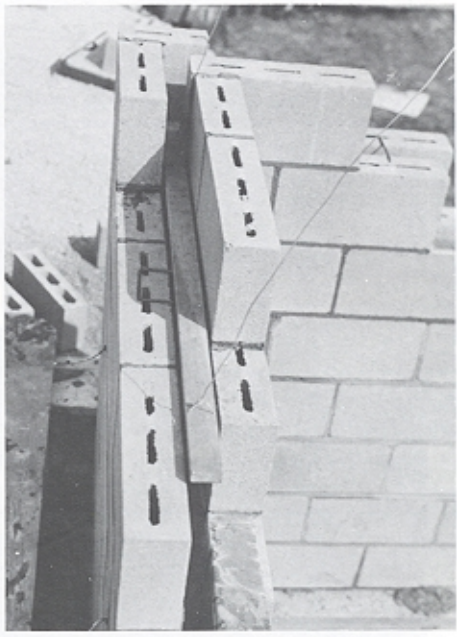

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Walls With Concrete Block Backup

Concrete block is often used as backup for brick to make a composite wall. The procedure for laying the concrete block is the same as that for a single wythe wall except that metal ties are used and the inside of the outer wythe may be parged. If the wall is to be parged, extruded mortar joints on the back of the facing units should be cut flush before the mortar hardens **[84]**; otherwise, parging applied over the hardened mortar may break the bond in the mortar joints and result in a leaky wall **[85]**. During parging, the mortar should be applied with a light pressure to avoid breaking the bed joints below.

Continuous metal ties (joint reinforcement) are used to tie the two wythes together **[86]**. When 12-in. (300-mm) blocks are used as backup, two masons might work together to lift each block into place **[87]**.

With a 4-in. (100-mm) backup block, sometimes mortar is applied on one face of one block and the other face of the next block **[88]**. Brick facing must be laid in a full mortar bed with *full* head joints **[89]**. If the block backup is laid first, parging of these blocks will help to ensure weathertight construction.

Where the inner wythe changes thickness at a corner, a cut block is required **[90]**. At each corner, the level and the butt of the trowel are used to level, plumb, and align the blocks **[91]**.

Concrete blocks can also be used as a backup for a stone facing **[92]**. Because the bed joints in the stone and the block do not line up, corrugated metal strips can be used to tie the two wythes together.

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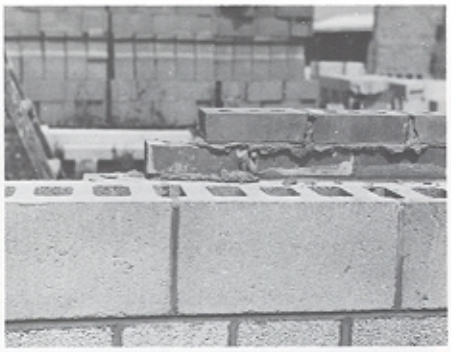

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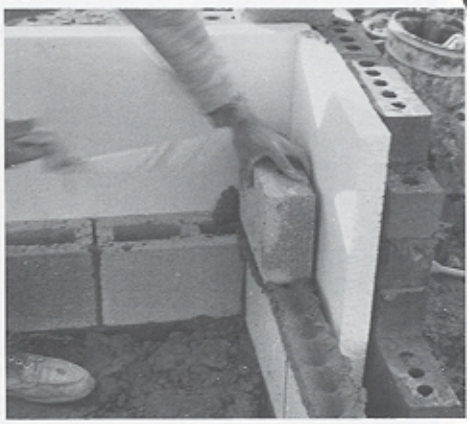

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Patching and Cleaning Block Walls

Any patching of mortar joints or filling of holes left by line pins should be done with fresh mortar.

Particular care is needed to prevent smearing mortar onto the surface of the block. Once hardened, embedded mortar smears can never be removed and they will detract from the appearance of the finished wall. Paint cannot hide mortar smears. Since concrete block walls should not be cleaned with acid, care must be taken to keep the wall surface clean during construction. Any mortar droppings that stick to the block wall should be allowed to dry before removal with a trowel [**93**]. The mortar may be smeared into the surface of the block if it is removed while soft. When dry and hard, most remaining mortar can be removed by rubbing with a small piece of block [**94**] and then brushing the spots [**95**].

Cutting Block

Concrete masonry units usually are available in half-length as well as full-length units. However, for special job conditions, it is sometimes necessary to cut a block with a brick set (chisel). The block should be scored on both sides to obtain a clean break [**96**]. For fast, neat cutting, masonry saws can be used [**97**].

In rough wall construction where appearance is not important, the block may be cut with the blade end of a brick hammer [**98**].

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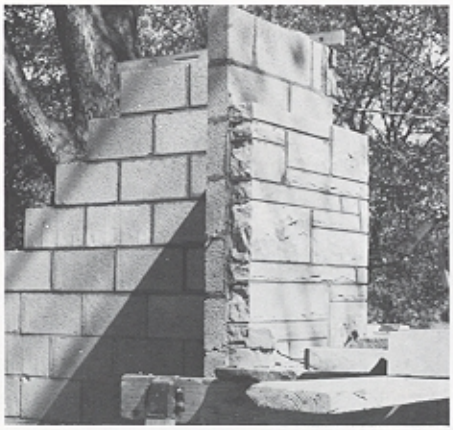

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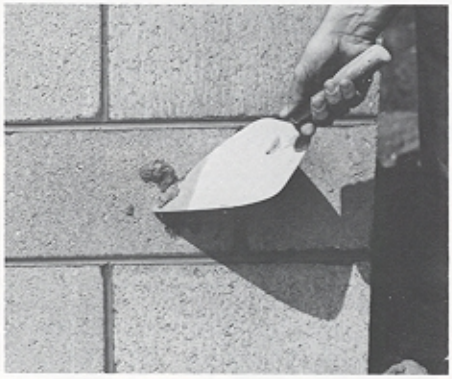

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Cover and Bracing

Building paper or tarpaulins should be used to cover the top of walls at the end of each day's work to prevent rain or snow from entering the cores and cavities [**99**]. Planks laid on the wall are not adequate cover. At the same time, all bags of cement at the mixer should be covered [**100**]. Also, a freshly-built, free-standing wall must be braced to prevent collapse from wind or other forces [**101a**]. Bracing should be provided if the height of the wall exceeds that given in the chart [**101b**] for various peak wind velocities.

Reinforced Block

Where extra strength is required of the masonry, especially in localities that have earthquakes, reinforcement may be specified. Reinforcing bars should be placed vertically in the cavities [**102**] and the cavities then filled with portland cement grout [**103**]. Horizontal bars may also be specified [**104**] to form a bond beam. In pilasters, a set of four reinforcing bars need to be connected with ties held in place with soft iron wire [**105**]. The finished product is a combination of the qualities of reinforced concrete and concrete masonry [**106**].

Dampproof Basements

Various methods can be used to dampproof concrete masonry basement walls, depending upon climate and subsurface drainage.

Portland cement plaster is very effective in decreasing the permeability of concrete masonry walls. The earth side of concrete masonry basement walls should be covered with a ½-in.-thick (12-mm) coat of plaster, preferably

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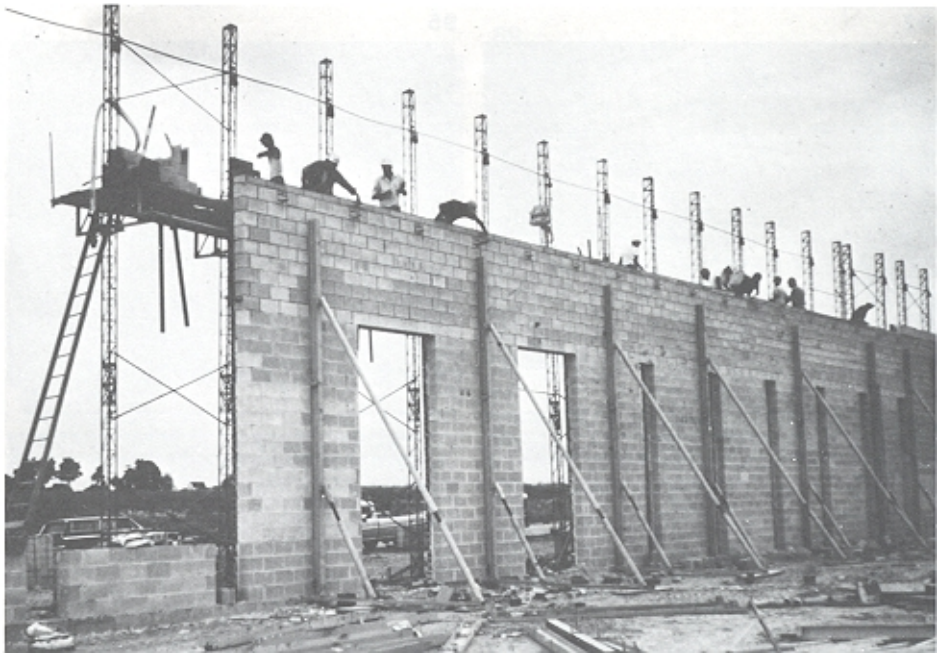

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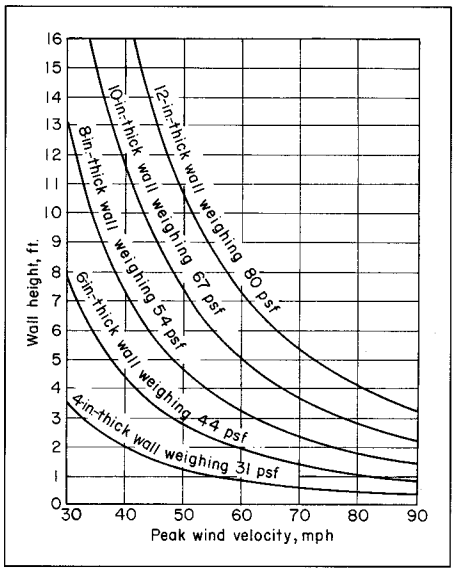

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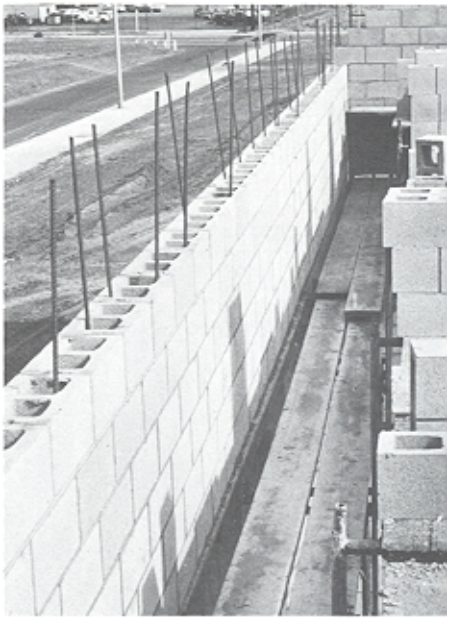

applied in two layers. Either portland cement plaster (a 1:2½ mix by volume) or the mortar used for laying up the block can be used. Proprietary portland cement-based coatings that have been specifically prepared to waterproof masonry basement walls can also be used for the plaster coat.

The wall surface should be clean and dampened with water (but not soaked), preferably by spraying, before the application of the plaster. This will prevent the block from absorbing excessive water from the plaster and will ensure better bond.

When the plaster is applied in two coats, the first coat should be troweled firmly over the masonry [**107**]. When it has partially hardened, the surface should be roughened [**108**] with a scratcher to provide good bond for the second coat. The first coat should be kept damp [**109**] and allowed to harden for at least 24 hours before applying the second coat. The plaster should extend from 6 in. (150 mm) above the finished groundline down to the footing where the plaster is coved [**110**] to help prevent water from collecting around the juncture of wall and footing.

Just before application of the second coat, the roughened surface should be dampened with water, but not soaked, for good bond. The second coat should be moist-cured for at least 48 hours after application.

If a single ½-in.-thick (12-mm) coat of plaster is used, the surface preparations are the same and the plaster should be kept moist for at least 48 hours after application.

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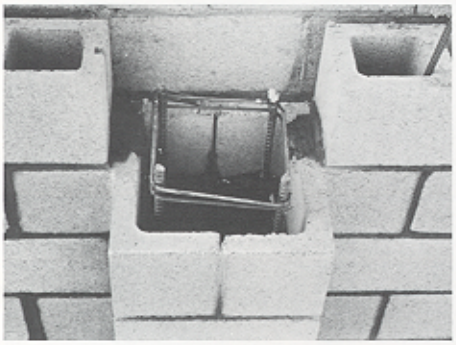

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Dampproof Basements, continued

In poorly drained, wet soils, the plaster coating should be covered with two thick cement-sand grout coats scrubbed well into the surface with a stiff-bristle brush, such as an ordinary floor scrub brush. The grout should be made of equal parts of portland cement and sand passing a No. 30 (600 μ m) sieve, and mixed with water to a consistency of heavy cream. The plaster should be dampened before applying the first coat of grout and the surface dampened again before applying the second coat. Each coat of grout should be cured by being kept wet for at least 24 hours.

Two coats of cement-based paint, prepared specifically for waterproofing foundation walls, or a waterproof membrane can be used instead of the grout. A heavy-duty bituminous coating applied by mopping asphalt or preferably coal tar onto bituminous-impregnated fabric is one of the best waterproof coatings for basement walls.

In order for any dampproofing method to be effective, the control joints in the masonry walls must have adequate joint sealant to keep out groundwater and to maintain the dampproofing.

Except in localities where the climate is dry or where the subsoil is well drained, 4-in. (100-mm) diameter drain tile should be placed around the outside of the footing and connected to a suitable outlet. The tile should be embedded in coarse gravel or crushed stone — 6 in. (150 mm) over and 2 in. (50 mm) under the tile — prior to backfilling.

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Insulation

The increasing need for energy conservation is putting particular emphasis on insulated concrete block walls and enlarging the role of the mason.

There are various insulating schemes:

- Granular lightweight fill can be poured into the cores as the wall progresses [**111**].
- Blocks are manufactured in a variety of shapes with a layer of insulation inside [**112**].
- A sheet of expanded polystyrene can be built into the wall [**113**].
- Outside insulation can be applied to the wall and then plastered or coated to create a final finish [**114**].

Lightweight aggregate used in the manufacture of the block itself furnishes further insulation.

For more information, see *Insulating Concrete Walls,* IS221B, Portland Cement Association, 1982.

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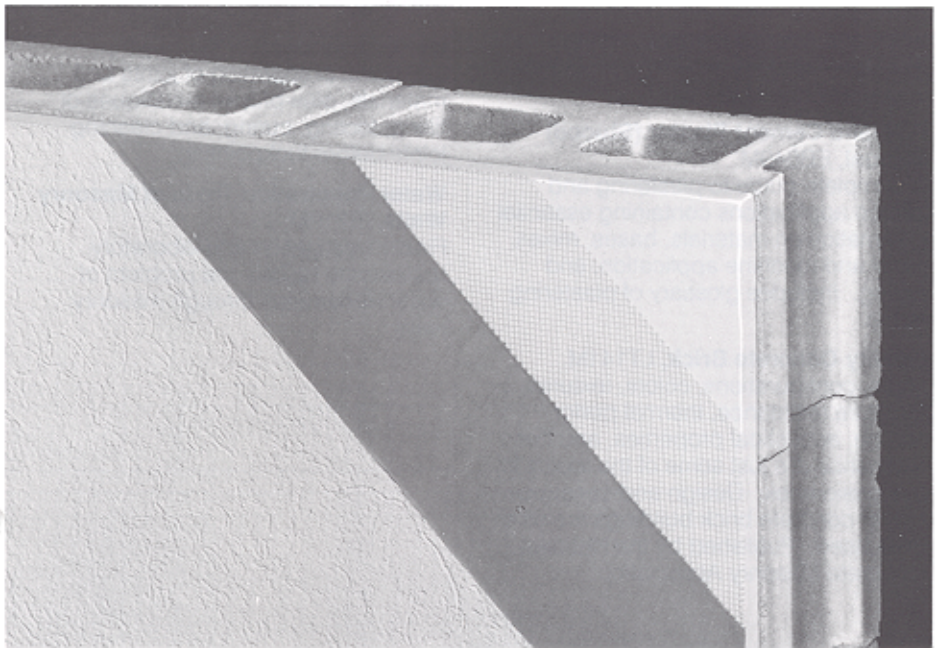

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Air Content of Mortar and Water Penetration of Masonry Walls, IS191M
Research covering a time span from the late 1930's to 1990 has been reviewed in this comprehensive literature search on the effect air content of mortar has on water penetration of masonry wall assemblies. Includes discussion of test methods, examination of the experimental design of test methods, and a summary of the information derived from the reviewed research.

Building Weather-Resistant Masonry Walls, IS220M
Preventing leaks with proper building design, selection of materials, workmanship, and maintenance.

Concrete Energy Conservation Guidelines, EB083B
Fundamental explanation of the effects of thermal mass and insulation on the energy performance characteristics of buildings. Covers both steady-state and dynamic heat flow. ANSI/ASHRAE/IES Standard 90A-80.

Concrete Masonry Handbook for Architects, Engineers, Builders, EB008M
Presents recommended practices in concrete masonry design and construction to meet requirements for firesafety, durability, economy, utility, good acoustics, beauty, and comfort.

Efflorescence (Trowel Tips), IS239M
Provides a concise reference on the subject of efflorescence of masonry walls. Discusses causes, practical preventive measures, and methods of removal.

Field Testing Masonry Mortar (Trowel Tips), IS242M
Provides information on standard ASTM field test procedures for masonry mortar. Discusses proper application of test methods and significance of test results.

Heat Transfer Characteristics of Walls Under Dynamic Temperature Conditions, RD075M
Describes tests conducted to evaluate thermal performance of a masonry wall and a wood-frame wall under steady-state and dynamic temperature conditions—particularly temperatures representative of those in Florida.

Insulating Concrete Walls, IS221B
Interior, exterior, embedded insulation methods: rigid-board, batt, spray-on insulation. Includes list of installers and manufacturers of insulation products.

Masonry Cement Mortars, IS181M
Desirable properties of mortar, specifications, mixing procedures, and cold-weather construction.

Masonry Cement Mortars: A Laboratory Investigation, RD095T
Reports on flexural bond strength and water penetration of assemblies made with masonry cement mortars. Variables include 20 different masonry cements and 10 different brick.

Mortar Sand (Trowel Tips), IS241M
Examines important properties of sand used for masonry mortar and summarizes ASTM specification requirements for masonry sand. Practical information on storage, handling, and batching is also included. The document provides a handy reference for contractors, owners, and specifiers on this basic construction material.

Mortars for Masonry Walls, IS040M
Discusses desirable properties of mortar, specifications and types, mortar components, measuring materials, white and colored mortars, mixing, retempering, cold-weather construction, and ready mixed mortars.

Portland Cement Plaster (Stucco) Manual, EB049M
A complete guide to plastering and stucco applications containing essential information on materials, bases, mixes, hand and machine application, and curing. Includes glossary of plastering terms.

Quality Concrete Brick, LT141M
Sizes, configurations, colors, textures, moisture resistance, thermal performance, acoustical properties, and fire resistance are just some of the topics in this basic book. Design and construction of concrete brick buildings are also discussed. Published by the National Concrete Masonry Association.

Selecting and Specifying Mortar and Grout for Unit Masonry, IS275M
Provides a guide specification for mortar and grout that is prefaced by discussion of mortar and grout materials and properties, an explanation of the proper use of related ASTM or UBC standards in project specifications, and information about coordinating project specifications with ACI 530/ASCE 5 or Uniform Building Code requirements.

Sound Transmission Loss Through Concrete and Concrete Masonry Walls, RD066M
Reports of tests made on 8-in.-thick (200 mm) concrete masonry walls and on 6- and 8-in.-thick (150- and 200-mm) cast concrete walls finished with materials intended to increase sound transmission loss.

Spec-Data: Masonry Cement, IS238M
Written in the Construction Specifications Institute (CSI) Spec-Data format designed for the specifier, this publication provides technical information on masonry cements, concisely covering a range of topics from basic use to performance characteristics.

Thermal Performance of Masonry Walls, RD071M
Presents results of an investigation of heat transmission characteristics of walls under steady-state and dynamic test conditions. Hollow concrete block, block-brick cavity, wood-frame, and wood-frame/brick veneer walls were evaluated.

Tuckpointing (Trowel Tips), IS240M
Presents a concise reference on tuckpointing of masonry walls. Discusses evaluation of the need to tuckpoint; preparation of joints and materials; plus proper techniques of filling, tooling, curing, and cleaning joints before tuckpointing.

Water Penetration Tests of Masonry Walls, IS219M
Field investigation and laboratory research to resolve the problem of water penetration through masonry walls.

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