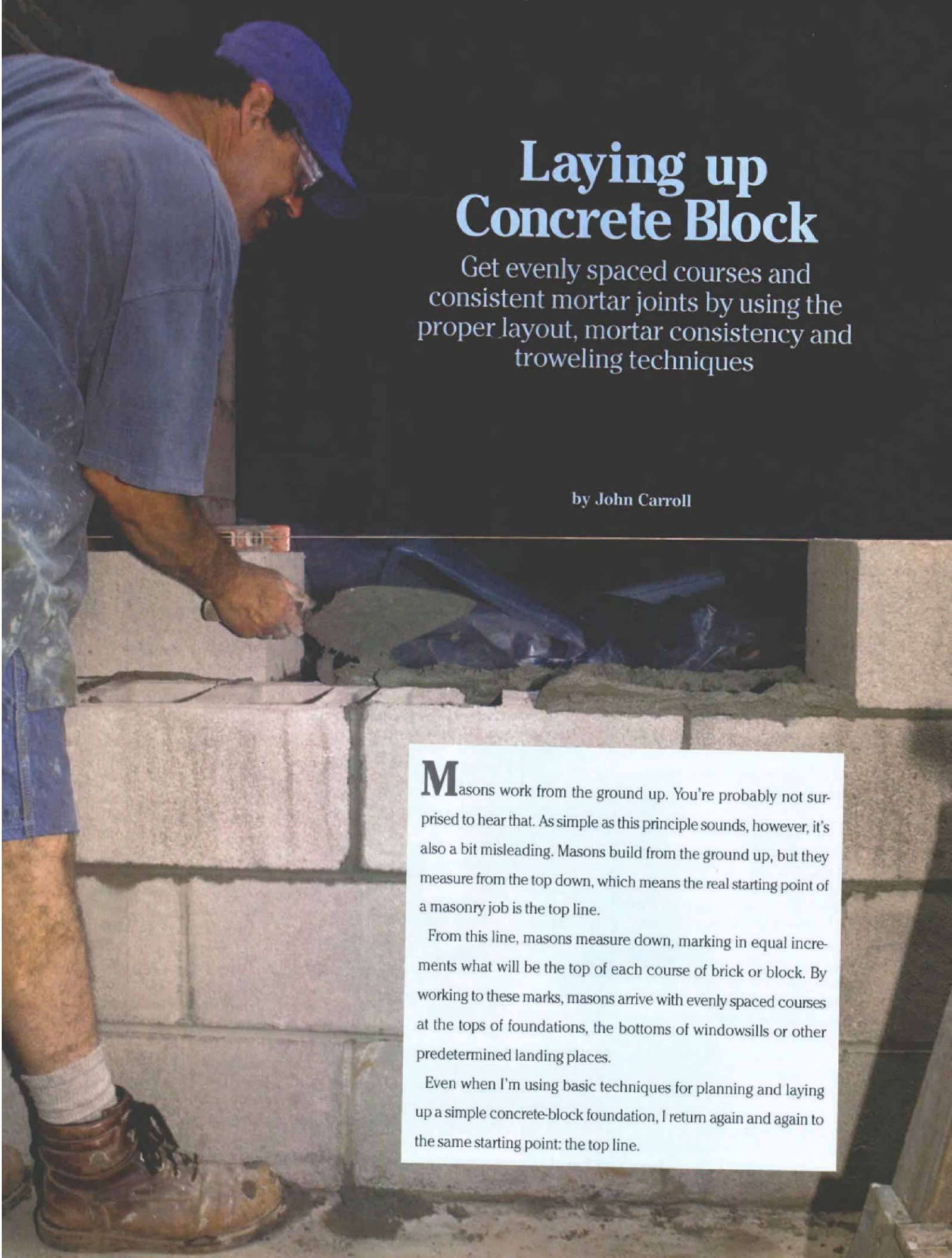


Laying up Concrete Block

Get evenly spaced courses and consistent mortar joints by using the proper layout, mortar consistency and troweling techniques

by John Carroll

Masons work from the ground up. You're probably not surprised to hear that. As simple as this principle sounds, however, it's also a bit misleading. Masons build from the ground up, but they measure from the top down, which means the real starting point of a masonry job is the top line.

From this line, masons measure down, marking in equal increments what will be the top of each course of brick or block. By working to these marks, masons arrive with evenly spaced courses at the tops of foundations, the bottoms of windowsills or other predetermined landing places.

Even when I'm using basic techniques for planning and laying up a simple concrete-block foundation, I return again and again to the same starting point: the top line.

Planning and laying out a block structure—Before any mud is slung or any blocks are buttered—indeed, before any dirt is dug or any concrete footings are poured—the finished dimensions of a block structure should be established. These dimensions are length and width—along with any variations in the basic rectangle—and exact height.

When I build a foundation, for instance, the first thing I do is see if any small dimension adjustments might allow the masonry units to fit without being cut. Say this foundation is 12 ft. by 13 ft. I try to change the 13-ft. dimension to 13 ft. 4 in. so that it works out to an even number of blocks.

Unlike the foundation for a freestanding building, where a difference of an inch or two in the final height usually isn't too important, the height of the foundation for an addition must be right on the money. To get to this point, the first thing I do is to mark the height of the existing finished floor on the outside wall of the house. For this, I set up my laser level, shoot the elevation of the floor through an open door or window, then transfer that elevation to the outside wall.

Next, I find out exactly what will be used in the addition as floor covering, subfloor, joists and sills. On the foundation project shown in this article, these included carpet and pad (¾ in.), tongue-and-groove plywood (¾ in.), 2x10 joists (9¼ in.) and 2x8 sills (1½ in.). By measuring down a total of these depths—12¼ in.—from the mark I made on the outside wall, I arrived at the correct height for the top of the foundation. Using my laser level, I made marks at this elevation at both ends of the planned addition, and I snapped a line on the house to represent the top of the new foundation.

Measure from the top down. Steel story poles at the outside corners of the block foundation are nailed to the footings, held in place with 1x4 braces and mark the corners of the foundation and the courses of block. Strings between the house and the poles mark the foundation height.

Establishing the entire top-of-foundation line—The project pictured in this article is a 16-ft. by 24-ft. foundation for an addition. Here's how it began. After I snapped a line on the house to represent the top of the foundation, I marked the beginning and end of the foundation on this chalkline, which served as a reference to lay out the rest of the foundation.

My next step was to set up a line that would represent the top of the outside foundation wall. This line had to be 16 ft. from—and parallel to—the house and at the same level as the chalkline. To hold the string, I set up a pair of batter boards. First, I drove a pair of 2x4 stakes into the ground several feet outside the corners of the planned foundation (I could judge this by eye by looking at the corner marks on the chalkline marked on the house).

I set the stakes in line, 14 ft. and 18 ft. out from the house so that they would straddle the planned 16-ft. line. After driving in the 2x4s, I used my laser level to transfer the top-of-foundation elevation, represented by the chalkline, to the stakes. Then I attached a horizontal batter board to each pair of stakes, keeping the top edge even with the top-of-foundation marks. Once the batter boards were attached, I stretched a line from one batter board to the other. To hold the line in place, I used mason's line blocks, which I could slide along the batter board. By methodically measuring and adjusting the work I was doing, I was able to get the line exactly parallel to and 16 ft. away from the house. This string represented the top outside edge of the foundation wall.

I now turned to the task of laying out the two sidewalls. These walls would run perpendicular to the house and would begin at the corners marked on the chalkline. To do this, I calculated the hypotenuse of a right triangle with sides of 16 ft. and 24 ft. This works out to 28 ft. 10⅛ in. I pulled this dimension diagonally across the planned foundation from one of the corner marks on the house to the string. Using a felt-tip pen, I marked where 28 ft. 10⅛ in. intersected the string. This dot represented the third corner of the foundation. Pulling this dimension diagonally in the other direction, I marked the fourth corner. To check my work, I measured from dot to dot along the string. Seeing that it was exactly 24 ft., I knew my layout was correct.

The basic tools for working with concrete block. To get started laying up block requires a trowel, a pointing tool, line blocks and string. Also helpful are line stretchers, left, and "twigs," shown next to the string.

After the third and fourth corners were marked on the string, I set up two more pairs of batter boards. To represent the top of each wall, I stretched a string from the corner mark on the house, through the mark on the string, to the

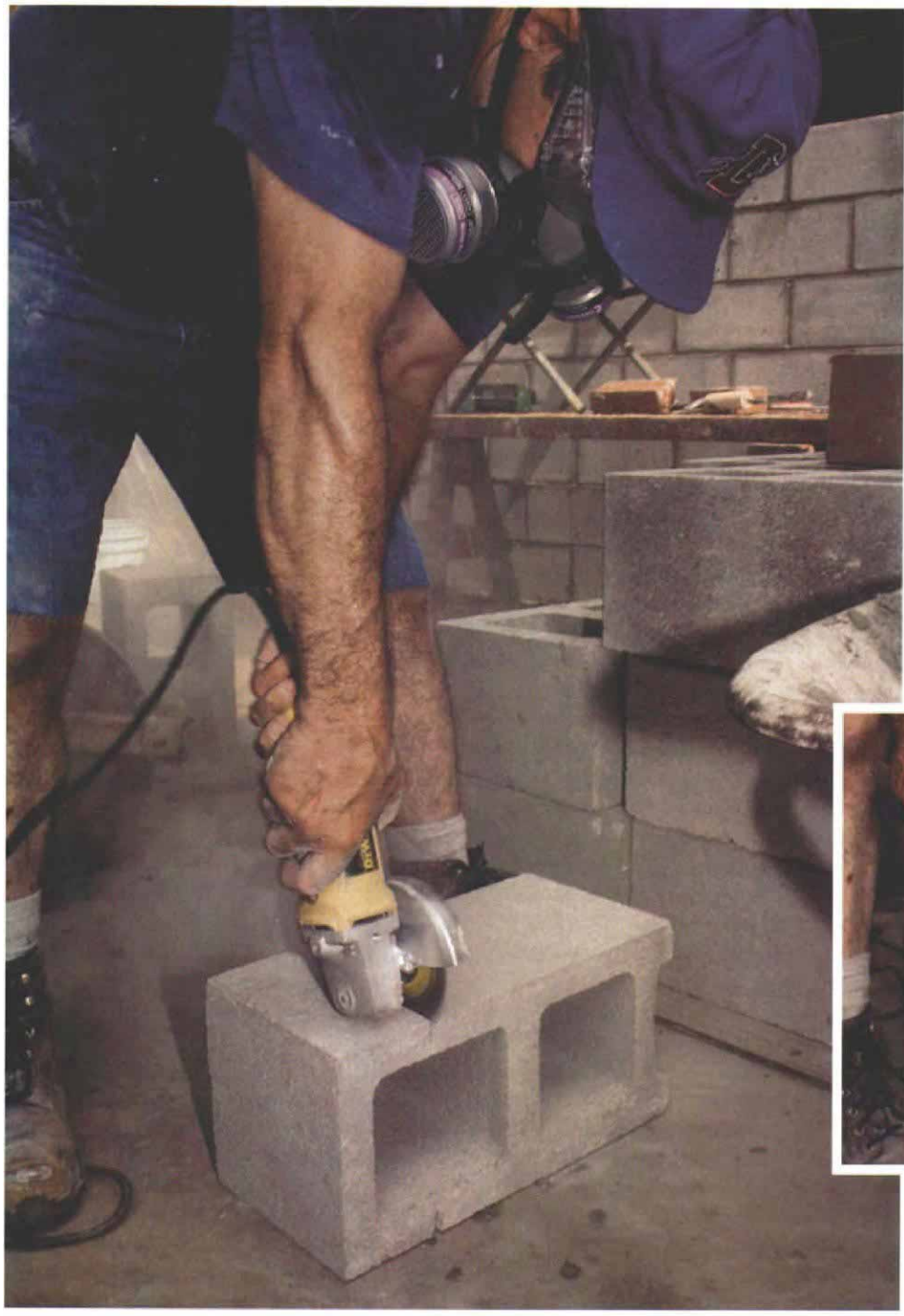
Bottom photo this page: Scott Phillips

new batter board. I now had strings outlining the top outside edge of the entire foundation.

A story pole aligns the courses and the corners—The top of the footing should be a set number of block courses below the top-of-foundation line. In the example that I'm using, the footing was exactly 80 in., or ten block courses, below the top line.

After the footings are poured, it's good to recheck the position of the top-of-foundation lines. After seeing that my top-of-foundation line hadn't moved, I dropped a plumb bob from the intersection of the lines to mark the outside corners of the block courses. At each outside corner, I attached a story pole of 2-in. tubular steel to the footing. The story poles I use have two L-shaped brackets welded to their bottoms. To attach the story poles, I nail through holes in the brackets with case-hardened, fluted masonry nails into the concrete footing. Then I set the story pole plumb, and I clamped 1x4 braces to the pole and to the batter boards (top photo, p. 59).

At the corners that engage the house, I affixed 1x4 story poles. Next, I marked down all the story poles in 8-in. increments from the top-of-foundation line and was ready to lay block.



For efficiency and looks, avoid cut blocks—Blocks are difficult and expensive to cut, and when they are cut, they can detract from the appearance of the job. So it's wise to avoid unnecessary cuts.

Cutting units lengthwise (the masonry equivalent of ripping) is referred to as splitting. Cutting units to length (the masonry equivalent of cross-cutting) is simply called cutting. Split blocks not only interrupt the orderly progression of horizontal courses—and look bad—but they're also a scourge of productivity. Not surprisingly, masons do their utmost to avoid split units. Units cut to length are a different matter. Because every house has windows, doors and corners, blocks inevitably have to be cut to length.

When I have to cut block, I avoid masonry hammers or chisels. I've never liked the ragged edges these tools leave. Instead, I use a 4-in. grinder equipped with a diamond blade (photo left). You can also use an abrasive blade in a circular saw. After cutting as far into the block as I can, I give it a good tap with a hammer, and it breaks easily (bottom photo).

Buckets are better than shovels when mixing mortar—Like all troweling tasks, block work is mainly a physical skill that takes a lot of practice. The best training is to have at it, ideally alongside an experienced mason.

The first thing a novice should learn is how to make good, consistent mortar. I've found that this cannot be done using ready-mix mortar. The material that comes already mixed with sand has poor plasticity and contains coarse sand.

For mixing mortar, you can rent electric mortar mixers for between $30 and $50 a day. However, most novices are laying block so slowly that

A grinder makes a clean cut. To avoid ragged edges in cut blocks, use a grinder equipped with a diamond blade, and give the block a tap with the hammer to get a clean split. This procedure is messy, however, so a respirator and eye protection are important.

they'd be just as well off mixing it in a wheelbarrow by hand. They're not using mortar fast enough to justify the cost of renting a machine.

Mortar is made up of portland cement mixed either with lime or any of several proprietary ingredients. One part of this mixture is combined with 2½ parts to 3 parts sand, and water is added to get the right consistency. Cement/lime mortars often come in separate bags and have to be mixed on the job. Masonry-cement mortars (those with the proprietary ingredients) come ready to be mixed with sand.

Masons often count 18 shovels of sand for every bag of mortar, but the size of a shovel is inexact. I measure the ingredients by filling a drywall bucket with dry mortar and three other drywall buckets with sand. I put all this in a mixer and add water until I get the right consistency.

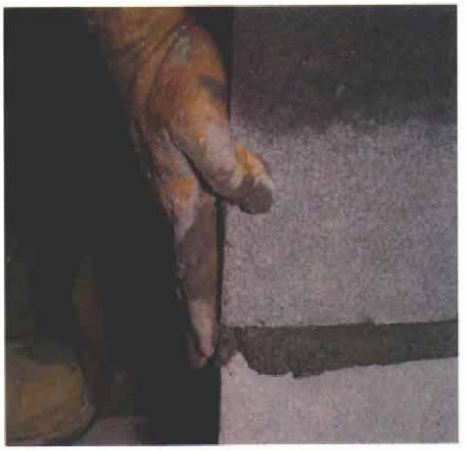
It's hard to describe the right consistency. As opposed to concrete, which should be kept as stiff as possible, mortar should be made as wet as possible, yet still be workable (photo bottom left). The primary role of mortar is to bond masonry units together. Wet mortar spread on dry units is absorbed deep into the pores and crevices of the units, producing a tenacious bond. A mixture that is too wet, however, is almost impossible to work with and makes a mess of the job. Good mortar is almost fluffy; some masons call mortar that's just right "fat mortar."

The best way to learn how to make good, wet, workable mortar is by actually making it and using it. Even perfect mortar doesn't stay that way for long. On hot days, you often have to "shake up" the mortar by mixing in a little water. Enthusiastic novices invariably mix too much mortar. The longer mortar sits, the harder it is to work. After two hours, it should be disposed of, usually into the cells of the block wall.

I try to make about an hour's worth of mortar at a time. Usually one bucket of mortar and three buckets of sand last me about an hour; however, a novice may want to start by mixing a half-batch. And before I mix the material, I make sure I have everything ready. To estimate what you'll need, figure three bags of mortar for every 100 blocks plus 9 cu. ft. of sand, or about 14 5-gal. buckets (a 5-gal. bucket is 0.668 cu. ft.).

Tap the block gently to get it plumb and level. This block was set into about an inch of mortar and gently tapped with the butt of the trowel until it was level and plumb. The layout line remains a fraction of an inch above the block to keep the string from snagging on the block.

Not too mushy and not too stiff. Mortar should be as wet as possible, yet still be workable. Mortar should have some body, but it still should be mushy.



You can feel if a block is aligned with the rest. Place the palm of your hand on the new block and your fingers across the joint between blocks to feel if the new block is even.

Consistent mortar joints testify to good work—Masons adjust the height or length of courses by altering the thickness of mortar joints. This is a basic part of masonry. It allows masons to make up for inconsistencies in the size of the units and to fit whole units into a given space (between windows, for instance). But this device is easily overused. Fat joints and abrupt changes in the thickness of joints look terrible.

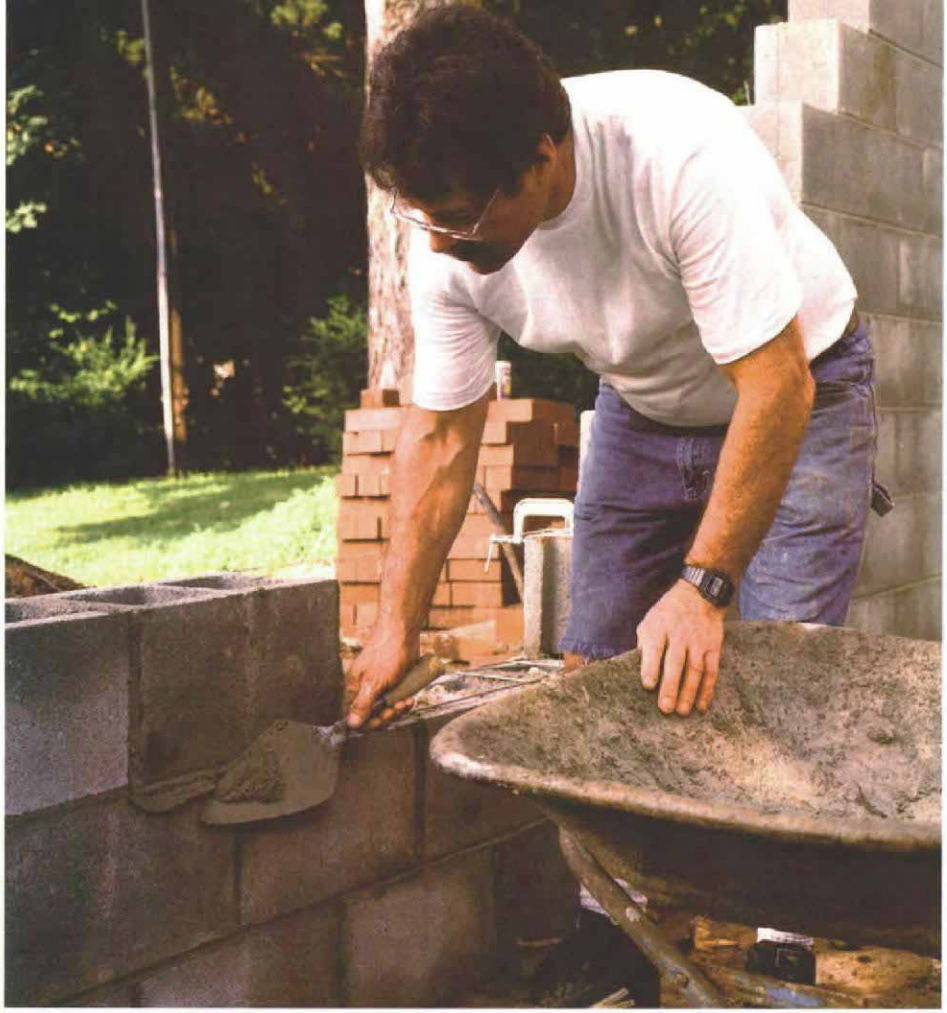
Joints that are thicker than ¾ in. can shrink excessively, which sometime results in leaky hairline cracks. And because masons tend to use a stiff mix when making thick joints, the bond is often poor, resulting in both leakage and structural compromise. For optimal appearance and performance, joints should be between 5/16 in. and ½ in. thick, and they should be as consistent as possible.

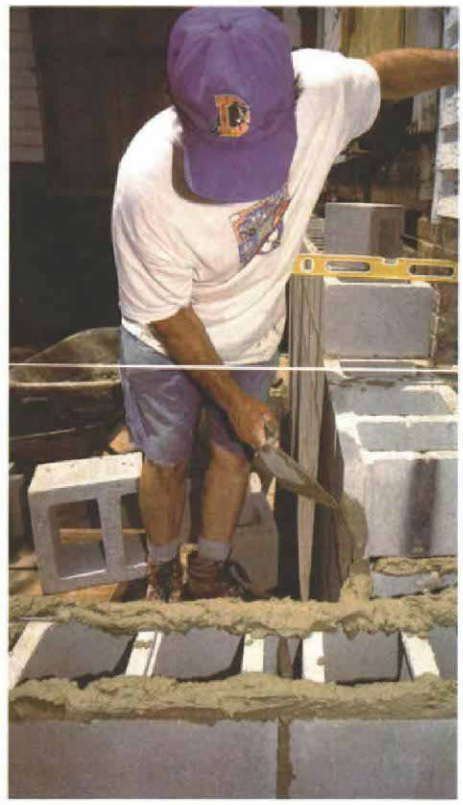
To attain evenly spaced courses with consistent mortar joints, masons lay out courses in standard modules based on the size of the block used. The height increments for concrete blocks are typically 8 in. or 4 in. Like lumber, blocks are smaller than their nominal size; an 8-in. block is actually 7⅝ in., and a 4-in. block is 3⅝ in. A block with a ⅜-in. bed joint, then, measures an even 8 in. or 4 in.

Getting started with the first course—After stretching stringlines for the first course in both directions from the corner pole, I lay my first block, a corner block. The top of this block fits snugly to the intersection formed by the strings.

After getting this block even with both strings, I start laying blocks in from the corner along one of the lines. After laying all or part of this line, I work down the other line, again working from the corner in.

After running all or part of this line, I move both lines up to the next mark on the story pole and start the second course. Like the first block I laid in the previous course, the first one here fits snugly into the intersection of the lines at the





Clean the joint of excess mortar. After a block is set in place, use the trowel to cut the mortar that has bulged out. Then give the trowel a shake and butter the end of the block with the remaining mortar.

story pole. This block, however, crosses to the corner block in the first course and thus begins the familiar bond pattern associated with most block walls.

At this point in the job, I have the option of either laying the entire length of each course or laying just far enough down the line to build up the corner. Usually, there's no need to build a corner lead. I often build entire small foundations straight off the story poles. On congested sites, however, it's often best to build the corner first so that you can get the story pole and braces out of the way as soon as possible. To set up a line for laying the rest of the wall, just hook the line block directly to the corner you've built.

The ability to set up a line quickly and securely is an important masonry skill. The two most common tools for doing this are line blocks and twigs (bottom photo, p. 59), which masonry-supply houses traditionally supply for free. To use a line block, wrap the string over and around the block a couple of times and hook it on either the outside corner of the masonry or on a corner pole.

Twigs fasten to the string, and a brick or a piece of block holds it on the top edge of the block. One of the advantages of using a twig is that the string can be pulled taut without exerting pressure on the masonry just laid. Sometimes, instead of hooking a line block on a corner I've laid, I attach the line to a stake or a block beyond the corner and use a twig to hold the line even with the top edge of the unit.

A third tool that is sometimes used to affix lines to the inside corners is the line stretcher. After the corner has been built, the string is wrapped around the line stretcher, and the stretcher is placed across the top of the first unit of the course being laid. The stretcher is held in place by tension on the line. All these tools are available from a good masonry-supply company.

While you're pulling together the tools and materials you need to get started, you should also consider lightweight block instead of standard block. Lightweight block is made with special lightweight aggregates rather than crushed stone. A standard 8-in. by 8-in. by 16-in. block weighs 32 lb. to 38 lb. A lightweight block weighs only 22 lb. to 27 lb., but it's weight that really adds up after a day of lifting. Lightweight block also costs up to 25% more than normal-weight block.

Troweling techniques: to sling or to butter—There are two techniques for spreading the bed joints, or horizontal joints, of a block wall. In the first, the mason loads his trowel, holds it above the top edge of the lower block and shakes some mortar loose from the trowel. Then, as he moves the trowel down the line toward himself, he shakes more of the mortar loose and lets it fall in a line along the block. After about a third of the mortar is laid down like this, he simultaneously turns his wrist downward and pulls the trowel quickly toward himself, slinging the rest of the mortar in a nice line on top of the block.

In the second technique, the mason loads his trowel and gives it a good shake (a hard shake makes the mortar stick to the trowel). Then, in a downward, pulling stroke, he butters the top edge of the block by sliding the trowel blade down and across the block.

There are also two methods for buttering the head joints of blocks. Some masons butter the ends of the block before they pick it up and set it in the wall. Others butter the ends of the block after they set it in the wall. Either way, you need to apply it with some oomph so that the mortar hits the surface hard and sticks.

Finally, a few words on the trowel, which is the most basic tool in masonry. For me, the size of the trowel is analogous to the size of a hammer. Some carpenters use a 24-oz. hammer, and some masons use a 13-in. trowel. A small trowel is 10½ in., and a large trowel is 13 in. My suggestion is to use whatever is most comfortable in

your hand. I use a small hammer and a small trowel because I have tendinitis. So whatever you use depends on how much weight you want to handle.

After a while, you'll get into the rhythm of working with mortar and block—Once I get going, the basic rhythm of masonry is to spread a bed of mortar an inch or so high, then gently push or tap the block until it's even with the line.

I like to keep about a 1/16-in. space between the line and the block because if the block touches the line, it can push it out (top photo, p. 61) and throw off a course. I almost always set the line up on the far side of the wall so that I don't have to lift blocks over it all day. As I set each block in the wall, I use the heel of my left hand (I'm right-handed) to feel when the top of the block is even with the preceding block (photo bottom right, p. 61). I get this corner even by feel and, looking straight down over the line, push or tap the outside of the block even with both the string and the block below it. At the same time, I push the block horizontally against the buttered ends of the preceding block until the joint size looks right.

Using the trowel in my right hand, I cut the mortar that has bulged out from the joints (photo to left, facing page) and, giving my trowel a good shake, butter the end of the block I just laid (photo right, facing page). I do any minor adjustments immediately. After blocks have set for a while, they should not be disturbed. Tapping blocks laterally after the initial set of the mortar breaks the bond and weakens the wall.

Another important consideration in block work is keeping the blocks dry. Although dry and absorbent brick sometimes needs to be dampened before it is laid, blocks should always be kept dry before they are installed. Wet blocks don't bond well and are difficult to lay, so it's prudent to cover blocks as soon as they're delivered. At the end of the day, it's also smart to cover the top of the wall, both to protect the bond of the day's work and to make sure the top course is dry when you return to lay blocks on top of it.

To finish off the wall of the foundation, I install anchor bolts at every corner and at each door and window jamb, as the local code requires. I also installed bolts at least every 6 ft. between these points. To anchor the sills, I drop broken bits of block or brick into the cores to provide support for the grout, which I make out of concrete or a portland cement-sand mix, which is stronger than mortar.

As for tooling the joints, it's necessary to wait until the mortar is thumbprint hard before tooling begins. When the joints are ready, they are usually about as stiff as putty and starting to pull away slightly from the edges of the blocks. Using a jointing tool, I tool the vertical joints first, then do the horizontal joints (top photo). Wherever the joints need a bit of mortar, I push a lump into the joint with my jointer.

There are many different jointers on the market. I own several different types. But for laying block, the S-shape jointer is a standard (bottom photo, p. 59). You don't get into much variation in jointers until you get into brickwork. The S-shape jointer has two different-size jointers, with one at each end. Use whichever end looks best. I usually use the widest one so that it doesn't cut the joint too deeply.

Sometimes, a block wall requires reinforcement—There are several ways to reinforce a unit masonry wall. The wall can be thickened by switching from 8-in. to 10-in. or 12-in. blocks. Ladder-type wire reinforcement can be added in the bed joints as the blocks are laid up (bottom photo). You can apply stucco reinforced with fibers to the outside of the wall after it's built. Or you can reinforce the wall with rebar and concrete grout (for more on block and reinforcement, see *FHB* #103, pp. 84-85).

To design a reinforced-block wall, it's best to hire a structural engineer for the project. You can also get an idea of what works in the area where you live by talking to other builders and to your local building inspector. Also, you can see what doesn't work by carefully looking in your area at foundations and retaining walls that have failed. □

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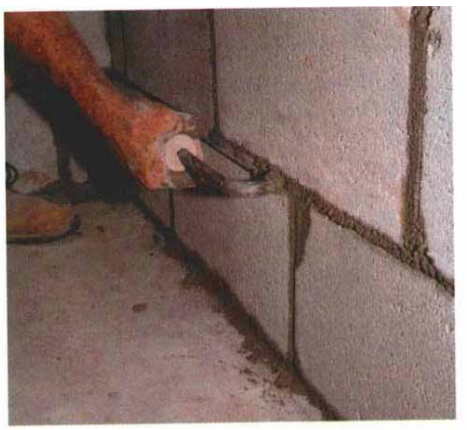

Tooling the joints for a neat look. When the mortar is as stiff as putty and beginning to pull away slightly from the edges of the blocks, it's ready for tooling.

"Ladder" reinforcement equals lateral strength. Ladder-type wire reinforcement can be added to the bed joints of a block wall as it's laid up. In this example, the ladder reinforcements were added at every other course.