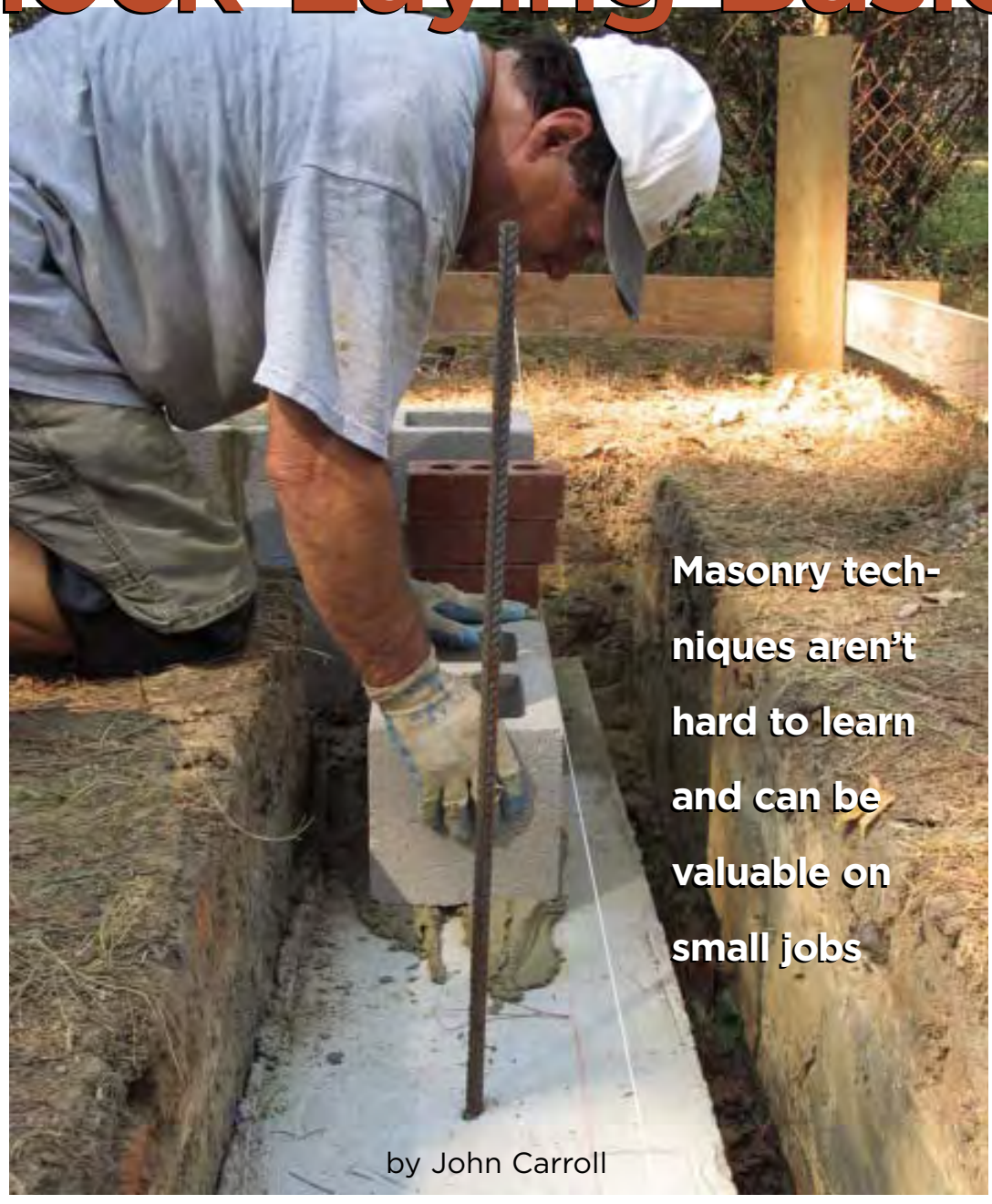
Block-Laying Basics



Masonry techniques aren't hard to learn and can be valuable on small jobs

by John Carroll

Placing a nice new home on top of a bare block foundation is like getting all dressed up for the prom and then wearing a pair of construction boots. So I like to build my foundations out of a combination of brick and block, a common method here in North Carolina.

Blocks — or CMUs (concrete masonry units) — are economical, come in different sizes, and lay up quickly, so they're used below grade. Bricks are more expensive and take longer to install, so they're saved for above-grade work, where they'll show.

While most GCs will never lay the foundation for an entire house, brick- and block-laying skills can come in handy on small jobs when it's tough to enlist a masonry contractor. In this article, I'll use a small workshop foundation that I built to illustrate

Cutting Masonry Units

One way to cut masonry is with a brick hammer and chisel, but it's an inaccurate and wasteful method that I use only for very rough work. Large, stationary masonry saws do a terrific job, but they're expensive and a hassle to move and set up. Most of the time, I use two relatively inexpensive tools that are light and portable, yet produce excellent cuts. The first is my Elmer's Midget Helper (about $400; E&R Mfg. Co., 765/279-8826, www.ermanufacturing.com), a portable brick-splitter I've owned for more than 25 years. Pulling down on its handle compresses the brick between two hardened blades; the tool works great for cutting bricks to length and for making the angled cuts needed for window sills (see photo, below).

To cleanly and accurately cut — rather than break — brick and block, I use a dry-cutting diamond blade attached to my 4½-inch grinder (blades are available to fit circular saws as well). This technique creates a lot of dust, so I use a high-quality dust mask. The 4½-inch blade cuts only about an inch deep. With brick, though, I can usually finish the cut by making another pass on the opposite side of the brick. With block, I can usually break the block cleanly along the cut by tapping it with a hammer.

This portable mechanical cutter — which weighs only 35 pounds — can be used to accurately break brick, stone, and concrete products.

some of the techniques you need to confidently lay concrete block and brick. Except for the size of the units, there's not a lot of difference between working with brick and with block.

Lay Out to Avoid Cutting

Bricks and blocks are hard to cut, so it pays to think in terms of unit sizes when laying out masonry work. Since the 1930s, masonry units have been manufactured in sizes that fit into a modular scheme based on 4 inches. So while a standard block is 7⅝ inches high by 15⅝ inches long, adding a horizontal joint below (the bed joint) and a vertical joint on one end (the head joint) brings the unit to an even 8 inches by 16 inches.

A standard modular brick measures 2¼ inches high by 7⅝ inches long. Three courses of brick with three bed joints add up to 8 inches in height, while a single brick with a head joint is 8 inches long.

Because they can be adjusted in size slightly, mortar joints provide some layout flexibility. While the ideal mortar joint is ⅜ inch wide, masons routinely shrink joints to as small as ¼ inch or stretch them to as large as ½ inch. Joints that fall outside this range are unsightly and, with a few small exceptions, prohibited by most building codes.

Masonry units can be cut to length when necessary to fit around windows and doors or to build a foundation to precise dimensions (see "Cutting Masonry Units," left). But cutting them along their length — what carpenters would call ripping — is another matter altogether. To avoid this aggravating job, masons usually begin course layout from the top, establishing a finish elevation and then measuring and marking down, in full courses, from that point.

In the small shop building shown here, for example, the reference point for the foundation was the projected top of the slab, which my client wanted a few inches above grade. Using batter boards, I set a string at this elevation for reference, then dug and poured the reinforced footing so that the top surface of the concrete would end up two full block courses and two full brick courses down from the string (see Figure 1, page 3).

Choosing the Right Mortar

Probably nothing is more confusing to the lay mason than mortar mixes. And it's not hard to see why: There are three different kinds of mortar available for brick- and block-work: cement-lime mortar, masonry cement mortar, and the awkwardly named mortar cement mortar.

Although they look pretty much the same, these are distinctly different products. Each can be made into four types of mortar, designated by the letters M, S, N, and O (taken from the

Block Dimensions Guide the Footing Layout

Figure 1. Batter boards and string guide the footing layout. Here, top of slab determines top of footing (A), positioned to allow for two courses of block and two courses of brick. Strings set at the exact center of the wall guide the placement of vertical rebar, every 40 inches, in the wet footing (B). After the footing sets, new strings placed along the outside edge of the wall guide the location of the corners, which the author transfers with a laser (C). Careful layout pays off when the block is laid and the reinforcing is centered in the cores (D).

Estimating Masonry Materials

I begin each project by carefully estimating the square footage that will be built and adding in a factor of about 12 percent for cuts and waste. Next, I calculate the number of units needed based on the padded square-footage calculation, then determine the amount of mortar needed based on the number of units. Finally, I calculate the amount of sand I need based on the number of bags of mortar. I use the following formulas for my calculations.

Units

- 1.125 8x16 concrete blocks are needed for each square foot of wall area
- 6.75 standard modular bricks are needed for each square foot of wall area

Mortar

- One 80-pound bag of masonry cement, mixed 1-3 with mason's sand, lays 35 8x16 blocks
- One 80-pound bag of masonry cement, mixed 1-3 with mason's sand, lays 135 standard modular bricks

Sand

- 3 cubic feet of sand are needed for each bag of masonry cement
- 1 cubic yard of sand is needed for every nine bags of masonry cement
- 4.5 5-gallon buckets of sand = 3 cubic feet, the amount needed for each bag of masonry cement

word "masonry"). The letters indicate each type's tested compressive strength, which is achieved by adding or reducing the percentage of portland cement in the mix. Type M mortar, for example, has the highest percentage of portland cement and the highest compressive strength, but for many applications it's not the best choice.

Masonry cement mortar is the best overall choice for beginner masons. It's inexpensive, easy to use, and the first choice for most residential masonry contractors. While cement-lime mortar and mortar cement mortar are frequently specified for large commercial projects, they are rarely necessary for residential work.

Generally speaking, Types M and S are used for foundations, for work under and in contact with the ground, and for flat work. Type N is a general-purpose mortar that can be used for loadbearing walls and exterior surfaces. It is usually recommended for vertical work above grade, such as brick veneer and chimneys. Type O is usually reserved for nonbearing walls not subjected to freezing temperatures. Because of local differences in climates, soils, and so forth, local codes concerning mortar requirements differ.

For the foundation shown here, I used Type S masonry cement mortar for both the block and the brick. This kind of mortar is required in my area for foundations and any work below grade.

Mixing Mortar

Because premixed mortars are expensive, somewhat hard to work with, and sometimes of suspect quality, I recommend buying mason's sand and mixing it with masonry cement on site, even for very small jobs. You can get mason's sand at just about any masonry supply house and most building supply stores. It's usually sold in very small quantities; my supplier sells it by the shovelful, the 5-gallon bucket, and the cubic yard (see "Estimating Masonry Materials," left).

While some masonry crews mix mortar by the bag (a common recipe is to add 18 shovelfuls of sand for each 80-pound bag of masonry cement), I think that this method is inexact and makes too much mortar. A better way of mixing perfect mortar in manageable batches is to measure the sand and the masonry cement in buckets.

The recommended proportions are 1 part masonry cement to 2½ to 3 parts sand. To make a fairly large batch of Type S mortar, therefore, I just fill up one 5-gallon bucket with Type S masonry cement and three equal-sized buckets with sand. I mix these together and add water until the proper consistency is reached to make correctly proportioned mortar that

Troweling Tips

Figure 2. To efficiently spread bed-joint mortar, the author brings his loaded trowel to the footing, gives the trowel a little downward motion, then stops abruptly (A). Next he quickly rotates his wrist while pulling the trowel back, leaving a uniform line of mortar (B). When buttering bricks or blocks, he picks up about half a trowelful of mortar (C), then gives it a good hard shake by thrusting it down and pulling it back up sharply. This flattens the mortar against the trowel (D) so that it will stay put when the trowel is turned over (E).

Laying the First Block Course

Figure 3. Block courses start at the corners; a string stretched between the two corner blocks helps align the remaining blocks in the course, while pencil marks placed 16 inches on-center on the footing help the author space the blocks properly (A). When setting the last block in the course, he orients it so that the flanged end is dry, which creates a bigger opening that's easier to fill with mortar (B). After setting the block, he throws mud in the joint until it's full (C), then uses a 3/4-inch tuck-pointer to pack the joint (D).

Building Brick Corner Leads

Figure 4. The author uses the edge of his trowel to quickly align the brick that he's laying with the one below (A), then uses a level to make sure the corner is plumb (B). When the mortar has had time to set up, he uses line blocks to hold strings (C). Because string tension can pop a freshly laid brick right out of the mortar, he sometimes runs the strings long and uses line twigs as guides (D).

remains consistent from batch to batch.

To make a midsized batch, I fill up two 1-gallon buckets with masonry cement and one 5-gallon bucket plus one 1-gallon bucket with sand. To make a small batch, I fill up one 1-gallon bucket with masonry cement and three 1-gallon buckets with sand. This basic 1-to-3 ratio of sand to cementitious materials (the combination of portland cement, lime, and other additives that are used to make the various mortars) is the same for most mortars.

Because the moisture content of sand varies, so does the amount of water that must be added to the mixture to get it right. Basically, the mortar should be as wet as possible and still be workable. Wet mortar is sucked up into the pores of the units and, in the finished wall, forms a tenacious bond. However, mortar that is too wet is just about impossible to work with and makes a mess of the finished wall. And mortar that is too dry does not bond well with the units.

Trowel Techniques

Good, workable mortar is soft and mushy but not soupy. If you're mixing it with a mechanical mixer, it should flow through and around the paddles in thick globs, leaving noticeable voids in each paddle's wake; if you're mixing it with a mortar hoe, it should pass easily through the holes in the blade, forming cylindrical-shaped

Finishing Up a Brick Course

Figure 5. After centering the final "closure" brick in the course (A), the author removes the string line and throws mud down the unmortared joint (B), packs it full with a 3/8-inch tuck-pointer so that the head joint is completely filled (C), then cleans up the front of the joint (D).

columns of mortar as it does. Workable mortar can be loaded up on a trowel without flowing off the sides yet yields readily when a brick is pushed into it.

There are two main troweling skills: spreading bed-joint mortar efficiently and buttering (in other words, getting the mortar to stick to vertical and inclined surfaces). With bed joints, the object is to bring as much mud to the wall as possible without dropping it en route. So you first scoop up a full but manageable trowelful of mortar and bring the loaded trowel a few inches above and in line with the units you're covering (Figure 2, page 5). Then you drop your arm, rotate your wrist, and pull the trowel toward your elbow. With practice, these steps become one fluid motion that leaves a nice line of mortar on the tops of brick or the face shells of blocks.

When buttering, the trick is to keep the mortar from sliding off the trowel. Begin by picking up about half a trowelful of mortar. Hold the trowel so the mortar is facing up, then give the trowel a good hard shake by thrusting it down and pulling it back up sharply. This motion — which flattens the mortar against the trowel so that it stays put when you turn the trowel over — comes in handy when you need to do things like butter the ends of bricks and blocks, apply mortar to the top edges of hollow blocks, or butter the edges of bricks laid in a rowlock pattern.

Work From the Corners

Whenever possible, I design a foundation so that each course can be built with full blocks. Before laying any block, I lay the corner blocks, then snap lines from corner to corner. To maintain accurate spacing while laying the block, I mark 16-inch centers along the chalk lines (Figure 3, page 6). This helps keep the mortar joints consistently sized and ensures that the last block in each course will fit into place.

I work from inside the wall, with all of my tools and materials set up within the footing perimeter so that I don't have to reach over the string lines. I set my first pair of corner blocks in mortar, aligning their bases with the chalk line and using a spirit level to keep the blocks plumb. Stretched between each pair of corner blocks, a string line helps align the remaining blocks in the course. To set the line, I attach it to a pair of line blocks and hook the line blocks over the corner leads. Tension, created by pulling the line taut, holds the line blocks in place.

As I set in place each of the remaining blocks in the first course, I align its bottom with the chalk line, its top with the mason's line, and its end with the pencil mark on the concrete. Buttering the ends of both the block I'm laying and the last block laid helps ensure that the mortar joints are fully packed. Orienting the last block in the course so that a flanged end is at

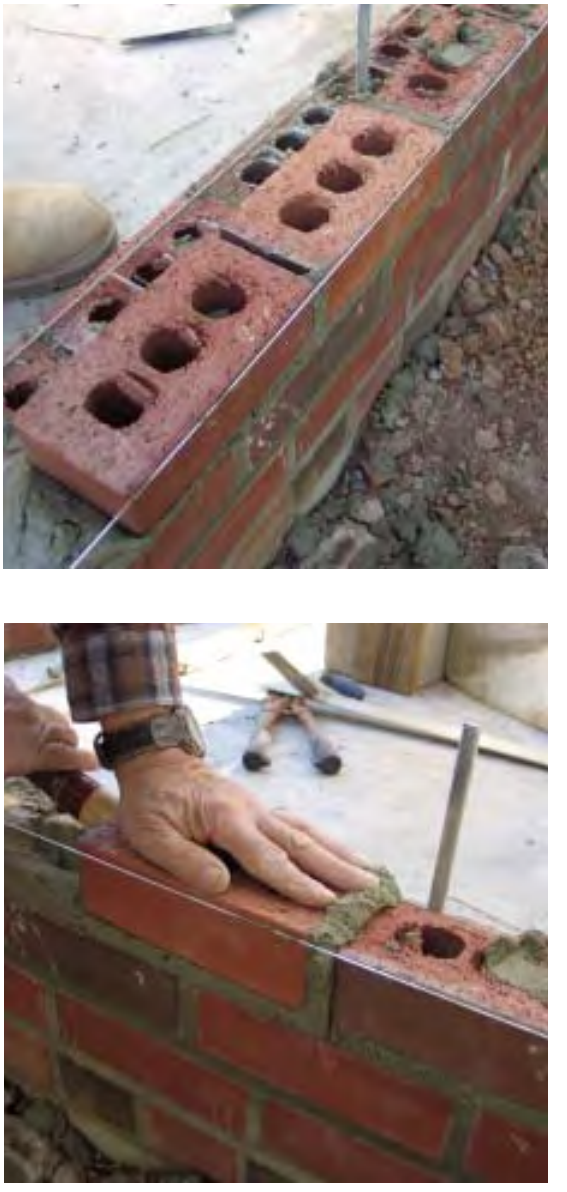


Figure 6. Though partially filled head joints (top) are all too commonly seen in the field, head joints should be completely packed with mortar to prevent water intrusion (above). The author butters the end of each brick before setting it, then taps the brick with his trowel to compress the mortar and align the brick with his layout marks, which are marked on the course below.

the last unfilled joint creates a bigger opening that's easier to fill with mortar.

I lay the second course of block the same way, setting the corners first and then setting up string lines. When I set these blocks, the block end needs to be half of a mortar joint (about 1/4 inch) shy of the center of the web of the block below for proper alignment.

Figure 7. To hold down the treated mudsill, the author installs L-shaped anchor bolts, cutting the bricks to fit around the bolts and filling any voids with mortar.

Figure 8. Synthetic steel wool works well for cleaning smooth-faced brick. The author scrubs carefully with a dry pad while the joints are still soft, then gives a more aggressive cleaning the following day with water.

Brick Tricks

When building with brick, it's easy to correct for out-of-level conditions by making the mortar joints slightly thicker or thinner as the corner leads are built (Figure 4, p. 7). Because the corners establish the elevation for the remaining bricks in each course and the final building dimensions, I'm careful to continually check that each one is plumb and at the right elevation as I lay up the walls.

To help space brickwork evenly, I always take the time to lay out each course, making marks with a pencil directly on the course below (Figure 5, page 8). This ensures that the final "closure" brick in each course fits perfectly.

When setting brick, it's important to completely fill head joints with mortar to prevent water from penetrating the wall. To do this, I'm careful to fully butter each brick before setting it, rather than partially buttering the last brick laid and setting the brick dry. When I set each brick, I push it into place so that mortar starts to squeeze out of the head joint (Figure 6, page 9).

Had this wall been taller, I would have needed to use additional steel to laterally reinforce the brickwork. But the only extra steel needed here was the 10-inch L-shaped anchor bolts for attaching the mudsill (Figure 7). I typically install the anchors as I lay up the final three courses of brick, cutting the bricks around the bolts where necessary and completely packing the space surrounding each bolt with mortar. Because three courses of standard bricks equals 8 inches, 2 inches of each bolt remain above the finished foundation for attaching the sill.

Keep It Clean

It's no fun removing dry mortar from brick, so I try to work as cleanly as I can. When cutting excess mortar from head and bed joints with my trowel, I turn the blade slightly outward, which reduces the amount of mortar that smudges the face of the brickwork. After the mortar has begun to dry in the section of wall that I'm working on, I dress the joints with a 7/8-inch concave jointer, which compresses the mortar and makes the joints look neat.

Later, if I'm working with smooth-faced brick, I'll carefully clean it off with a dry Norton synthetic steel-wool pad while the joints are still soft (Figure 8). The next day, I'll use a nylon pad and water to give the brick a more aggressive cleaning.

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