

Guidelines for Laying Stone Walls

Master the basics and gravity will do the rest

by Joseph Kenlan

When I assess the quality of a stone wall, I look not at the stones, but at the spaces between them. That's where the knowledge and the craftsmanship of the mason is revealed. By reading the joints, I can tell how tightly the wall is tied together and how well the stones fit.

Dry-laid stone is perhaps the oldest form of building. Fieldstones stacked and shimmed together created rough walls long before recorded history. But because there is no mortar in dry-laid work, it has the disadvantage of being permeable by air and moisture. That's why its use is usually limited to retaining walls, where the passage of water is necessary, or to simple foundations where ventilation is desirable.

Dry-stack construction is nearly as old as dry-laid work. Mortar is used in dry-stack work, but it isn't visible. The mortar is trowelled in behind the stones, filling the voids between them. Dry-stack walls are laid stone-on-stone, like dry-laid walls. But because they're less permeable by air and moisture, they're the better choice for house walls and chimneys.

In my area, dry-stack chimneys built stone-on-stone and backed with clay mortar have stood for over two-hundred years. Although it's arguable that today's stronger portland-cement mortars make this meticulous fitting unnecessary, I prefer to build the old way. To Steve Magers, the mason who taught me stone, the only law of masonry is gravity. Gravity always prevails, so it's best to learn how to cooperate with it. Whether you're building a dry-laid or a dry-stacked wall, a garden wall or a chimney, the same basic guidelines apply.

The footings—Though it isn't always possible, my helpers and I like to provide a footing under every stone wall or chimney we build. A lot of the repairs we've done would have been unnecessary had there been footings in the first place. Footings distribute the weight of the stone and provide protection against frost heave. The footing must sit on solid, compacted earth below the frost line. It should be at least twice as wide as the wall it is going to carry. In most cases, local building codes spell out the depth and dimensions of the footings.

Sometimes, dry-laid stone footings are used for retaining walls instead of concrete. They should have broad, flat stones at the base to spread the weight evenly. In this type of footing, we usually lay 1 in. to 2 in. of crushed

stone under the first course and below the frost line to help it drain.

String lines and story poles—When the footing is complete, the use of string lines or story poles will help keep the stone courses straight. For walls, two methods are commonly used. Batter boards are the preferred method for foundations and low walls (top photo, facing page). A line strung between them is

used to indicate both the face of the wall and its top edge. By sighting between the line and a chalk line snapped directly on the footing (or the first course), you can keep the walls plumb without the constant use of a level.

For taller walls, story poles can be set up at each corner of the wall. They should be carefully plumbed and braced (bottom right photo, facing page). The poles serve as vertical sight lines. Strings can be pulled between them to

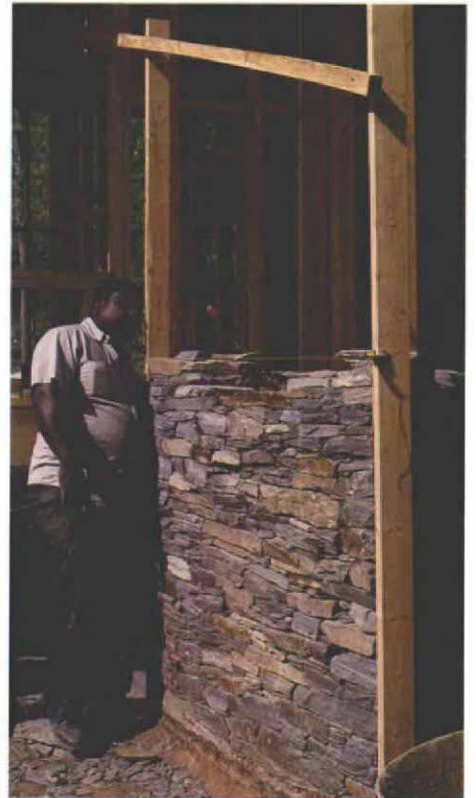
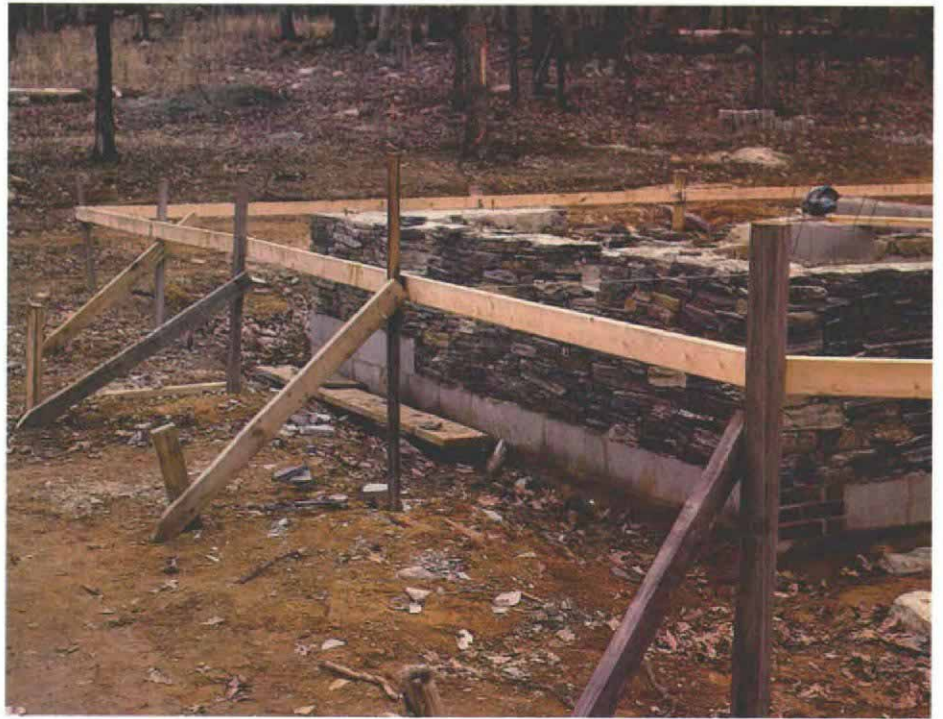


indicate the top of the wall or any other horizontal detail, such as a window opening. If there's framing above the work, two plumb lines suspended from it can also serve as vertical sight lines.

Hold the stone about $\frac{1}{8}$ in. back from the strings to keep from pushing them out of alignment. Check the strings periodically to make sure they're straight and taut.

Examining the stone—Once the stone is on the site, you can begin to sort through it. Pick out the "specials" and store these in separate piles. For example, stones that have a true 90° angle and are of sufficient size should be set aside for use as cornerstones. It isn't necessary to go through the whole pile at this point. Specials can be set aside during the regular course of the work.

While going through the pile, examine the stone carefully. Most stone has a definite structure. The direction in which the stone splits the easiest is called the *rift* and reflects the way the stone was formed. The rift is very pronounced in slates and many sedimentary



A successful stonework style is as much a process of cooperating with stone as in executing a preconceived plan. Here (photo left), the use of sandstone makes the complex pattern-work possible. Gravity keeps the carefully bedded stone in place. Batter boards (photo top) are used for foundations and low walls. Lines are strung between them and they indicate both the top edge and the face of the wall. For taller walls (photo above), story poles are placed at each corner of the wall and are carefully plumbed and braced. Strings pulled between them indicate horizontal details such as window openings and the top of the wall. The story poles also serve as vertical sight lines. Here, a helper is sighting across the poles.

Quick tips for stonelaying

- Because a stone is more complicated to fit when it's bounded on both sides, it helps to lay the corner stones in a wall first and work toward the middle. That way, there's just one "closure" stone in each course.

- The height of a corner stone is its least important dimension. Resist the temptation to stand a stone on edge to get the maximum "corner" out of it.

- Ideally, the sides of a stone should be roughly perpendicular to the exposed face (or faces). Theoretically, when you look squarely at the face of a stone, no part of the adjacent sides should be visible. In practice, however, you will find that some deviation from this rule is acceptable. More important, the top and base of the stone should be nearly perpendicular to the face. The top should never slope toward the outside face of the work because this will encourage stones laid above it to slide out of the wall.

- A good rule of thumb is that you should be able to stand on a stone right after it's placed. If it rocks, either shim it with a stone chip or trim off the high spots. You can see the high spots by looking under the stone. The shadows between the stones indicate the places that need trimming.

- When laying stone, always try to anticipate problems you may be creating for yourself later on. In a sense, you must see the spaces you are creating as well as the stones you are laying. Once you have located a potential fit, try it in the wall to make sure it will do what you want.

- Each stone should fit snugly against the one next to it. The tops of adjacent stones should be exactly the same height. That way, you can span, or face bond, the joint with a stone in the succeeding course. If

the tops aren't even, leave one stone at least an inch or so higher than the other. That way, a stone can be inserted above the short one to make the tops flush. Virtually every stone in the wall should be bonded. The easiest way to see this bonding pattern is to look at both the face and the corners of a brick building. The regularity of the bricks makes the bond apparent.

- It's important that two stones not meet on a rising joint, with the stones inclining upward towards the place where they meet. Bonding such a joint is extremely difficult, and the joint creates a wedge that can snap a stone above it.

- Often you'll be left with a narrow space between two stones which otherwise fit well. Fill this gap with a thin stone but on the next course, treat this stone as if it were a joint. The stone above must span it completely.

- Rarely will a stone fit without trimming. If the stone needs trimming, mark it in place on the wall (photos below). I use a blue lumber crayon to mark light-colored stone or a piece of soapstone to mark darker stone. Then take the stone off the wall and set it on the banker or on the ground to trim it. Don't trim the stone while it's still on the wall because you can dislodge stones nearby and disturb the bond between stones and mortar. After the main trimming is done, take the stone back to the wall for a final fitting. If the stone was bedded in mortar before trimming, make sure to reset it with new mortar. Be sure to use eye protection when trimming stone.

- Thick walls require internal bonding, or header bonding to tie the opposite faces together. At least 20% of the stones on each side should extend deep into the wall at

regular intervals. It's best if the stones extend completely through the wall, but they may not be available. In that case, use stones that extend well into the wall, leaving enough space on the other face to lay a stable stone. On the next course, lay similar stones from the opposite face so that the tails overlap. You may also lay stones tail to tail at the same level and then lay a stone above them in the middle of the wall to tie them together.

- Sometimes it's desirable to use a shiner—a stone that doesn't project far into the wall. For example, shiners are used where the depth of the stone is limited by a pipe or other obstacle in the wall, or where a particular stone fits in well with the wall pattern. Be sure when using shiners that the surrounding stones tie well back into the wall. Avoid using too many shiners. An abundance of shiners and shims in a wall is one of the surest signs of a poor mason.

- You will occasionally come to places where nothing seems to fit. If you are stuck in one spot for a long time, move to another place and come back to that spot later.

Be careful of fingers when moving large stones. I often place sticks under a stone while setting it in order to allow room for my fingers. Then I pry up the stone and remove the sticks.

- Prepare for the final course before you actually get there so that you can top out with stones of substantial height. Use large stones and cut them down to meet the line.

In areas where thin stones are abundant, masons sometimes save the biggest cornerstones for the top and stand thin stones on edge between them—like books on a shelf—to bind the top of the wall.

~J. K.



When you need to trim a stone, first mark it in place with a lumber crayon or a piece of soapstone (photo left). Then remove it from the wall and set it on the banker or on the ground for trimming. Reposition the stone on the wall, taking care not to jar the adjacent stones out of position. The top should finish out flush with that of the adjacent stone so the joint between them can be bonded (photo right). Make sure you reset the stone with new mortar if the stone was set in mortar before trimming.

rocks, but is not so obvious in some igneous stone such as diabase or basalt, or in some metamorphic stone such as quartzite. Stone should be laid with the rift aligned horizontally, when possible. This positions the strongest part of the stone in the horizontal plane and prevents the delamination that is seen with carelessly laid sandstone and limestone. When the rift isn't obvious, you can usually find it by breaking a stone with a hammer or pitching chisel (more on these tools later). By splitting just one or two stones, you can usually determine the rift of the whole pile. Our general rule of thumb regarding the rift is that the more pronounced the rift is in the stone, the more important it is to orient it properly in the wall.

The grain is the second easiest direction to cut the stone. It runs roughly perpendicular to the plane of the rift, although in some stones it runs diagonally instead. The face of a stone (the visible side of a stone once it's in a wall) has typically been formed by a split along the grain. When working stone, try to plan your cuts to take advantage of the rift and grain. If you plan your work to go along with the stone's inclinations, you'll save a lot of effort.

Occasionally we run across freestone, which works equally well in all directions. This has its advantages, but it also makes it tough to distinguish between the rift and the grain. Since the rift represents the optimal bedding plane of a stone in a wall, you'll want to be careful to orient the freestone properly, or it could weather excessively. We also run across stone that doesn't work well in any direction. It can be laid with little regard to bedding planes. Examining the stone pile will also tell if there are obvious flaws and cracks to watch out for; a visual and hammer inspection is helpful here. Unless it's sandstone or other soft stone, a flawless stone will have a characteristic ring when struck with a hammer. A cracked stone will give off a dull thud.

Stone that has been exposed for long periods of time will often deteriorate to the point where it is no longer suitable for use. Cracking and crumbling are the primary indicators of this problem. Be careful when reusing stone from houses that have burned down. The heat from a fire will often crack and weaken the stone.

We also run across stone that has been quarried with explosives. This stone is more likely to have internal cracks than most stone and should also be checked with a hammer for soundness.

A visual inspection can also suggest ideas on how to lay up the stone. Certain types of stone naturally lend themselves to particular styles and patterns. Slates and strongly layered sedimentary stones, for example, are best laid on long horizontal lines. Freestone, or stone that presents larger, more vertical faces, allows the mason more latitude in design. A successful style is as much a process of cooperating with the stone as in executing a preconceived plan (photo, pp. 54-55).



If you are doing a lot of cutting, a banker will make it easier. The one shown above is built from plywood sandwiched between a pair of 2x2 frames and filled with sand on top. The principal tools for working stone on a banker are, left to right, a 3-lb. sledge (two styles are pictured here), a point, a flat chisel, a pitching chisel and a tracer. The cutting tools in the photo have heavy-duty carbide tips.

Tools of the trade—On small jobs, it's convenient to do your stone cutting right at the base of the wall. If you're doing a lot of cutting, a banker will make the work easier. This is simply a strong table on which to work the stone. A barrel or tree stump and a sand bag will serve in a pinch. The sand bag acts as a cushion for the stone to prevent it from sliding while you're working on it. We usually make a simple portable banker by sandwiching a piece of plywood between a pair of 2x2 frames. We set this on a stack of cinder blocks and fill it with sand (photo above).

Experience will determine the most comfortable working height for you. I prefer a banker about 6 in. below my waist for general work and a little higher for fine work. This allows me to swing the hammer downward, letting the weight of the hammer head do the work, not my arm.

The principal tools for cutting stone are a 2-lb. to 3-lb. sledge hammer used with either a pitching chisel, a flat chisel, a point or a tracer (photo above). I recommend using a hammer with a short wooden handle. Hold the hammer near the head for light work and slide your hand down the handle for heavier hitting. You'll find that a stone can be hit only a certain number of times before it breaks badly. Try to do as much work as possible with each blow of the hammer.

The pitching chisel, or set, is a wide blunt chisel used for blocking out the edges of a stone. It's driven at a right angle to the stone and, when struck hard, it quickly removes large pieces in a short time.

The flat chisel, or cold chisel, is used to clean up the rest of the stone, providing there's an indentation in the stone on which to seat the tip of the chisel. To remove large flakes, the chisel is driven hard at about a 30° to 60° angle. When used to smooth the edges or for fine final trimming, the chisel is struck lightly.

If there isn't a good seat for the flat chisel, a point is used instead. The point, which is held at nearly 90° to the stone, is also useful for smoothing out nobs and high spots. Some masons use a point almost to the ex-

clusion of the flat chisel for cleaning up stone. The choice is based largely on the type of stone the mason works. Points are the better choice for working hard stone. The point can also be used to put a decorative finish on the face, but this is time-consuming and is rarely done these days.

Flats and points should be kept sharp (I sharpen mine on a grinding wheel). When using a flat chisel or a point, angle the tip away from the face of the stone. Driving a chisel toward the face will break out sections of stone you want to keep.

The tracer is used like a brickmason's set to score and break a stone along a straight line. It is usually held perpendicular to the line and is struck sharply. On large stones, mark out the line with the tracer and finish the cut with the pitching tool or stone mason's hammer.

You may also want to add a thin-bladed mason's chisel to your collection. It's handy for splitting layered types of stone such as flagstone (see *FHB* #40, p. 49). A toothed chisel is useful for putting a decorative finish on softer stones such as sandstone.

For most work, hardware-store cold chisels and points are satisfactory. They usually cost under \$10 apiece. Several tool companies carry carbide-tipped tools for continuous cutting in hard stone. These cost \$35 and up, but hold up well enough to make them worth the price.

For light trimming, you'll also need a small hammer such as a brick hammer. I use a welder's scaling hammer for this purpose. It has two blade faces set at right angles to each other.

Stonemason's hammers come in two principal styles, which I call *American* and *European*. The American-style hammer, or walling hammer, has its roots in early America. The hammer resembles a large, blunt hatchet with a hammer face and ranges in weight from 3 lb. to 16 lb. The hammer face is used primarily to trim away large pieces of waste from a stone. If you need to break the stone along a straight line, use the blade as you would a tracer to score the line first.

The European-style hammer has a point instead of a blade, and its hammer face is smaller and more square than the American version. The point is used like a chisel point for cleaning up stone. A less commonly used style, called a *side hammer*, has two squared faces, sometimes with a carbide inset. The squared edges are used like a pitching chisel. *Bull sets* and *rifters* are heavy hammers shaped like a wood-splitting maul. They are held against the stone and struck with a sledge hammer. Think of bull sets as large pitching tools and rifters as large tracers.

For very large splitting, drills and wedges are commonly used, but this applies more to the actual quarrying of stone than to stone masonry (see *FHB* #35, pp. 35-37). □

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