Repairing Old Stonework

With the materials already delivered and paid for, why not use them?

by Stephen Kennedy

At first glance, a lot of old stone buildings and foundations look like ruins ready for bulldozing. But much of the work that went into those structures was in gathering the stones and bringing them to the site. In the case of the pre-Civil War barn foundation pictured below, we're talking about 135 tons of carefully selected fieldstone, some of which is rough dressed with hammer and chisel. That's an incredible head start, even if all the stones need to be relaid. And luckily, three-quarters of the stones in this foundation were still in the right position, needing only to be repointed.

The major problems were created by the rotting of the wooden lintels over the windows, which caused the stone above to collapse. Making matters worse, the top-plate timbers had decayed so thoroughly that the resulting humus supported vegetation whose roots had damaged the top course of stones.

The relaying and repointing that we did on this foundation is fairly typical of stonework repair, and seems a good occasion to note some guidelines for such work.

Bed first, point later—There are several reasons to bed stones and point the wall as separate procedures. For one, you never have to work above the finished project—you build first, then point your way down the wall without leaving a mess. By laying up and pointing down, you also avoid shocking the finished joint with big stones being set above. It is much less crucial when the bedding mud gets jarred and cracked from new work.

Color photo: Will Lane

The wooden lintels over the windows of this pre-Civil War barn foundation had rotted (below), causing the stonework to collapse. Though it looked like a ruin, most of the stones needed only repointing. With new lintels and all the joints neatly packed with fresh mortar (above), the foundation once again supports a structure.

If you take this approach, you can use different mixes for bedding mortar and pointing mortar. This will allow you to fine-tune each mix for the different jobs each has to do. Another advantage of a separate bedding mix is that variables in the weather are less likely to halt production. If you go strictly by the masonry books, only about three days a year here in Pennsylvania are fit for laying stones. It's either too hot or too cold, or there's a chance of frost or rain. With the separate bedding approach, you can work through the bad weather, and try to do the pointing during the few good days.

Weaker is better—The bedding mix in a stone masonry wall needn't be very sticky or have much compressive strength. A typical cubic foot of stonework weighs around 144 lb. and exerts a force of one pound per square inch (psi) on the mortar below it. At the bottom of an 8-ft. wall, the force increases to 8 psi. A two-story building on top of the wall might only double the weight. There is simply no advantage in using a mortar mix that will support thousands of pounds per square inch when all you need is 100 psi at the most. There's no sense wasting portland cement where it isn't needed. In fact,

there are disadvantages in using bedding mortar that is too strong.

Excessively strong bedding mortars (high in portland cement) contract on setting, causing cracks that open passageways for water. Also, a mortar that is nearly as hard as the stone will not cushion the stones from movement due to settling or to expansion and contraction. The walls that last longest do so because they can handle a certain amount of motion. When it is stressed, the mortar will give, sparing the stone.

Weak mortars (low in portland cement) allow the passage of water vapor and accommodate changes in humidity in a wall. Waterproof masonry coatings, which prevent the passage of water vapor, can cause spalling on the surface of walls. Water needs to be kept out, but a good pointing job will do that. Water vapor should flow more freely. More significantly, mortar high in lime can react with water and carbon dioxide in the atmosphere and seal its own fissures. The longest-lasting mortar joints have no portland cement in them.

Masonry manuals abound in contradictions, but most agree that sand grains of varying size will best stretch your cement and water, giving you a stronger mortar for your money. They also stress the importance of using clean, drinkable water in the mix in order to minimize organic particles, though I feel confident that I could mix a bedding mortar, using dirty water, that would last for centuries.

The temperature of the ingredients significantly affects the way any mortar sets, and bedding mortar is no different. It's best to keep all the components between 40°F and 80°F (50°F to 70°F is even better). Colder temperatures generally cause slower setting, and warmer ones speed things up. In summer, you can get into trouble by using water that's been heated in a long hose lying in the sun. Mortar that freezes before setting is also pretty worthless.

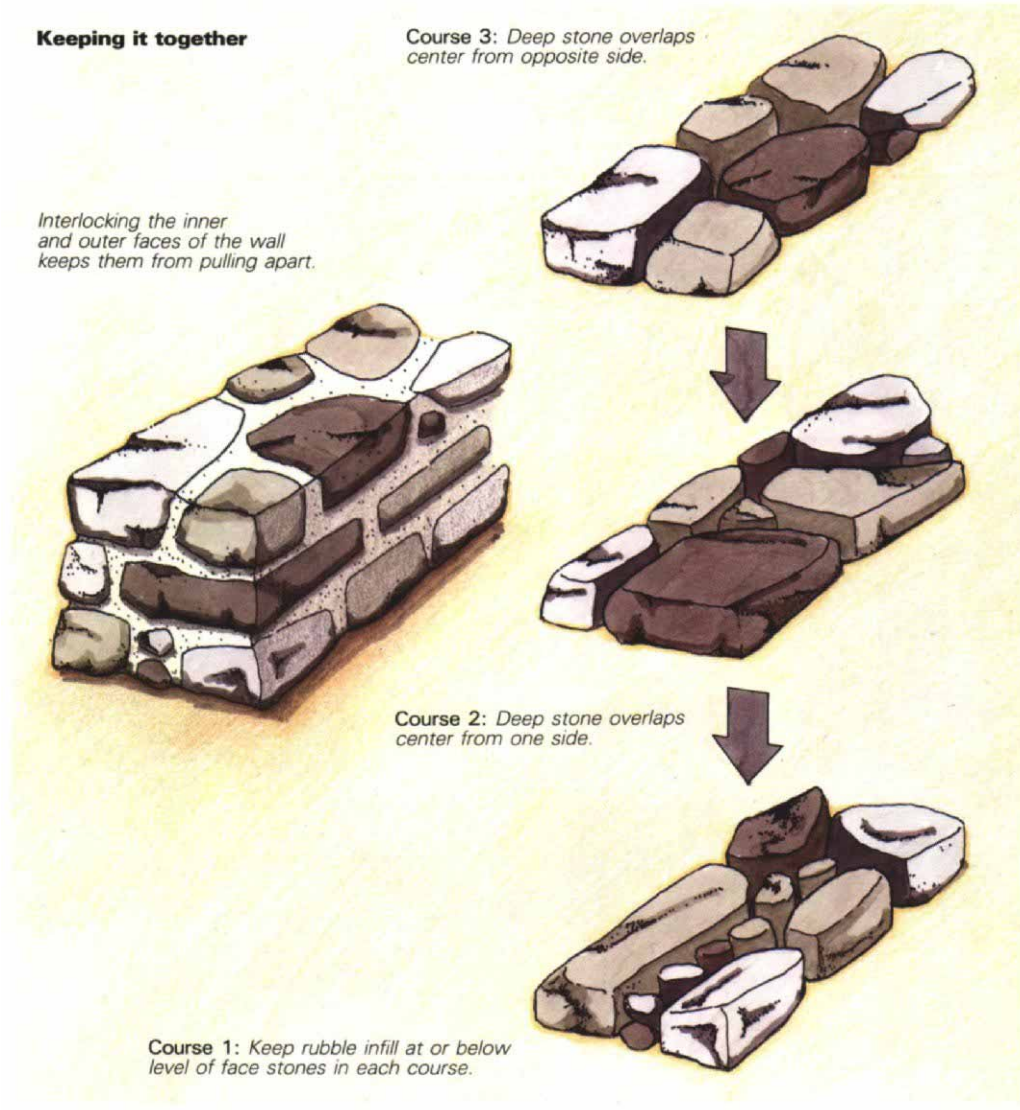
The bedding mortar we used on this job was (by volume) 1 part Type 1 portland cement, 2 parts Type S hydrated mason's lime and 13 parts regular mason's sand. We added water gradually to the dry mix until we had a workable paste. The amount of water needed depends on how wet the sand is. Soaked sand often requires no additional water for mortar.

Setting the lintels–The owner of the barn wanted to repair its foundation and build a new house on top. So he and I tore down the old stonework to the level of the window tops, except for the corners and an area between windows, which we left stepped up to build into later. We had the dubious good fortune of acquiring a pair of 1,200-lb. granite blocks for replacement lintels.

When we were ready to set the lintel stones, we enticed some bystanders into being slaves for an hour. They demanded to see the cold beer first, but then helped us build crude ramps from the ground up to the wall (photo above right). It's important not to rest ramps right on the wall because the top stones can tip dangerously. Also, planks can get trapped under the lintel if they extend onto the wall.

With five of us pushing from behind, we slow-

On the promise of cold beer in return for their brawn, a handful of bystanders agreed to help flop the granite lintels up the ramp to the windows.



Drawing: Frances Ashforth

ly rolled a lintel up the ramp. When it was one flip from the top, we adjusted its position so that the best face would end up on the outside of the wall. It's much harder to move the tonnage once it's sitting on the wall.

When we flipped the mammoth lintels into place, the stones beneath were displaced and their bedding mix was broken up. Using a car jack, we raised the lintels a few inches, repaired the damage and pushed in a fresh bed of mortar. The new bed was slightly stronger than the usual mix because of the increased pressure on those areas (I would likewise use a stronger mortar on either side of an arch).

Putting the old stones to bed—With the new lintels in place, we started building the wall back to its original height. We laid up the ends first, then filled in the middle. If the stonework in the middle goes up first, it dictates how you make the ends, which are far more critical.

The same is true for the thickness of the wall. The 2-ft. thick walls of this foundation are essentially two separate walls, with rubble infill. If the middle gets above the faces, it sets limits on the choice of the next face stone.

Interlocking the inner and outer faces of the walls by overlapping the stones across the center keeps the wall from pulling apart. This overlapping is best done by continually creating flat surfaces on which to work. Then it's a matter of laying the deeper stones on alternate sides in successive courses (drawing, previous page).

Turning raw, uncut stone into solid walls is a very slow, conservative process. Here are a few guidelines that will help make the job easier. First, laying up the stones in courses is essential to getting well-crossed joints. The height of each course is determined by the end stone at a corner. The middle stones needn't all be the same height—they can be added together in various combinations to bring the course up in layers to the desired height.

For appearance and structural integrity, spread out the big, beautiful stones. Beginners often reach for all the best stones right away. But you should avoid the syndrome of the beautiful lower right-hand corner. Most authorities on the subject say to lay the big stones on the bottom of the wall, using smaller ones as the height of the wall increases. I disagree. The top of the wall is most vulnerable to being knocked loose, and having big heavy stones there will do a lot to protect it, especially if the wall has no building on top.

Individual stones should be laid in their most stable position (i.e., flat). I can't build a good wall if the stones aren't approximately rectangular, although thicker walls can more easily accommodate irregularly shaped stones. In the balancing act of rubble masonry, the idea is not to try anything fancy.

As we built these walls, we roughly scraped back the bedding mix before it set up to leave room for an inch or so of pointing mortar. Smears of bedding mix can be removed with a wire brush and water, as shown in the photo below. It helps to have a hose handy. If cleaned within 24 hours, this low-in-portland mix comes off very easily. I usually spend about ten minutes first thing each workday cleaning the mess from the previous day's laying. This good soaking also ensures that the mortar will cure more slowly. Additional soakings should be applied regularly for about a week.

To the pointing—On this foundation, after all the stones were laid, the bedding mortar raked back and the wall cleaned, we were ready to point the work. Like a continuous bead of permanent caulk, pointing mortar keeps the bedding mix from eroding and spalling. Pointing mortar must be harder and stickier than the bedding mortar in order to endure the weather.

Other things being equal, mortar acts differently as its thickness changes. Joints narrower than ½ in. don't have much integrity unless finer sand and a richer mix are used. Fat joints do better with mortar that has more and larger sand. Round sand is good, perhaps preferable, if it is clean and graded, and if extra lime is used in the mortar to compensate for the decreased adhesion or friction between the grains.

When repointing a stone wall, there is a limit to how large a lump of mortar you can keep in place. A fist-sized blob will often slump out. I usually fill large spaces with small, clean stones. Deep holes may need to be filled in layers.

The pointing mix we used was (by volume) 1 part Type 1 white portland cement, 2 parts Type S hydrated lime and 9 parts mason's sand. Using white portland cement not only makes a lighter-looking joint, which looks more like the high-lime joints in older masonry, but also makes smears easier to remove. If you use pigmented mortars, it is advisable to start with white cement and sand, as the grey of regular portland is difficult to cover. White portland gives a slightly weaker mortar, but with laid stone walls, that's not a problem. Again, compressive strength is not as important as the flexibility that high-lime mortars achieve.

Starting at the top of the wall, we lightly misted the area with water from a hose, then pushed the pointing mortar into the clean, moist spaces between stones. I used a trowel or hawk to hold a big blob of mortar and pushed it in with a thinner trowel that just fit the spaces, until each joint was filled (photo facing page, left). The mortar we used was something like peanut butter in consistency, though not quite that sticky.

Once a section of the joint was full, I moved horizontally along the wall without stopping to pretty it up, leaving the mortar crude at this stage. It's much easier to dress later when mortar has lost its smeary quality and become crumbly. The less you manipulate the mortar, the better it will set. Just dragging a trowel across wet mortar brings too much lime and water to the surface, creating a slick, hard skin and leaving a sandier mix inside. You can mix half-set mortar back into a soft paste again (this is called retempering), but it will be weaker when it finally sets than if you had left it alone.

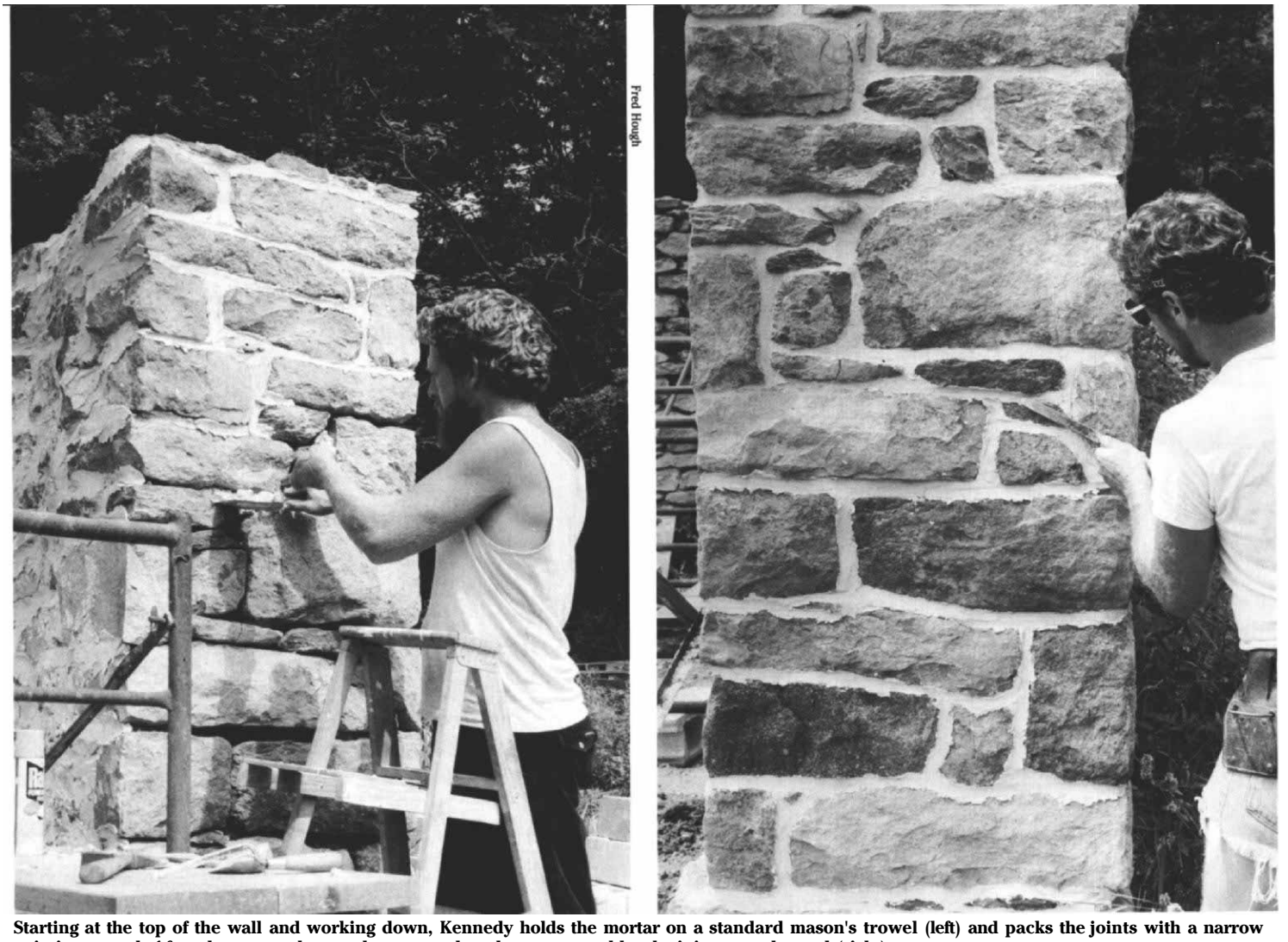
Adding extra water to a batch that's getting hard will greatly undermine its final strength. With bedding mud, I occasionally allow myself to do this, but I never do it when pointing. If you are pointing by yourself, keep your batches small (about nine shovels of sand), and mix them by hand in a wheelbarrow. Batches this size aren't worth the bother of a mixer.

Getting mud to the wall—Mobile mortar is a joy, so I work right out of the wheelbarrow when I can. On scaffolding, I transfer the mud to an old wheelbarrow pan or piece of plywood. By keeping the pan or board directly beneath the working area, I can catch most of the spills and reuse them. If the droppings get dirty, however, I use them to fill interior cavities in the wall.

Beginners are often frustrated by the amount

One advantage of bedding the stones first and pointing them later is that you don't need a strong bedding mix. The smears of mortar on the stonework clean up easily with a wire brush and water.

Photos, except where noted: Stephen Kennedy



Starting at the top of the wall and working down, Kennedy holds the mortar on a standard mason's trowel (left) and packs the joints with a narrow pointing trowel. After the mortar has set long enough to become crumbly, the joints are dressed (right).

of mortar that falls off their trowels, but it just takes a while to get the feel of tools and mud. My best advice is to assume a lot will spill, and that it's okay. Position a catch board beneath you so you won't get upset by the waste, and wait to clean up flops that hang on the wall until later, when they become crumbly.

After using up a batch of pointing mortar, check the spot where you began. If the mortar is still smeary and sticks to the trowel, leave it alone. Timing can be tricky on a pointing job. It's predictable, but there are lots of variables. If you wait too long to dress the mud, it will be obnoxiously slow and hard to remove. On a warm dry day, the mix should be ready for dressing within an hour. On a cool, wet day, the first pointing of the day may not be ready until afternoon. A dry mix will set faster than a wet one; colder ingredients mean a slower set. Dry porous stone will absorb moisture from the mud and cause a fast, weak set. Direct sunlight, especially on black mortar, will also cause quick water loss and a weak product. Extra portland cement in the mortar gives a faster set; all-lime mixes are very slow.

If the mortar is crumbly, you can start dressing the joint. There are many schools of thought on finishing mortar joints. Some masons form a convex protruding joint with a special trowel; some use various S-shaped metal jointers to create a slick, hard surface. I prefer the look of a recessed joint. The stones become the dominant visual element this way.

Scrape off the lumps, and smooth out the irregularities until the joint is uniform. As shown in the photo above right, I use the tip of a 1-in. pointing trowel for this, though a stick will work, and I know one mason who uses a kitchen spoon. A brisk brushing with a small dry paintbrush or auto-parts brush will then tighten the joint by removing protruding grains of sand, and will bring a little extra lime and water to the surface of the joint.

By working in horizontal layers when pointing, you will avoid the dead look of a joint where one day's work ended and the next day's began. If you completed a vertical section on one day, then started next to it the following day, you would be able to see the junction (as with painting a house). If you can't finish a horizontal run in one day, end your efforts in jagged steps, for a less obvious blending the next day. Because every mason's dressing work looks a little different, it's also a good idea for a single mason to complete a given visual area.

Dressing joints usually takes me half as long as mixing and packing the mortar. If you underestimate this time, you're likely to point for six hours, start dressing down, and realize you won't get home for dinner. Then you're tempted to finish the next morning (usually a horrible mistake, unless the mud was very wet and cold to begin with) or rush through the cleanup and get a messy-looking job. If you want to work an eight-hour day on pointing, don't do much more than five hours of packing the joints. Leave time to cover the cement and clean the tools.

Keep it wet—Mortar sets up. It doesn't (or shouldn't) dry. It is best if the mortar, as it is setting in the wall, is kept moist and between 50°F and 80°F for five days or so. (A month would be better, but let's be realistic.) This means no freezing, no heating, no rain, no drought. So if it isn't actually 60°F and drizzling lightly the whole time your mortar is setting, you must create those conditions.

Drape burlap over the finished areas and keep it moist by spraying it occasionally with a hose. Few masons bother with this step, but it is particularly important with these primitive lime mortars. My attitude is to be loose about the bedding mix but persnickety about the pointing job, since it has so much more to do with the looks and longevity of the stonework. □

Stephen Kennedy lives in Orrtanna, Pa. His book Practical Stonemasonry Made Easy *is available from TAB Books Inc. (P.O. Box 40, Blue Ridge Summit, Pa. 17214; $16.95).*