Block Retaining Walls

Interlocking concrete blocks look like stone but cost less and are easier to install

by Scott Gibson

Instead of spiking together landscape timbers for your next retaining wall, maybe it's time to expand your hardscaping repertoire by offering modular concrete-block walls to your clients. Walls made from interlocking concrete blocks — called segmental retaining walls, or SRWs, in the industry — have the appearance and durability of stone, but they don't require a big investment in tools, equipment, or training to install.

First introduced in the 1980s, precast-concrete-block walls are relatively simple to build (although not always simple to engineer) and lend themselves easily to curved shapes. Unlike poured-concrete walls, block walls don't require a below-grade concrete footing, and they can be placed in hard-to-reach spots where a cast-in-place wall would be much tougher to form and pour.

Versatile Design

Highway engineers planning 75-foot-high retaining walls love giant SRW components — panel systems and gravity wall blocks that weigh as much as a car and require heavy equipment to place. But

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Figure 1. Some manufacturers use pins to align the blocks in their segmental retaining walls. Versa-Lok's pin system (left) ensures that each course has a 3/4-inch setback, giving the wall face an angle of about 7 degrees away from vertical.

LOCK+LOAD

LOCK+LOAD

Figure 2. In Lock+Load's retaining wall system (above and right), face pieces are attached to separate anchoring components called counterforts. The counterforts work like geogrid fabric, anchoring each panel to the soil mass behind the wall.

90% of the retaining walls built in the U.S. are 4 feet high or less, and there are plenty of smaller-scale SRW systems useful to deck builders who want to move into hardscaping. These low walls often require little engineering, and many blocks are small and light enough for one person to move and set manually.

Residentially scaled SRWs rely on mass and the friction between blocks to resist tipping forces from the soil they're containing. But details between brands vary. Some systems, such as Versa-Lok and Keystone, align the blocks with glass-reinforced nylon pins that slip through holes in one course to engage slots in the next course (**Figure 1**). Other blocks, such as those made by Anchor, have integral lips that align one course with the next. The pins or interlocking profiles that join the blocks together keep courses straight while automatically establishing a cant (the angle of the wall off perpendicular), which helps the wall resist the push of soil behind it.

Not all SRWs are made with blocks. Lock+Load's two-part system (**Figure 2**) consists of precast facing panels that

Sources

Allan Block 952/835-5309, allanblock.com

Anchor 877/295-5415, anchorwall.com

Keystone 800/747-8971, keystonewalls.com

Lock+Load 604/732-9990, lock-load.com

Versa-Lok 800/770-4525, versa-lok.com

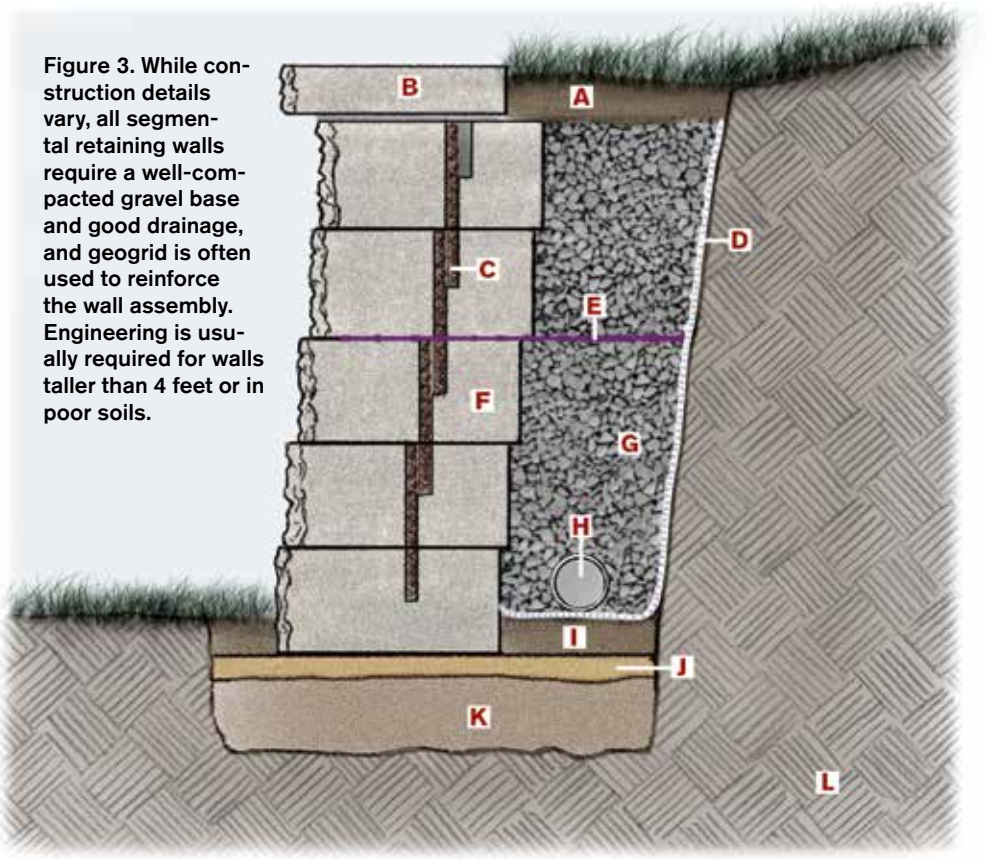

Figure 3. While construction details vary, all segmental retaining walls require a well-compacted gravel base and good drainage, and geogrid is often used to reinforce the wall assembly. Engineering is usually required for walls taller than 4 feet or in poor soils.

A. Compacted topsoil

B. Cap block

C. Reinforcement pin

D. Filter fabric (as needed)

E. Geogrid (usage and location within wall as determined by engineer)

F. Wall block

G. ¾-inch wall rock, compacted in 8-inch lifts

H. Drainage (as required)

I. Compacted native soil

J. Coarse setting/ leveling sand

K. Compacted base material

L. Undisturbed soil

CHUCK LOCKHART

Getting Started: Advice From the Pros

While landscapers Josh Peterson and Mark Tompkins use different brands of wall systems and work in different parts of the country, they're in complete agreement on one point: If you've never built a retaining wall, get some training before you do.

"If you're going to start doing this, you really need to do your homework and learn the rights and wrongs," Tompkins says. "If I were to go build a deck I wouldn't just say, 'OK, I need 4,000 square feet of 2x6s,' and just starting building it. I'd get a design done and go from there."

To help bring installers up to speed, most block manufacturers are generous with technical help and often offer training seminars. Another resource is the National Concrete Masonry Association (ncma.org), which also provides technical information and maintains a listing of installer classes at its website.

attach to counterforts during wall assembly. The counterforts anchor and reinforce the large (16-inch by 32-inch) but relatively lightweight (110-pound) panels.

Despite the differences between specific systems, residential modular-block walls are all assembled in essentially the same way and require the same site evaluation, drainage details, and engineering. Usually, price, local availability, and individual taste determine the type of SRW chosen for a specific project. Familiarity with a particular kind of block is also important, according to the builders I spoke with, who said they often return to a brand based on experience with the local manufacturer or its engineering department.

Evaluating Site Conditions

Before you build any retaining wall, your first stop should be at the local building department to ask about permitting and engineering requirements. Some states and municipalities require stamped engineered drawings for any wall 3 feet or higher, no matter what the site looks like, while in other areas, requirements aren't as rigorous.

In general, retaining walls up to 4 feet tall won't require any engineering (**Figure 3**). But building even a low wall can be more complicated than it looks, especially when the site has

Figure 4. Segmental retaining walls don't require a concrete footing but do require a solid base of compacted crushed rock (below). Some manufacturers recommend adding a layer of coarse sand to make leveling the first course of block easier (bottom).

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problem soils or poor drainage. Sloping surfaces and extra weight on the top of a wall — what the industry calls "surcharges" — are also problematic.

If the retaining wall is going to hold up a driveway, for instance, engineering may be required on even a 2-foot-high wall, according to Versa-Lok's Matt Singer. "Four feet is a kind of rule of thumb," says Singer, "but only when there is a level front and level back and no slope going away from the wall at the bottom and no slope coming to the wall at the top. And no additional surcharge."

Soil type also has a bearing on how retaining walls are designed and built. Gravel and sand are good, while silts and clays are not — soils rich in sand and gravel can maintain a steeper angle before collapsing than those composed of clay and silt. Engineers call this angle the "failure plane"; it helps determine how much weight the retaining wall must be capable of supporting.

You'll get help figuring this out from the manufacturer of the block you buy. For example, maximum wall heights for a particular line of block manufactured by Allan Block range from 5 feet 4 inches in silty sand to only 3½ feet in clay. Adding a surcharge of 100 pounds per square foot at the top of the wall (from a parked car, let's say) reduces the recommended wall heights to 4 feet in silty sand and only 1 foot 8 inches in clay.

Site Prep

A segmental retaining wall is typically built on a base of compacted ¾-inch washed angular rock, or "wall rock." Even in areas where frost gets deep into the ground, the mortarless construction of the wall gives it enough flexibility to cope with minor frost heaves.

While details will vary from manufacturer to manufacturer, the general idea is to excavate a level trench 4 to 6 inches deep, compact the soil with a plate compactor, and then add wall rock. After being compacted again, the base is ready for construction of the retaining wall (**Figure 4**).

The first block course is set in place, and backfilled with a 12-inch layer of wall rock followed by on-site soil (or fill approved by an engineer), then compacted. The base course should be checked carefully for level in both directions.

Each remaining course is handled the same way: Set the block, check for level, backfill, and compact. At the top, cap pieces, usually glued in place with concrete adhesive, finish off the wall.

Reinforcement

When an engineering plan recommends installing a reinforcing geogrid for more strength, the material is added at specified levels — between the first and second course, and then every other course, for example (**Figure 5, page 56**). Typically, geogrid is placed between block courses, set back from the face of the block (it's very difficult to trim later), and rolled back into the excavated area. Then the

installer adds fill and compacts it over the grid to lock it in place.

There are different kinds of geogrid; when an engineer calls for it, the plan may specify the brand and the tensile strength. The kind of soil on the site and the height of the wall will help the engineer determine the specifics of geogrid placement.

Using geogrid increases the cost and complexity of the job. Besides the cost of the material itself, a larger area needs to be excavated to allow room for the grid to be buried, so there's more fill and more compaction involved. Josh Peterson, a field superintendent for Villa Landscapes in Oakdale, Minn., estimates that incorporating geogrid can double or triple the cost of a wall. He uses it only where it's really necessary, which he says is on 10% of the retaining walls he builds.

At the other end of the spectrum is Mark Tompkins, the owner of Total Grounds in Monmouth County, N.J., who uses geogrid on 90% of the walls he builds, because engineers in his area typically call for it. It's a cheap insurance policy against wall failure, Tompkins says. "If you have a wall failure, it doesn't matter who manufactured the block," Tompkins says. "It doesn't matter who the installer is. It puts a big dent in the whole industry in that area. It puts a red light up. The engineers are more cautious, and they review the plans more."

Figure 5. Synthetic geogrid is used when retaining walls are built on soils containing a lot of silt or clay, or when wall heights exceed four feet (top). The geogrid reinforces the soil mass behind the wall and helps anchor the block courses in place (above).

Drainage

Managing on-site water so it can't get trapped behind the wall is an essential part of retaining-wall design. Hydrostatic pressure from trapped water can easily push a wall off its base or cause it to topple over. Fortunately, one of the main advantages of an SRW is that the blocks aren't mortared together, which allows the face of the wall to remain porous.

"Water is the biggest enemy of any wall," says Versa-Lok's Singer. Even in the perfect scenario for a 4-foot-high wall (no slopes, good soil, and no surcharges), 12 inches of wall rock should be placed behind the face of each course of block to allow for drainage.

Because PVC drain pipe is relatively inexpensive, many builders routinely incorporate a drain line into the base of their walls. The line is then run to daylight or to an underground water-retention basin. In either case, the goal is to allow water migrating through the soil behind the wall to eventually reach the compacted wall rock and then exit through the front of the wall or down the drain line.

Singer explains that if the face of a block retaining wall isn't wet after a big rainstorm, the wall isn't draining properly. "If you have five days of rain and the face of your retaining wall never gets wet, then I would be concerned," he says. "Unless there's a great drainage system taking the water immediately away from the back of the wall, this would indicate that there's something behind the wall that's holding the water back."

Another potential problem is wet subsoil at the base of the wall. "If that site soil is real wet, or springy, or not very supportive, it doesn't really matter how good and solid a base you put in," says Josh Peterson. "If you stack a heavy wall on

ALLAN BLOCK

VERSA-LOK

ALLAN BLOCK

Figure 6. The first segmental retaining wall you build likely won't look like one of these projects, but the photos here illustrate the design possibilities offered by these versatile systems, including curved walls, planting areas, and coordinated paving-stone options.

top of it, the base is going to move." When faced with those conditions, Peterson digs out additional material at the base and adds more rock — preferably without any fines — before compacting it. He may add up to a foot of rock to firm up spongy subsoil. In difficult situations, getting advice from the manufacturer's in-house engineers or an outside engineer is always a good idea.

Cost

Once the base material has been packed and leveled and the first course of block set, SRWs go up fairly quickly. "It's basically just like stacking Legos at that point," Josh Peterson says (**Figure 6**).

As with any type of retaining wall, installation costs for a typical SRW depend on a number of variables, including required engineering, complexity, the height of the wall, required drainage, local labor rates, and local product costs. One Minnesota landscaper I spoke with estimated that a basic SRW costs about $20 to $25 a square foot to install. ❖

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