Foundation for a Problem Site

A carefully engineered foundation and alternative septic system add value to a bargain-priced lot

by Fred and Ezra Ambrose

Last year, we had an opportunity to buy a one-acre lot in a desirable neighborhood at a very attractive price. In many ways it was the perfect spot for the spec house we wanted to build. But the low price came at a cost: Building there, we knew, would be a challenge. The lot had a bowl-like configuration with a designated wetland at the bottom. The only possible building site lay close to the street that defined the lot's upper boundary, and the grade dropped about 16 feet over the 75-foot distance to the permissible rear limit of work.

The best option, we decided, was to create a usable, level front yard by cutting and filling the slope between the foundation and the street. The front yard was also the only place to put a septic system, which by code can't be installed within 100 feet of any wetland. An existing municipal storm drain limited the available space even further.

Foundation Design

The local health code requires a minimum distance of 20 feet between the edge of a leach field and a full foundation or crawlspace, and the lot was too small to accommodate that much separation. The minimum distance between a leach field and a slab foundation, however, is only 10 feet. We realized that if we designed critical portions of the foundation to qualify as slab, we could obtain our building permit without needing a variance (**see Figure 1**).

Sealed compartments. Forming a shallow slab foundation on backfilled soil wouldn't have been practical. Instead, we designed one large and one smaller section of the foundation — both of which lay between 10 and 20 feet from the leach field — as sealed full-height compartments that could be filled with compacted soil and capped with concrete. We had an engineer design the walls and provide a rebar schedule for the entire foundation. The full-height, 7-foot-9-inch walls are all 10 inches thick, with a #5 rebar grid spaced 15 inches on-center both vertically and horizontally. At the rear, this walk-out foundation steps down to a frost wall that tops out at 6 inches above finished grade and is a more conventional 8 inches thick. For added strength, we used a 4,000-psi mix for all pours.

Managing Workflow

Those robust specs were dictated in part by the clay soil and sloping nature of the lot. But the limited work space was also a factor. On a more accessible lot, it's usual to install the foundation and frame the deck before backfilling. In this case, though, the newly poured foundation would be remote from any direct, convenient access. Framing the deck before backfilling would have involved scrambling down into the hole and up an extension ladder countless times. Postponing any framing until after the foundation had been backfilled, on the other hand, would let us use the new front yard as a convenient staging ground for the framing phase. Therefore, we made sure that the engineered

A Tight Site Plan

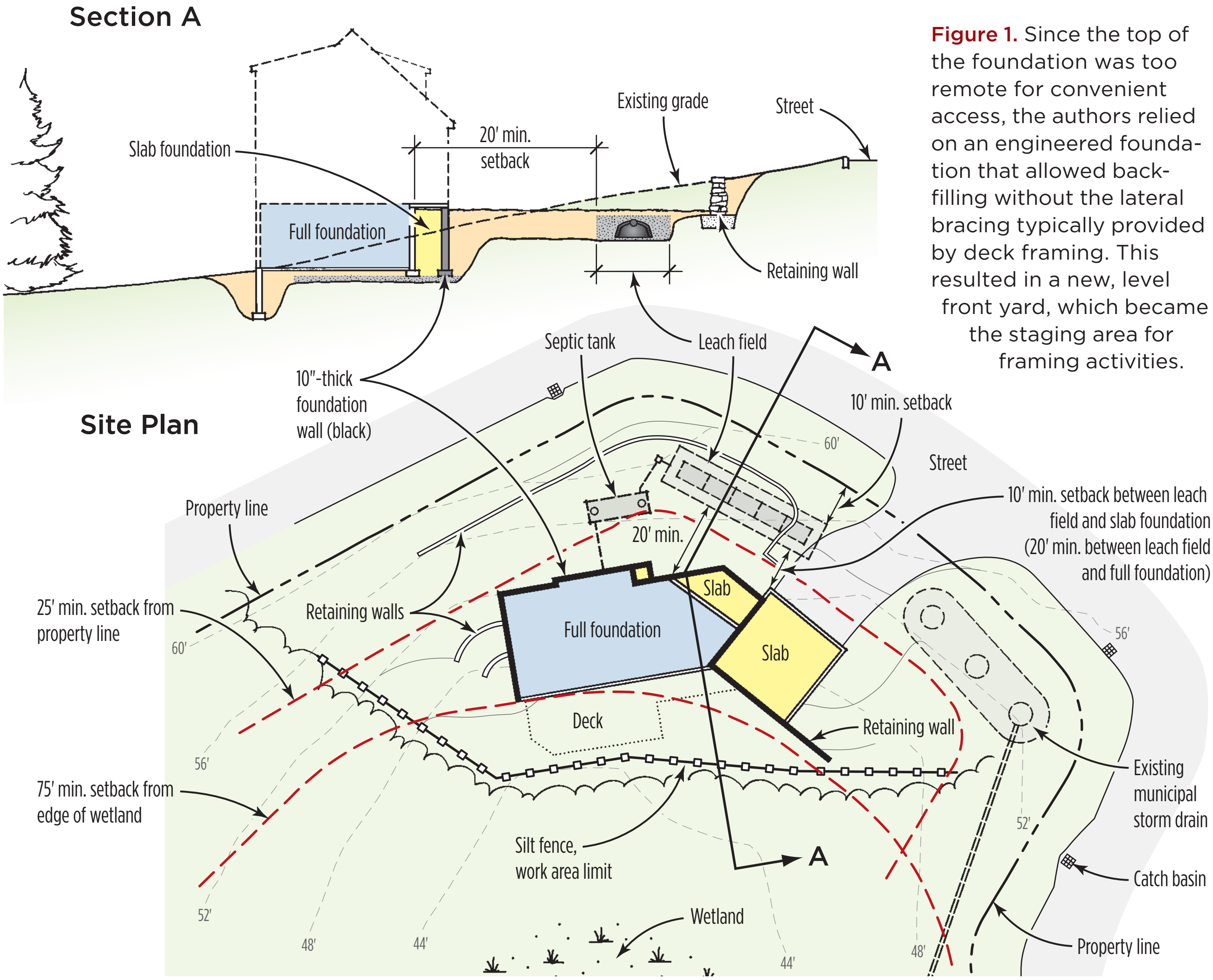

Figure 1. Since the top of the foundation was too remote for convenient access, the authors relied on an engineered foundation that allowed backfilling without the lateral bracing typically provided by deck framing. This resulted in a new, level front yard, which became the staging area for framing activities.

Figure 2. To improve traction for workers, the authors spread stone over the wet clay soil. Footing forms were placed on top of the stone.

foundation was strong enough to withstand the soil pressures and vibration of the backfilling without the reinforcement typically provided by the deck.

A rented excavator. Excavation work of one kind or another was a near-constant activity during the first month of construction. If subcontracted, the necessary stop-and-start sequencing of the foundation and septic installations would have added significant time to the schedule and cost at least $50,000. We own our own dump trucks, along with a skid-steer loader and a mini-excavator. But to speed things along, we rented a 40-ton crawler-excavator at a monthly rate of $3,425, ultimately cutting that excavation estimate by half. We kept the machine on the site for two months.

To protect the wetland, we installed a silt fence along the limit of work line. This left us with little space for stockpiling the spoils. In all, we removed nearly 200 yards of clay soil from the site. For backfilling, we trucked in about 150 yards of clean sand.

Figure 3. For the 10-inch-thick foundation walls, the engineer specified a grid of #5 rebar. The footings step down 5 feet on the walk-in side of the foundation. Because this portion of the wall is not subject to soil pressure, its thickness is reduced to 8 inches.

Footings and Forms

To prevent our feet from sinking into the soft clay subsoil, we dug the foundation hole about 6 inches deeper than the intended bottom of the footings, brought in 24 yards of 3/4-inch stone, and spread it over the floor area (**Figure 2**). The footing forms were set fully on top of the stone. Later, we filled the area inside the foundation to the top of the footings with clean, compacted sand. We poured 10-inch by 18-inch-wide footings with #4 rebar run continuously along the bottom and inserted 3-foot lengths of #5 rebar vertically on 15-inch centers to pin the walls to the footings (**Figure 3**).

Forming the compartments. For the larger of the two slab compartments, we added the interior wall after we poured and stripped the forms from the main walls (**Figure 4, page 4**). We did this by drilling a series of 4-inch-deep by 3/4-inch holes into the existing wall on 16-inch centers, and installing #5 rebar pins using Red Head epoxy (800/348-3231, itw-redhead.com). The pins project the standard 2 feet from the wall, allowing for a solid connection between the interior and exterior walls. With the interior compartment walls in place, we were able to fill the compartments themselves with compacted soil. The capping slabs were

Figure 4. Slab areas were poured atop full-height foundation compartments. The smaller of the two compartments is visible on the left side of the photo at left; the larger, not yet complete, is defined by the row of vertical rebar visible at the rear. The finished compartments were filled with compacted soil (above) and later capped with concrete slabs, providing a code-required setback from the septic system's leaching field.

Figure 5. The authors installed drain tile, which outlets to daylight around the completed foundation (top). Note the standing water just inside the silt fence. A section of the lot between the foundation and the street above was then backfilled to provide the required level base for the septic system (above).

poured flush with the top of the wall; the floor framing clears it by the thickness of the sill plates.

After stripping the wall forms, we damp-proofed the foundation and installed continuous drain tile along the bottom of the footing, which ran to daylight at the rear of the foundation. We covered the drain tile with clean, medium sand followed by a layer of filter fabric to prevent silting. Then we backfilled the foundation, at the same time cutting back the slope along the street to create the level area necessary to install the septic system. The bottom of the leach field was planned at 4 1/2 feet below the top of the foundation, so for the time being we only filled to within a couple feet of the top of the wall (**Figure 5**).

Lightweight Septic

We tackled the septic system installation and the garage foundation simultaneously. Adding the garage foundation to the completed house foundation, rather than pouring it at the same time, made sense for several reasons: First, it allowed us to run the drain tile and damp-proofing only where it mattered, around the three major sides of the house foundation. Second, temporary truck access to the site came in at the garage end, so pouring the

Figure 6. One crew began installing the septic system while another formed the attached garage foundation. The heavily reinforced spread footing (left) will anchor a retaining wall that extends from the back wall of the garage (below).

main foundation first simplified issues of access and workflow by allowing us to work our way back out of the driveway. Third, because the garage foundation would be filled with soil, neutralizing exterior soil pressure, there was no need to pour 10-inch walls at the front or sides of the structure. We were able to save time and material by going with 8-inch walls in these areas.

Because the garage foundation is essentially a filled container and the back is unsupported by the exterior grade, however, a 10-inch wall was required there. A retaining wall extends from its outside corner to ease the final grade around the structure; it's tied to a reinforced spread footing (**Figure 6**).

No boom truck. A typical septic system involves several heavy concrete components, delivered and placed by boom truck. But because we couldn't get one close enough to the drop zone, we opted to use lightweight HDPE (high-density polyethylene) system components instead. We used a 1,500-gallon tank, a distribution box, and five leaching chambers from Cultec in Brookfield, Conn. (800/428-5832, cultec.com). The components are easily transported in a pickup truck and can be moved around by hand (see "On-Site Septic for Problem Soils," 3/04). Because a corner of the leach field lay beneath the garage approach and final grading by skid-steer was still to come, we ordered heavy-duty components made for traffic applications. Although this added about $40 per component, the final cost was still comparable to that of a conventional concrete system.

Finishing Up

There's an average height difference of about 7 feet between the street and the top of the foundation. To retain the slope between street and yard, we installed a 3-foot-high retaining wall of interlocking concrete landscaping blocks (**Figure 7**). And to keep the indoors as mud-free as possible during construction, we immediately graded and seeded the yard and paved the walkways and garage driveway. This made a big difference in early curb appeal and kept our shoes and the floors relatively clean for the duration of the project.

Counting costs. The final cost of the foundation came to $28,000, or about $105 per linear foot. Conventional foundations in this area, by comparison, typically go for about $75 per foot. But because the lot itself was such a bargain — we paid about two-thirds its $415,000 assessed value — we came out well ahead. With good buildable lots becoming increasingly scarce, we'd certainly consider taking a similar approach in the future if the right lot came along.

Figure 7. A dry-laid masonry retaining wall and hard-surfaced walkways, installed as soon as possible after the completion of foundation work, provided early curb appeal and a mud-free site throughout the rest of the project.

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