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Roughing Out Site Work
Lessons learned taming a difficult site

BY ANDREW BORGESE

Site work is fundamental phase of many building projects, but it's often overlooked and underappreciated, particularly by clients unfamiliar with the nuances of the construction process. To untrained eyes it can seem as if little progress is being made until the actual structure begins to rise from the ground. But just as a good foundation is required for a sound structure, well-engineered and properly executed site work is crucial to a strong, stable foundation.

Site work may include the clearing of trees and vegetation, excavation, grading, roadway and driveway construction, septic system installation, sewer connection, stormwater management, and installation of underground utilities. On more complex projects, it may also include hazardous material removal, installation of irrigation systems, rock or ledge removal, protection of neighboring properties or sensitive environments, construction of retaining walls, or drilling for wells or soil borings. The scope varies with each project. For this one, the combination of tasks required literally transformed the site—above and below grade—and helped create a more functional home.

ASSESSING THE SITE

We began by taking a close look at the site with my excavation contractor, George Botelho, and the site plans to get a rough idea of


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the scope of the work. On this Cape Cod project, the clients owned a small cottage that sat in the back of a narrow, overgrown lot **(1)**. Built in the 1940s, the existing house was so far from being code compliant that demolishing it and salvaging materials from it was more financially feasible than trying to renovate it.

When I first visited the property, I noticed that the back corner of the house sat on what appeared to be a large boulder **(2)**. But with no other such outcroppings visible as the site sloped downhill, I wasn't overly concerned and didn't feel that my observation justified spending thousands of additional dollars to do soil borings throughout the lot to investigate what obstructions, if any, might lie beneath the surface. My excavation contractor had done extensive digging in the nearby area and although he had encountered some poor soil and rocks, he wasn't too concerned either.

However, as a precaution, we decided early in the design phase to locate the new house closer to the road (and farther away from the visible outcropping of stone). We also designed the rear uphill portion of the house to sit over a crawlspace with a shallower foundation; a full foundation would have required a much deeper excavation in that area.

Call Dig Safe. Before the first shovel hit the ground, we called Dig Safe to locate and mark underground utilities on the site. In this area, that call is required before the local building department will issue a permit. A free service, Dig Safe is a not-for-profit clearinghouse that notifies utility companies when a contractor or homeowner plans to dig on a property. In turn, those utilities come to the site and mark out the location of their underground facilities. In most states, dialing 811 connects you to a similar service.

STRIPPING THE SITE

The rough site work began with clearing any trees and vegetation located within the footprint of the new structure and in the access path of construction vehicles **(3)**. In this case, that meant getting the site ready for the equipment that would raze the house and remove the debris.

Once we had stripped the existing cottage of salvageable items, and all utilities were disconnected at the property line or at the street, the demolition team came in and removed the structure (including the existing foundation) with remarkable speed.

Typically, when demolition is finished, any valuable loam on a

Photos: 1, Andrew Borgese; 2, George Botelho


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site is stripped and stockpiled safely on the lot for use during final grading. But because this site was so overgrown and littered with surface rocks, separating out the loam was not worth the effort.

EROSION CONTROL

A messy construction site is a sure way to sabotage your clients' future relationships with their neighbors. So as a best practice, we took measures to control runoff and to keep mud and mess contained on the site. Although not mandated in this area, these measures may be required for permitting in other locations.

Mud mat. One of George's first tasks was scooping out a 12-foot-wide by 10-inch-deep area along the length of the property where it abutted the street (which was also the lowest elevation of our sloping lot). He filled the resulting wide, shallow trench with crushed stone to create a large "mud mat" to filter runoff from the site and to help remove dirt from the tires of construction vehicles.

Straw wattle. As an additional measure, we placed a straw wattle along the edge of the crushed-stone mat, parallel with the roadway. This wattle is a biodegradable woven tube filled with absorbent fiber designed to collect any silt or debris that might get past the mat, and requires no special removal after it begins to break down from wheel traffic. The combination of mud mat and straw wattle was incredibly effective in keeping the roadway clean despite several days of heavy downpours during the excavation **(4)**.

Silt fence. To keep mud and debris from washing off the site onto neighboring properties on both sides, we installed a silt fence made from a plastic fabric that holds back soil while allowing water to pass through. We buried the bottom 6 inches of the fence in the ground, and it, too, was quite effective in keeping the excavated soil contained on site **(5)**.

DIGGING THE FOUNDATION HOLE

After we cleared the site and set up erosion controls, our surveyor staked out the corners of the foundation. Siting the house accurately is important on small, narrow lots such as this one, where the building setbacks from property lines can be within feet—and sometimes inches—of what is allowable under local zoning bylaws. We were finally ready to excavate for the foundation hole.

We had anticipated an easy dig through sandy soil (this was, after all, Cape Cod), but we were unpleasantly surprised to find

Photos: 3, George Botelho; 4 & 5, Andrew Borgese


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layers of clay and silt throughout the entire building footprint. This material has a poor capacity for drainage, so most of it wasn't suitable for backfilling around the foundation and couldn't be saved. Instead all unusable material had to be hauled off site, to be replaced by clean sandy soil after the foundation walls were installed. In the end, we were able to save and reuse only about 10% of the soil that was excavated from the site. This soil was piled at the rear of the lot until it was needed as fill.

Rock bottom. After removing 967 yards of clay and silt (George kept close tabs), we thought that we had exhausted our bad luck and had hit rock bottom. That is, until we actually hit rock. About 18 inches above our designed slab elevation for the crawlspace area, we hit glacial till. George found a "rock" that kept getting bigger as he tried to dig under and around it **(6)**. It was not to be moved.

The densely developed neighborhood where this property was located was definitely not a "blast-friendly" zone, so breaking up the rock with explosives was not an option. Breaking it up with a pneumatic impact drill was also ruled out as being too noisy. Instead, George chipped away at the stone protrusion by repeatedly dropping a one-ton steel-alloy weight (appropriately nicknamed "the headache ball") from the bucket of his excavator **(7)**. Eventually he broke the rock down to the desired elevation for the slab.

The possibility that we may find poor soil and large rocks during excavation is the reason why we include a clause in our clients' contracts that addresses "unforeseen conditions" to cover costs that are outside the scope of our original agreement. (We also explain to clients at the outset that site-work overruns are often unavoidable, and we are careful to communicate with them at every step during the process.)

Driveway base. Part of the excavation process was preparing the driveway area for the heavy construction vehicles, including the concrete pump truck, that would need to drive up the hill. A good driveway that would provide access to the main floor of the house was also a crucial part of the plan. George excavated the poor soils from the driveway area and brought in clean, structual fill that he installed in 6-inch lifts, compacting each layer before placing the next one **(8)**.

The footings and foundation for the house and garage went in smoothly. To put the main floor of the house at an accessible level, the foundation contractors formed a shelf in the upper part of the walls. It would support an I-joist floor that would be at the same

Photos: 6 & 8, George Boteltho; 7, Andrew Borgese


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level as the grade at the driveway and garage floor. On two sides of the house, the foundation walls extend almost two feet above the shelf to allow the grade next to the foundation to be higher than the floor and then slope away from the house properly **(9)**.

ACCESSIBILITY FOR AGING IN PLACE

Accessibility was a priority for our clients. As they were getting older, they were finding it increasingly difficult to travel from the parking area at the road to the front door more than 12 feet higher. One option was to build the garage at the street elevation and install a residential elevator. Because the cost of doing that was substantial, we decided to take advantage of the sloping site, instead.

By cutting into the site, we made use of the basement as finished space with a full bathroom and two bedrooms. Generous amounts of south-facing glazing will give it the feeling of a sunlit first-floor space. To create an evenly sloped driveway up to the garage and the entry at the main-floor level, George raised the grade along most of the east side of the site. This proved to be a successful strategy: Accessibility will no longer be a challenge for the clients in their new home.

Driveway slope and basement elevation. Because we opted to move the house's location forward on the lot—to a point where the topography had begun to drop—we were able to lower the elevation of the main floor, and at the same time reduce the driveway's slope. But that also required dropping the basement further into the ground. Eventually we found a compromise that provided a comfortably navigable driveway and located the basement floor about a foot below finished grade.

Backfill. Now it was up to the excavator to backfill the foundation and finish the rough grade for the driveway to bring it all together. Using the bucket on his excavator, as well as his skid steer, George backfilled around the foundation at the back and sides of the house with excavated material that had been piled behind the house **(10)**. He also used the bucket to fill the foundation of the garage with clean material, which he compacted using the bucket and a hand-operated compactor **(11)**. To make up for the materials that had been hauled off site, George brought in 400 yards of screened and structural fill material to finish backfilling the sides of the foundation and to fill the rest of the garage foundation as a base for the slab **(12)**.

Patio area. A design priority for the clients was creating a flat, accessible outdoor patio area. With such a narrow and sloping lot,

Photos: 9, Andrew Borgese; 10–12, Roe Osborn


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the only area that would work was behind the house. But the topography there continued to slope uphill, so our original design called for cutting into the grade and containing the patio area with 3-foot-high retaining walls. After backfilling the foundation, George began roughing out the ground behind the house. Sculpting and smoothing the grade with the blade of his skid-steer machine, he was able to carve out the area needed for the patio and then gently slope the grade up to meet the natural topography, eliminating the need for thousands of dollars worth of retaining walls **(13)**. Those savings at least put a dent in the unforeseen excavation expenses.

SEPTIC BEFORE FRAMING

One of the last steps in the rough grading was making the site safe and ready for the framers. This involved smoothing the ground with the skid steer after the backfill was placed **(14)**, and hand-grading the area immediately beside the foundation to get rid of what George called "ankle breakers"—chunky soil that when frozen can be dangerous underfoot **(15)**. Ideally, this last step would have been completed after the septic system (located in front of the house) was installed. But we were anxious to get the site ready for the framers, and George needed a window of about a week to complete the septic, during which time the foundation would be inaccessible. When weather delayed the arrival of the framers, we had the green light to go ahead with the septic.

The initial perc test done a few months earlier had shown a 4-foot-deep layer of medium sand that started 10 feet below natural grade, so we budgeted for a 12-foot-deep by 48-foot-long by 20-foot-wide strip out for the new four-bedroom septic system. This would have equated to approximately 430 yards of soil being removed.

Unfortunately perc tests don't reflect all of the conditions below grade, and excavation for the septic system uncovered the same clay and silt mixture that we'd found earlier. It wasn't until we reached a depth of 25 feet below grade that we discovered suitable sandy material. To excavate for the septic system, George dug out some huge boulders **(16)** and ended up removing 1,121 yards of material, more than twice what we'd estimated based on the perc test. Within a few days, George was able to complete the septic system **(17)**.

The extra work needed for the septic system also fell under the "unforeseen conditions" part of the contract, and I began to rethink

Photos: Roe Osborn


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my decision not to do the soil borings. But even those test results can't always be trusted when dealing with quirky soil conditions such as these, underlining the importance of preparing your clients for cost overruns and communicating with them throughout the process.

STORMWATER DRAINAGE

In this area, as in many places around the country, local code or zoning bylaws require that the stormwater from an owner's property be contained on that property and not be allowed to run off onto adjacent private or public lands. This becomes even more critical when there are sensitive environmental areas nearby such as wetlands or wildlife habitat. That was the case here—a vernal pond was located just a few yards downhill from the site. As part of the permitting process, we submitted plans to install a linear channel drain at the bottom of the driveway to collect runoff from the property and direct it to a dry well. The drain and dry well will be installed at a later stage so that they aren't damaged during construction. At that time, another dry well will be installed to collect water from the gutters and downspouts on the house.

The surface of the driveway will play a major role in how runoff will travel down the slope of the property. For that surface we considered materials such as pervious concrete, gravel, seashells, and pervious pavers, but decided to pave the driveway with asphalt, which will more successfully suit the clients' need for a hard, durable surface that will accommodate a walker or wheelchair. The paved surface also requires the least amount of maintenance and can be easily plowed during the winter. The final layers of compacted road base and pavement will be added in the final phases of construction.

Before packing up his equipment and leaving, George put down a layer of crushed stone on the driveway **(18)**. The stone will help keep the ground from turning into a soupy mess during freeze/thaw cycles as work progresses into the spring. The stone also created a clean, even surface for staging materials throughout all phases of construction that followed.

Andrew P. Borgese is an architect, a licensed construction supervisor, and the founding principal of INTEGRATA Architecture + Construction (integrata-ac.com), in Falmouth, Mass. To see more pictures of this project, watch the slideshow, "Site Work: Roughing Out A Lot Before Construction," at JLConline.com.

Photos: George Botelho