PHOTOS AND ILLUSTRATIONS BY TIM HEALEY

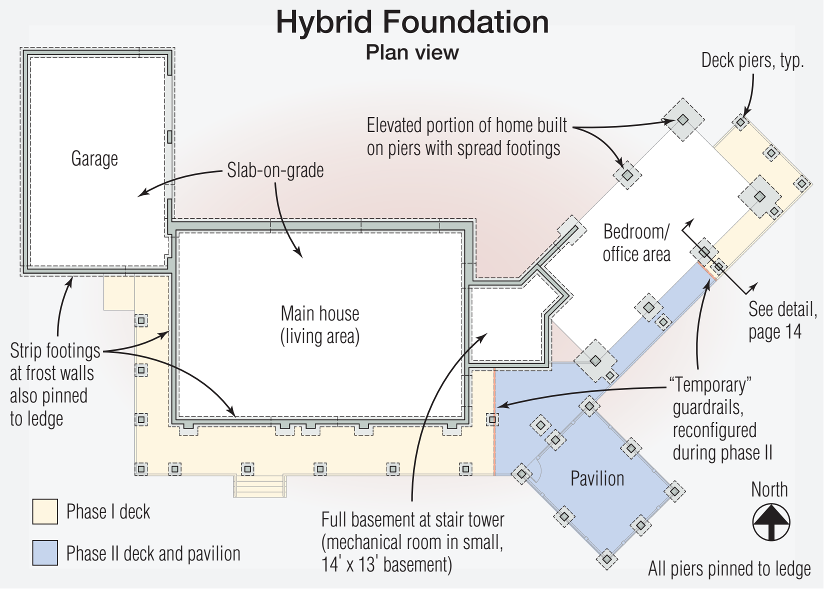
Pinning a Deck to Ledge

On a steep and rocky site, tall piers were the key to adding outdoor living space to a new lakefront home

by Jim Bradley

In the summer of 2017, the company I work for, Hayward Design Build, broke ground on a new high-performance home on the shore of Lake Champlain in northern Vermont. The 2.5-acre, mostly wooded site was located on the tip of a small peninsula and featured a rock outcropping that dropped off steeply to the water's edge some 70 feet below. The homeowners wanted their new home to blend into the landscape while also taking advantage of the property's stunning 230-degree lake views. With the help of architect David Pill of Pill-Maharam Architects in Shelburne, Vt., they designed a sleek minimalist-style structure and sited it on the point's rocky bluff.

Because of the sloping ledge, the home's foundations needed to be a mix of slab-on-grade and pier construction. The living areas in the main part of the home would be supported by a slab-on-grade, while the bedroom-office wing (which doglegged 45 degrees from the main structure) would be "floated" on concrete piers. An important part of the design was a wrap-around deck running the full length of the home's southern elevation and along portions of the east and



Built on a rocky bluff, the home's foundation was a mix of slab-on-grade and pier construction. A wrap-around deck and screened porch (or "pavilion") were also supported by piers. The project's two phases spanned three years.

Figure 1. The bedroom-office wing was "floated" on the piers. Here, the deck was being framed on the home's elevated southeast corner (A). The larger deck off the main living area was close to grade and supported by shorter piers (B).

west elevations, which would also be built on piers (see Hybrid Foundation, left). Although the home's aesthetic was simple, building the complicated, near Passive House–level structure and expansive deck areas proved otherwise.

Pinning to Ledge

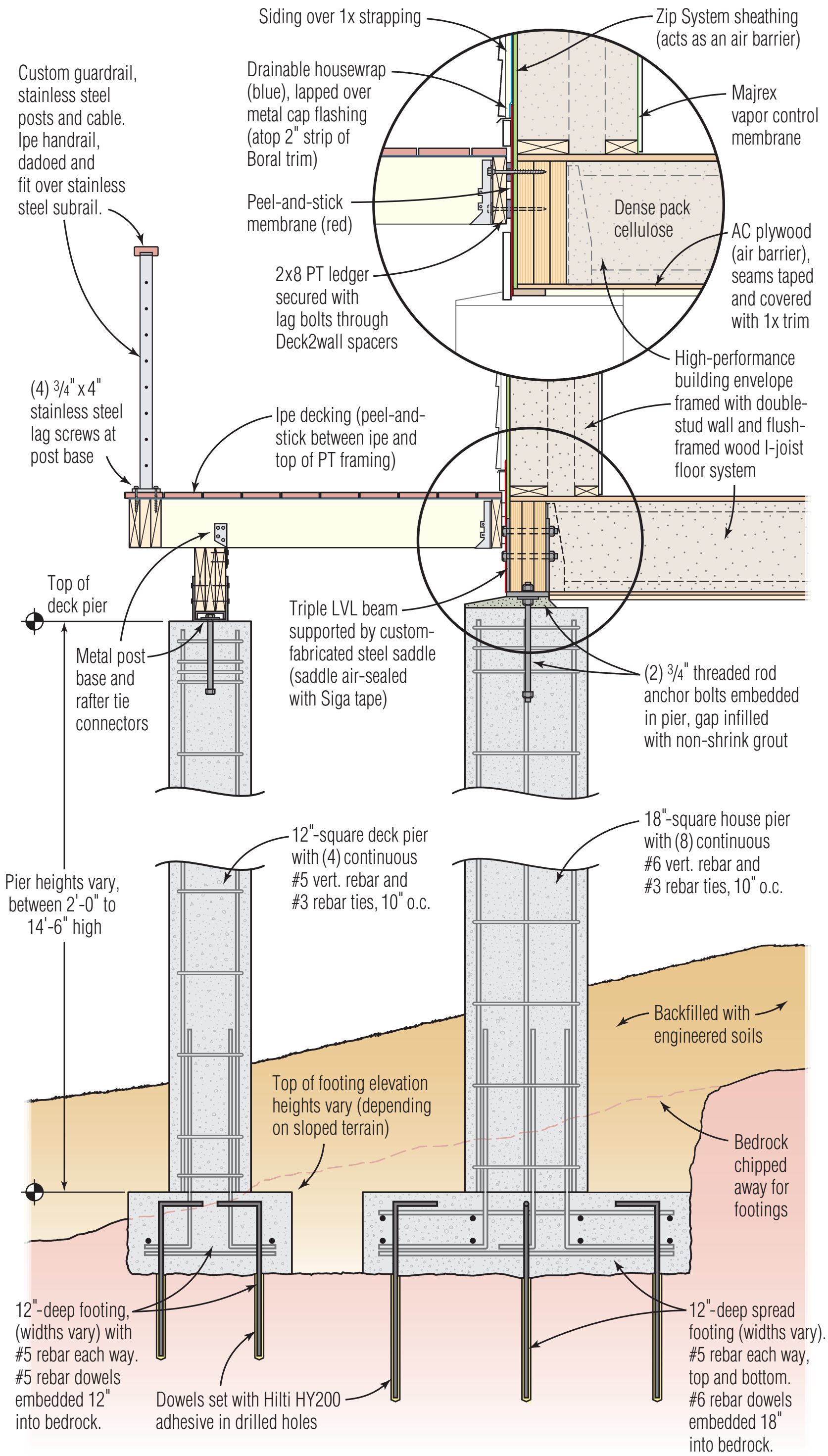
During the project's design phase, a geotechnical engineer inspected the geology of the proposed house placement and adjacent areas and consulted with the structural engineer. They concluded the rock outcrop was ledge (as opposed to large, fragmented boulders), but that it was fractured and could become unstable if it were site-blasted to make way for full-depth foundations. This brittleness of the bedrock necessitated the "half slab-on-grade, half pier" foundation solution.

In lieu of blasting, we brought in an excavator with a hydraulic breaker hammer to chip out ledge for the footings. The excavator carved trenching for strip footings out of the rock where frost walls were needed in the slab-on-grade areas, and hammered out holes for individual footings at pier locations in the bedroom wing and deck areas. Larger holes were made for spread footings at piers supporting the "floating" house.

Dowels. To pin the footings to ledge, L-shaped dowels were embedded 12 to 18 inches—depending on the footing size—into the rock and set with Hilti HY200 adhesive. After drilling the holes, we blew them clean with compressed air and then set the dowels. At the frost walls, we pinned the strip footings to rock with rebar dowels in a staggered pattern and installed dowels at each of the large spread footings and smaller deck footings. The size and number of dowels varied depended on the footing size.

Working concurrently on the slab-on-grade and piers, the foundation crew poured the footings and frost walls, then assembled the heavy rebar reinforcement for the piers. To level the irregular rock surface for the slab-on-grade portion of

Connection Details



Taken through the bedroom wing, the section drawing shows the footings for the heavily reinforced piers pinned to the ledge with L-shaped dowels. Dowel size, number, and depth varied depending on footing size.

the home's foundation system (a 4-inch radiant slab in the home's conditioned space with 8 inches of sub-slab EPS insulation), we trucked in gravel and fully compacted it.

Piers. The larger, 18-inch-square house piers were heavily reinforced with continuous #6 vertical rebar, while the 12-inch-square deck piers were reinforced with continuous #5 rebar. Depending on the sloping topography, the height of the piers ranged anywhere from 2 to 14 1/2 feet (see Connection Details, left).

After the piers were poured, the site was backfilled with engineered soils.

Prepping for a Pavilion

Included in the foundation work was the installation of eight piers for a stand-alone, screened-in porch (or "pavilion") located in the middle of the home's south elevation. The pavilion was in the initial job scope, but due to budgetary issues, it was deferred to a future Phase II. As a result, the middle portion of the wrap-around deck was left unbuilt for a year and a half while the homeowners contemplated whether to build it. In the interim, the deck section adjacent to the bedroom wing and the one at the main house were treated as two separate decks, with code-approved guardrails. *[Note: The pavilion and middle deck section were completed this summer. See Figure 6, page 20, and* Day's End*, page 28.]*

Framing Decks, High and Low

We began installing the deck at the higher, southeast corner of the home, where the bedroom wing's elevated first-floor 14-inch-deep wood I-joists were flush-framed to triple LVL rim beams (**Figure 1**). The built-up LVLs ran around the perimeter of the floor system and were connected to the piers with custom-fabricated steel saddle connectors (see Connection Details, left). These LVL rim beams provided plenty of "meat" for the threads of the lag bolts we used to secure the deck ledgers.

Prior to installing the 2x8 PT ledgers,

Figure 2. Ledgers were lag-bolted through spacers to the elevated floor's triple LVL rim beams spanning the piers (A). Fentrim flashing tape was used for both water- and air-sealing. Here, it air-seals a deck beam pocketed into a wall (B).

Figure 3. In the slab-on-grade areas, the wider grade-level deck section was framed with beefier 2-by stock (A). Threaded rod set in adhesive attached the ledgers to the top of the frost walls (B). Peel-and-stick capped the 2-by stock.

we installed Fentrim 430 Grey flashing tape (sigatapes.com), starting a couple of inches above the ledger and running to the bottom of the wall. Fentrim is a semi-permeable flashing tape that offers effective protection from air leakage and water penetration. I've found that the peel-and-stick tape hugs the shafts of the fasteners well during installation.

Deck connections. We secured the 2x8 PT ledgers for the narrow decks in the elevated southeast corner with lag bolts driven through 1/2-inch-thick polypropylene Deck2wall spacers (deck2wallspacer.com). These spacers stand the ledger off the framed wall to protect it long-term from water and debris (**Figure 2**).

At the outer deck, a triple PT 2x10 beam spans between the deck piers. We connected the built-up beams to the piers with metal post-base anchors with 1-inch standoffs to help prevent rotting. 2x8 PT joists cantilever over the carrying beams and attach to the beam with rafter tie connectors. At the ledger, the joists are flush-framed and attached with joist hangers.

Down low. We framed the wider grade-level deck along the south and west elevations similarly, though it required beefier 2x10 joists with a triple 2x12 carrying beam for the longer spans. At the top of the frost walls, we attached the deck ledger to the concrete with 1/2-inch threaded rods set with Hilti HY200 adhesive, again using Deck2wall spacers to stand the ledger off the frost wall (**Figure 3**).

Finishing Off the Deck

With the two deck sections framed, we began to install the ipe decking on the "high" deck. First, we applied strips of peel-and-stick flashing to the top of the framing members to help extend the lifespan of the PT wood. It's a little bit of a belt-and-suspenders assembly, but ipe lasts longer than pressure treated wood, so we deemed it worth the effort.

Cutting. Due to the site's steep topography and the height of the deck off grade,

Figure 4. The ipe decking was installed on the elevated deck area first (A). Cut ends were sealed (B) and the decking was predrilled for stainless steel trim screws (C). A couple of 8d nails helped uniformly gap the boards (D).

Figure 5. The south elevation was 80% glass. Large high-performance European-style lift-and-slide glass doors set in a steel moment frame (left exposed as an architectural feature) opened onto the ipe deck.

we set up our cutting station on level ground at the north-facing front of the house. Unfortunately, this was a long hike back and forth through the length of the house for our cut guy, which added time to the job. Immediately after the decking was sawn and prior to lugging it to the install area, we sealed the cut ends of the ipe with Ipe Seal (deckwise.com).

Fastening. We face-fastened the ipe to the framing with 2 1/2-inch-long stainless steel coated trim screws (fastenmaster .com), which were color matched to the ipe. After running a perimeter band of decking, we started applying the field boards, working from the outer edge towards the house (**Figures 4, 5**).

Because of the visible fastener pattern, we predrilled holes and carefully aligned them using a layout square, placing two screws at each joist. To uniformly gap the 1x6 boards, we temporarily tacked a couple of 8d nails into the framing at each course, then set the deck screws with an impact driver. Then we removed the temporary spacer nails, repeating the process until we reached the exterior wall.

Deck to wall. Where the decking meets the exterior wall, we installed a 2-inch-wide strip of Boral trim with metal cap flashing. The cap's vertical leg runs up the Zip sheathing and is taped off with Zip System flashing tape, while its prominent 45-degree kickout directs water away from the deck-to-wall juncture.

The home is clad with a mix of fiber-cement and Galvalume siding. For an extra layer of water protection, we installed Hydrogap drainable housewrap over the Zip System sheathing in preparation for the home's rainscreen siding (1-by strapping was installed over the Hydrogap). The drainable housewrap laps over the cap flashing's vertical leg.

Guardrails. One of the last tasks of the project was to install guardrails on the two deck sections. Like most people who have invested in homes with spectacular views, our clients wanted their views, of Lake Champlain, to be as

Figure 6. A custom-built guardrail with cable railing was installed (A). The deck was temporarily treated as two separate decks with code-approved guardrails (B, C). Guardrails and decking were reconfigured during the pavilion work (D).

unobstructed as possible. They didn't want to sit in their chairs—whether on the deck or on the inside—staring at a railing and an array of balusters. So, we installed a custom-built guardrail system with stainless steel posts and cable railing.

We used 1½-inch-thick ipe stock for the cap rail, which we dadoed to fit over a stainless steel subrail. Local town code allows for 36-inch-high guardrails, which helped keep the rail out of view lines. The posts were set with stainless steel lag bolts set into solid framing (**Figure 6**).

Because we ended up building the pavilion and middle portion of the deck connecting the two decks a year and a half after the house was completed, we needed to reconfigure the guardrails and change the orientation of the decking in some locations to avoid a patchwork look. We reused as much of the expansive rail system as we could but had to install a few new sections. Last, we pressure-washed the older decking, which brought a lot of the color back, then sealed it to match the new. There was slight difference between the two, but I think the ipe is going to weather evenly over time. ❖

Jim Bradley is a BPI-certified home-performance contractor, builder, and remodeler based in Vermont.