Saving a Hilltop Pool

Averting disaster with a new steel-panned slab that serves as a header and grade beam

BY RAY PETRIN

Photos by Ray Petrin and Igor Kryvokon

Though still beautiful, my clients' backyard was clearly in trouble. Situated atop a knoll in Belmont, Calif., the backyard contained a gunite pool, which was built in the early 1960s but now had developed a noticeable crack **(1)** and was regularly losing water. The surrounding concrete and wood decks were also failing **(2)**. In fact, the backyard was in motion, largely the result of rotted wood laggings in the retaining wall that flanked one side of the pool and was supporting everything **(3, 4)**.

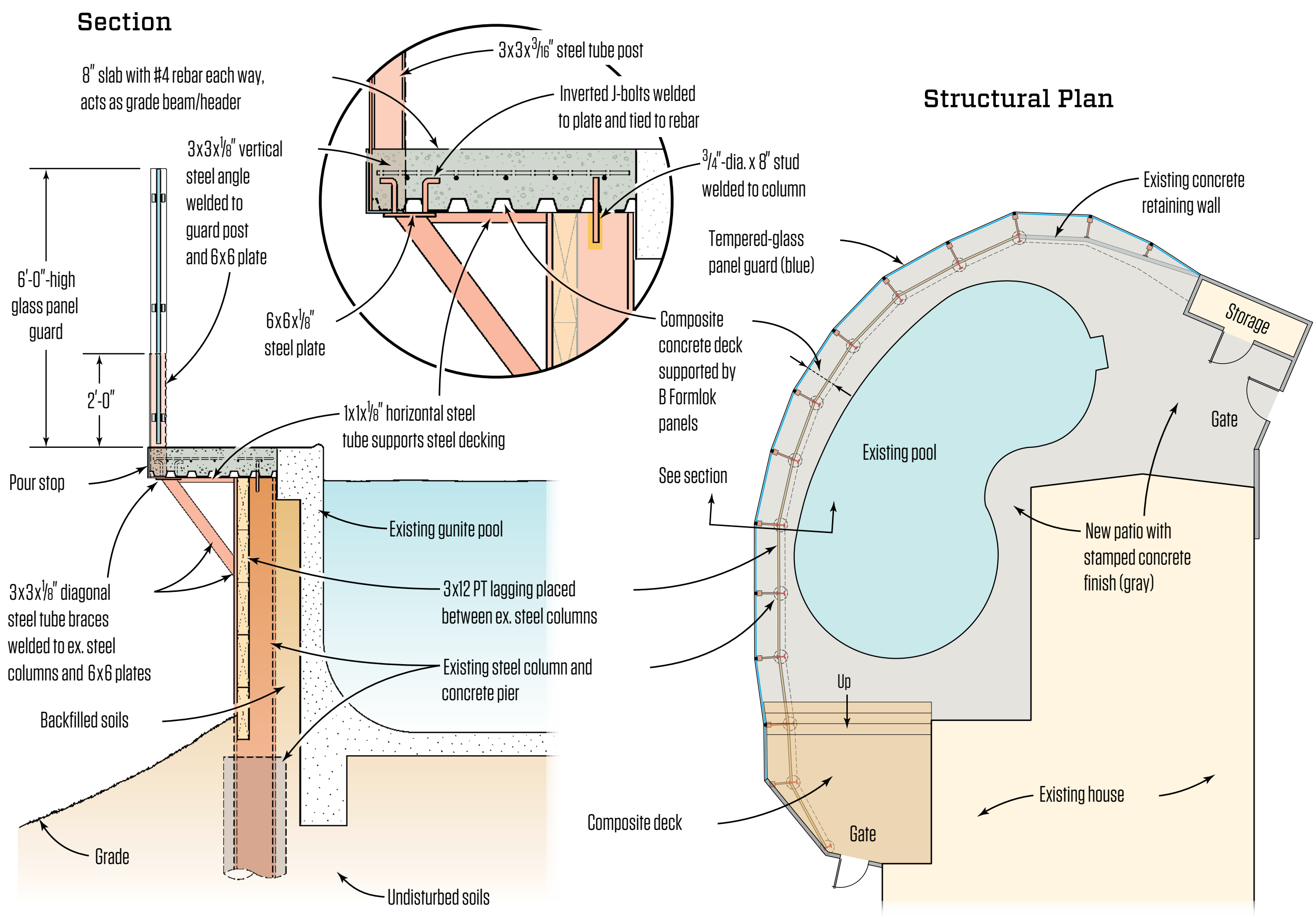
The existing retaining wall varied in height from 4 to 8 feet, and consisted of a series of vertical steel I-beams encapsulated in concrete. Perched atop the retaining wall around the outside perimeter of the pool was a cantilevered 4-foot-wide concrete-slab walking surface that was supported by a framework of wood and aluminum. While the I-beams seemed sound, there was no way of knowing for sure without stripping away the existing structures.

We thought that we could solve the problem by replacing the existing pool deck with an engineered system of square tubular steel framework supporting a steel-reinforced concrete slab. But the condition of the I-beams was one of the keys to the project: If they could be re-used, it would result in a $70,000 to $100,000 savings in the overall budget, because to bring in an excavator to drill new holes and set new steel I-beams in concrete on a 40% sloped hill would be no small or inexpensive task.

DIFFICULT SITE CONDITIONS

After discussing the situation with geotechnical engineer Dan

Pool Deck Retaining Wall Repair



Dyckman, who had evaluated the site, I investigated the condition of the I-beams. I have a strong background in metallurgy and a lot of field experience and decided that their condition appeared to be good enough to proceed with the project. But the pool was another stumbling block: Every one of the seven engineers who we initially contacted to design the project declined to bid, because it involved working on and around an existing pool (apparently, that was not permitted by their insurance carriers).

Another concern was that they all felt that the concept would have to rely on attaching support of the new concrete slab to the superstructure of the pool. In addition, there was no real design information about the existing concrete piers that were anchoring the steel I-beams, which would also have to support the cantilevered slab. Finally, with a 20-foot drop immediately next to the edge of the cantilevered deck, building codes required a robust guardrail system surrounding the pool area, which would be subject to major wind loads.

To solve these problems, engineer Javier Chavarria designed an 8-inch-thick, steel-reinforced concrete slab that would lie on top of B Formlok galvanized-steel pan decking. It would serve as both a header and a grade beam wrapping around one side of the pool and connecting to the thinner, main slab surrounding the entire pool. This would create a diaphragm effect, so that the main header/grade-beam slab would derive some of its strength from pulling on, or tensioning, the main slab. This element of the construction would run parallel to and over the retaining wall, and it would carry all of the loads and stresses of the I-beam wall, the pan deck with concrete, and the wind loads on a 6-foot-tall tempered-glass

Illustration by Tim Healey

enclosure, which would act as the required guardrail and as a wind block (see Pool Deck Retaining Wall Repair, facing page).

RETAINING-WALL REPAIR

Since the construction began during the winter, there was some concern about the possibility of the pool becoming a concrete boat and floating right out of its anchorage in the soil. If it rained, and the area surrounding and under the pool filled with water and became a buoyant force, it could overcome the weight of the pool itself. We were also concerned that as the timber laggings between the existing I-beams were removed, the pool might crack more and want to move down the hill and toward the existing failing retaining wall. In consultation with the soils and structural engineers, we drained only as much water as was necessary to reduce the stress exerted by the water in the pool on the pool wall and the existing crack, but still prevent the pool from floating.

After we completed demolition and exposed and inspected the I-beams, it turned out that only one (out of 17) had damage that required repair. That consisted of a 2-inch hole **(5)** that we repaired—to stronger than new—by welding two 8-by-12-by-¼-inch patches of steel plate onto the I-beam **(6)**. Then we cleaned and wire-brushed the I-beams, primed them with two coats of metal primer, and installed stout, 3x12 pressure-treated number-one-or-better Douglas-fir timber laggings. Temporary blocks were needed to hold the timber lagging in place until the retaining wall was backfilled, and we installed a cable to help reinforce the wall's rim while the wall was backfilled **(7)**.

The powder-coated tubular-steel knee braces that were needed

to support the pan deck were fabricated off site. This saved a lot of cost because all welding on site—except for welding the pan deck itself—had to be done by a certified welder and required special inspections. We clamped the knee braces in place using a jig we fabricated from tubular steel **(8)**. This held the railing secure and allowed us to precisely set the position of the braces while we welded the bottom end to the I-beam **(9)** and secured cross braces to support the pan decking **(10)**. The result **(11)** was a tremendously strong support system engineered to handle the load of the wet concrete that would lie on top of the pan decking.

PAN DECKING

Pan decking comes in various sizes and shapes and is usually made of galvanized plated steel. Ordinarily, it is specified in the design drawings, as was the case in this project, but it does not always have to be engineered. While we often work with steel, we weren't familiar with installing pan decking, but it turned out not to be that difficult.

The material, which looks very similar to corrugated roofing, can be cut using a standard wormdrive saw with a metal-cutting blade. We mitered the ends, just as you would miter a piece of decking, and used self-tapping screws and performed some MIG welding (non-certified) to install the pieces of the pan decking **(12)**. As long as the pan decking stays in place and can support the weight of the wet concrete, it is merely a form until the concrete hardens. We did have to protect the areas of welding by cold-galvanizing them, and installed a pour stop of ¼-inch-by-6-inch steel welded (also non-certified) to the posts to form the edge of the slab **(13)**.

At any of the joints in the pan decking—where concrete might leak through—we used duct tape as a sealer.

The pan decking was needed and installed only in the areas that cantilevered out over the retaining wall. Next, we tied up the matrix of steel rebar that would reinforce the slab **(14)**, as specified in the drawings. When Bob Peek and the crew from Burch Brothers Concrete poured the monolithic slab that tied the whole assembly together, they colored the concrete and stamped it with its finish surface. All of this was done without attaching to the pool at any point, just as the engineer had promised.

FRAMING THE DECK

Meanwhile, we framed a new deck at the end of the pool, which we later finished with Azek composite decking, again taking advantage of a cantilever design concept **(15)**. Using the I-beam retaining wall and various tubular steel arms, knee braces, and additional pressure-treated supports, we cantilevered the deck out over space. Much of the steel work was non-welded and consisted of drilling holes through the steel and then mechanically fastening the components together with bolts, a technique that we've often used on other hillside projects in the San Francisco Bay area.

GLASS GUARDRAIL

The crowning jewel of the entire project is the 6-foot-tall tempered-glass panel guard that surrounds one entire side of the pool **(16)**. That barrier—which serves as both a 6-foot-high pool fence and a 42-inch-high guardrail—was required by the Belmont Building Department, because the drop-off at the edge of

the concrete slab to the street below is as much as 20 feet. There was a $26,000 upcharge for the tempered-glass fence over a typical wooden fence, but our clients felt much more comfortable paying it after learning that the total cost to repair the I-beams was only $700 as opposed to the estimated $70,000 to $100,000 it would have cost to replace them.

The final design of the glass and posts—a collaboration of the owners, our structural engineer, Dave Capps of D.J. Capps Glass Company, and me—consists of blue powder-coated engineered 3-inch-by-3-inch steel posts and chrome-plated shower panel brackets **(17)**. The backs of the brackets were machined at various angles required to compensate for the radius of the pool **(18)**. The 6-foot-by-6-foot by 3⁄8-inch-thick tempered-glass panels—which needed to be delivered in several truck loads because of the tremendous weight—rest on rubber support pads on metal brackets welded to the posts. This glass—along with the steel posts, brackets, and anchorages into the concrete header-and-beam assembly—can handle the potential 100-mph wind loads that may act on it over the years.

BOTTOM LINE

In the end, this project was right on budget, and its success was largely the result of our company's ability to understand and work with steel. Steel frameworks are increasingly becoming a big part of what we do as deck builders in the San Francisco Bay Area, where many homes back up to or are near fire zones that require the use of heavy beams, fire sprinkler systems, and fire-retardant exterior materials.

Ray Petrin owns Hy-Tech Construction, in Belmont, Calif. This is a revised version of an article that originally appeared in Professional Deck Builder.