BUILDING TOUGH

Lifting Slab-On-Grade Homes

Structure meets style in Houston's flood zones

BY TED CUSHMAN

When Hurricane Harvey drenched coastal Texas with more than 60 inches of rain in the summer of 2017, tens of thousands of homes were inundated by floodwater. As of the summer of 2018, thousands of those homes remain unrepaired. But some houses in the flood zone escaped the damage suffered by their neighbors because they had already been lifted above the flood level. And in the year since the storm passed, hundreds more homes have been lifted to safe elevations.

At the heart of that story is a custom design-build firm called Arkitektura Development, headed by architect and contractor Phillip Contreras. Arkitektura specializes in lifting homes in low-lying Texas flood zones. Unlike most house lifters, Arkitektura also brings architecture skill to the task of reconstructing the homes' ground levels in a way that blends with the style of the original home, and Contreras strives to fit each newly lifted house into the visual context of the surrounding neighborhood. This spring, *JLC* visited Houston's flood-prone Meyerland neighborhood and met with Contreras on site to learn about his company's work.

Photos by Ted Cushman

NEIGHBORHOOD SCALE

The leafy street where we met with Phillip Contreras is like many other flooded neighborhoods in the Houston metro area: scraped

Tunneling along the footings. Here, Arkitektura's tunnel crew has excavated tunnels along all the grade-beam footings. Solid blocks with center pins have been placed under the footings at close intervals and driven into the clay soil with hydraulic jacks to the point of refusal. Now, the house is ready for lifting.

lots and unrepaired homes sit side by side with bulky new rebuilds and with older houses that have been either lifted or repaired where they sit.

On these blocks, Arkitektura's work is hard to miss. "We have three projects on this street," said Contreras, "two on the next street, four on the next street, and then as we spread out, they are just everywhere."

The Meyerland area flooded twice in the years just before Harvey, though floodwaters were not as deep as during Harvey's extreme rains. Because of the earlier floods, Arkitektura was already active in Meyerland. While the whole area was still underwater, a news crew boated down the flooded streets filming the devastation. Here and there, Arkitektura's work stood proud in the form of high-and-dry houses—often sitting just inches above the unprecedented floodwaters.

The TV segment was a great commercial for Arkitektura, Contreras said. But it begs the question: How high is high enough? In Meyerland, the rules are changing, Contreras explained: "Currently, if a house has been substantially damaged, they have to bring it up to the current code, which is the 100-year Base Flood Elevation plus one foot. But in September or October, there's a new rule coming out based on the 500-year floodplain elevation, plus 2 feet. So where it used to be like 3 to 5 feet above grade in this area, now we're going to be lifting 5 to 8 feet." Under the new rules, most of the homes Contreras lifted in the past would now be too low.

Is the new requirement right? "I have no idea," said Contreras. "Because it just seems like the flooding is not stopping. It's getting worse. But they've never had a Harvey. They've never had a hurricane come and sit over this area for three, four, five days and just dump water on it like that."

Lift and support. The house above has been lifted with a unified jacking system to its new elevation. Existing grade beams **(3)** for the original slab are exposed and are supported by stacks of 6-inch-by-6-inch solid-core block with center stacking pins. Large spans between the grade beams are temporarily supported by cribbing **(4)**, and the crew is excavating for a new slab **(5)**.

Some of Arkitektura's current jobs are funded by FEMA awards related to the two earlier flood events, and some are privately financed. None of his current work is paid for by insurance from Harvey claims, Contreras told us: "The grants from Harvey probably won't happen for another two or three years." So some homeowners are repairing their homes on grade where they sit, and hoping to elevate later, when funds become available.

Often, Contreras says, he'll contract to lift a house when the building is fully gutted. But by the time he comes back to do the work, the homeowner has restored the building finishes already. "I say, oh my gosh, let's get this up as soon as possible," said Contreras. "This area has flooded several times already, and it's a lot of work and expense to finish them out, only to get flooded again."

But Contreras doesn't have to damage any existing interior work in the process of lifting a building—not even the floors. "Some foundation companies punch holes in the floors trying to find the grade beams," he said, "and it's like Swiss cheese in there by the time they're done. But we don't break through floors like that; we tunnel under from the sides."

TUNNELING UNDER

Much like other homes in the Houston area, existing homes in Meyerland are built with structural-grade-beam-and-slab foundations. Because of the area's soft, unreliable active clay soils, the grade beams usually bear on deep piers driven down to a depth below the "active zone." At these lower levels (12 feet below grade is typical), the soils are less exposed to changing weather and thus more stable. Typically, piers have "under-reams" at this lower zone of sound soil—bell-shaped thickened sections, formed directly in the soil using a special auger.

New underpinnings. Supporting the heavy slab foundation and its house requires beefy new structure beneath the house. Here, a worker builds a rebar cage **(6)** for a 16-inch-by-16-inch main support column. The rebar cage will be set into holes drilled into the newly poured grade beam **(7, 8)**. At lower right **(9)**, the crew member readies the heavy 16-inch-square block for constructing the column. Once the blocks are stacked and mortared in place, the pier will be fully grouted to create a solid masonry column.

To lift the house, Contreras's team starts by digging tunnels by hand beneath the house, to locate the grade beams. The beams are commonly found underneath bearing partition walls in the home above the slab, which provides a clue for the digging crew. Next, the team places solid-core concrete block with center alignment pins at intervals of 4 to 6 feet underneath the structural grade beams, along every grade beam within the home's footprint as well as all around the perimeter. Using hydraulic jacks and stacking block atop block as they go, the crew drives the columns into the soil "to refusal"—at which point any further jacking would begin to lift the slab.

At that point, the crew cuts any structural connections between the existing grade beams and the existing bell-bottom piers. Individual jacks used to drive the new block piers are replaced with a "unified jacking system," setting the stage for a slow, steady, continuous lift.

LIFTING THE STRUCTURE

Lifting a house can take all day, or even several days, using the unified jacking system. One central hydraulic pump operates all the jacks in the system, allowing smooth calibration and a simultaneous lift. "Most of these houses require a 24-port system," said Contreras. Each port can run three jacks, so the system permits as many as 72 lift points under the slab. As the jacks slowly raise the house, the lift crew pauses the lift every so often to stack the cribbing and block supports higher under the building.

The lift proceeds at least up to the required flood elevation for the location, but some lifts go higher (at an additional cost, of course). In the example shown on page 42, a full story was added underneath the existing house. The ground-level space is not allowed to be occupied, but it may be used for parking, recreational activities, or storage of belongings.

Elevating a Slab Home

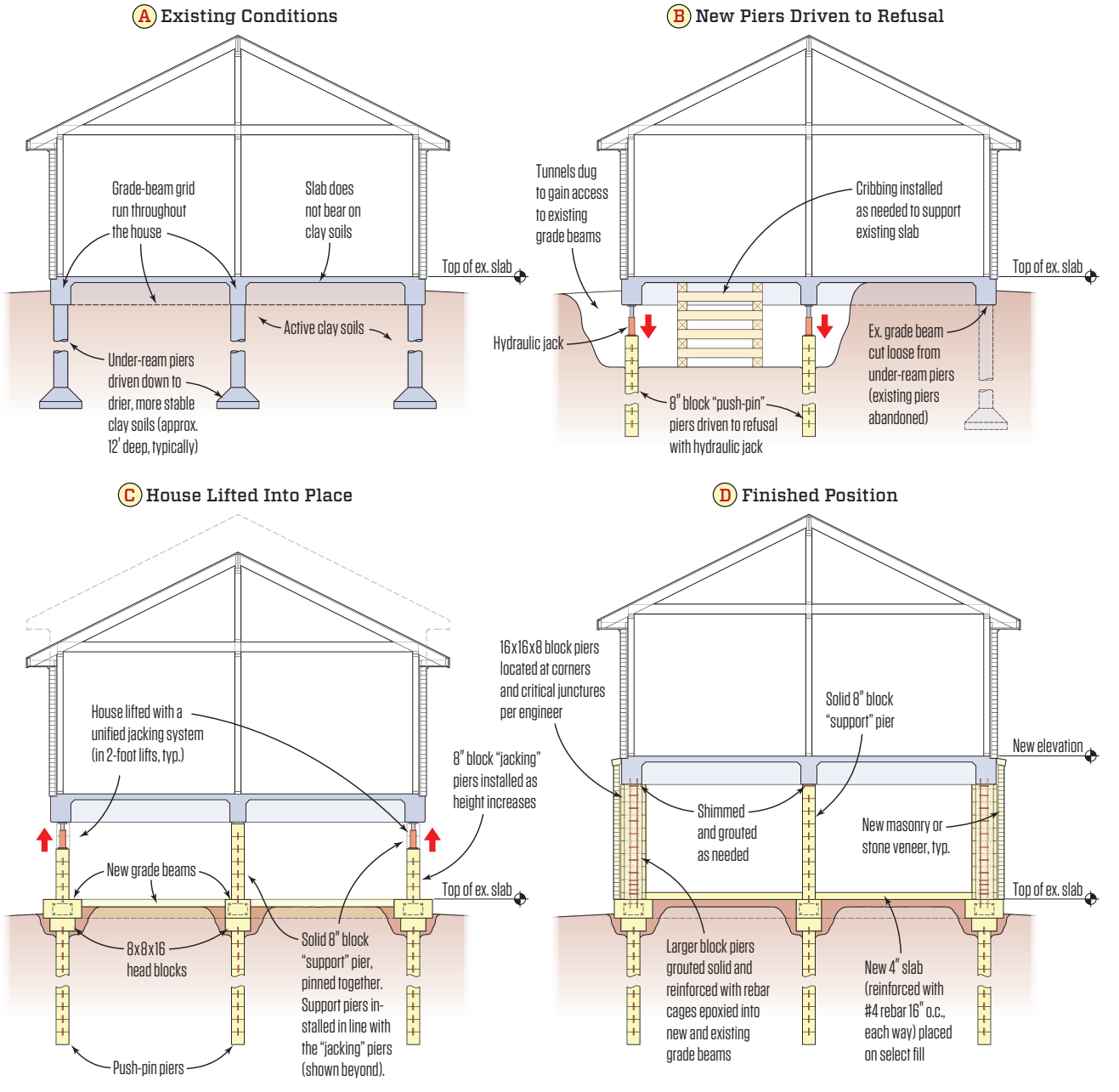

Illustration by Tim Healey

Old tree, new roots. Existing houses at street level in Meyerland and similar Houston neighborhoods may have slab foundations resting directly on difficult clay soils but are likely to have foundations as shown in figure A, with deep bell-bottom piers supporting grade beams that in turn carry the first-floor slab. To lift these houses, Arkitektura drives push piers into the soil around the existing grade beams (B), driving piers to the point of refusal. Once the piers have developed sufficient capacity, a unified jacking system begins to lift the house (C), with pin piers and cribbing installed with every 2 feet or so of progress. Finally, permanent supports are added (D), including 16-inch reinforced piers at corners and critical interior locations.

Finishing touches. Arkitektura's work is set apart from that of many house-lifting companies by the attention to architectural and finish detail. Above is a new entry stair in the grade-level space under the house **(10)**. Exterior decorative details are also key. Here, a mason clads a new exterior column on the street side of the building **(11)**, using original matching brick **(12)** salvaged from the home next door, which was demolished after the flood.

SUPPORTING THE SLAB

As the jacks lift the house and its slab up into the air, workers pause every 2 feet or so to stack additional blocks onto the supporting piers and to add cribbing in areas of the slab that span long distances between reinforced beams. Once the blocks and cribbing have gotten high enough to support the building at its new permanent height, the lift is stopped and the building is set gently back down onto the new supports.

The original house was supported by its steel-reinforced concrete grade beams, which rested on the earth but were also supported by deep concrete piers with under-reamed bell footings. The reinforced slab of the original house had some capacity to span between these grade beams, but it was also partially supported by the ground. Once the house is lifted, the ground is no longer helping to support either the grade beams or the slab. So the new pin-block columns have to be spaced closed enough together to hold up the grade beams. Also, steel beams may be necessary at mid-span points under some wider areas of the newly elevated slab. In cases where the design calls for open spaces under the house for the homeowners to use, steel beams may also be used to support the grade beams between larger columns, in order to replace some of the block supports (see facing page).

ENGINEERING OVERSIGHT

All this heavy engineering requires expert supervision. To learn more, *JLC* spoke with professional engineer Chandra Womack, of Aran and Franklin Engineering, near Galveston, Texas. Womack's firm works closely with Arkitektura on every house lift, starting with a preliminary evaluation. "Once the house is raised," said Womack, "we can look at how big the foundation is, how deep it

Fitting in. The leafy tree-lined streets of Meyerland **(13)** define the neighborhood's character. As Arkitektura lifts house after house to the new required elevations, Contreras designs and builds transitional elements to join the elevated homes to their existing streetscape **(15, 16)**. Homes that are lifted high enough also get customization of the ground level **(14)**.

is, how wide it is. It's hard to tell these things before they dig it out and raise it; but to do that, they need a permit. So we do an initial permit drawing set of our best guess. Then after they dig it out and start raising, we make some field adjustments based on actual conditions."

Besides the initial evaluation, Womack's team does at least four more inspections during the job—what Womack calls "30-60-90 inspections" plus a final inspection. "Thirty is when the piers are pushed, and the house is lifted; sixty is when the grade beams are formed, and they are forming the columns. Ninety is where everything structurally is in place—so all the columns are done, grouted, cored, attached, and the grade beams are completely done. And then final is when the skirts are on, the vents are in, the air conditioning platforms have been lifted and raised, the stairs are in—all those finishing things to actually access and use the house are done."

ARCHITECTURAL FINISH DETAILS

But Contreras brings his own expertise to bear in those final details: skirts, stairs, railings, and the like. "We use a little more time on the details at the base of the house," he said, "to make it a lot more interesting and to integrate more into the house, instead of just looking like a house that was lifted and some masonry thrown up around it."

"People love this neighborhood," said Contreras, "and people love their homes. That's another reason for elevating rather than replacing that I hear a lot from people. They say, 'Okay, we're going to tear down and rebuild.' And the wife says, "Okay, but I want this same house.' They want the same floor plan, the same everything. And so in the end, they say, 'Well, then let's just lift it!'"

Ted Cushman is a senior editor at JLC.