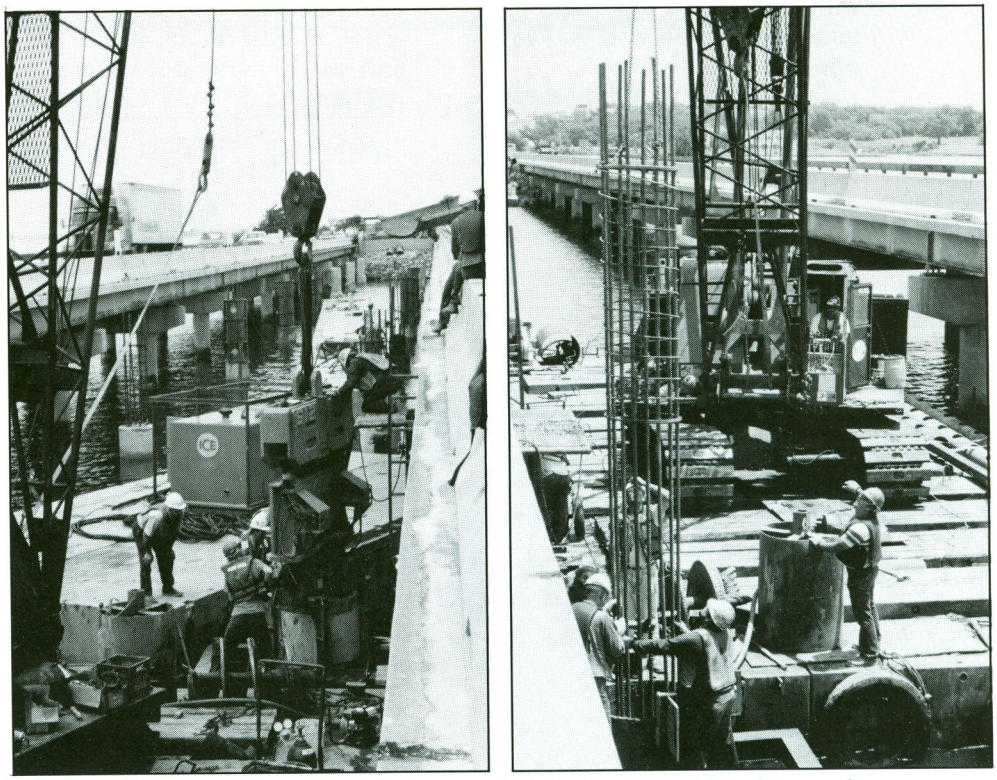
Underwater and Between Two Bridges: It Rocks But It Don't Roll

by S. Scot Litke

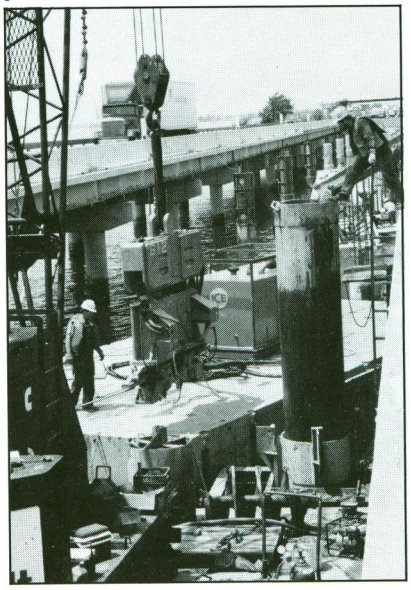
What goes underwater, is 86 ft. deep, and is installed between two existing high traffic bridges 30 ft. apart? Correct . . . a typical drilled shaft foundation system. The site for this day-in-the-life of a drilled shaft job is Highway I-30 over Lake Ray Hubbard near Dallas, Texas. ADSC Contractor Texas Shafts, Inc., Fort Worth, Texas, is tackling this complex project. Texas Shafts, under the leadership of Ty and Marie Savage, find themselves doing a good deal of highway work these days. The drilled foundation industry overall is finding that most of its activities are in the public sector.

The Lake Ray Hubbard Interstate-30 project is a three phase affair with an overall construction price tag of some $50 million. Part of the project is to construct a new bridge between two existing bridges. Once completed, one of the two existing bridges will be torn down. Phase two will be to build a second new bridge where the old bridge was and then tear down the remaining old bridge and build a new one there. Thoroughly confused? The result will be one eight-lane bridge to accommodate the ever-increasing traffic flow across Lake Ray Hubbard, which links Dallas with several growing eastside satellite cities. Phase one commenced in April, 1992. There are 72 shafts in the water in each of the three phases. Texas Shafts expects that its part will be accomplished in three four-month segments with an overall completion date of January, 1994.

While the drilled shafts themselves may not be inordinately daunting in size, ranging in diameters of 36 to 42 inches and depths up to 86 feet, the logistics are imposing. Each project segment will be constructed in such a way as to create minimal impact on daily traffic flow. Any work that must be performed from the bridge deck is restricted to a 9:00 a.m. to 3:00 p.m. window. This is to minimize the impact on heavy commuter-time traffic. Texas Shafts runs two shifts whenever necessary.



Vibrating casing (left) and placing reinforcing cage (right) under very tight working conditions. Drilled shafts and bridge piers in various forms of completion are visable.



Concrete being poured into inner casing.

While the 86′ overall depth may not be out of the ordinary for innovative drilling contractors, dealing with an average water depth of 30 ft. is another thing entirely. Construction has to be accomplished within a 30′ space between the existing bridges.

This creates a single concrete column to full depth, a Texas Shafts creative design revision.

All work is being done off of barges, which serve many purposes. First, they comprise the

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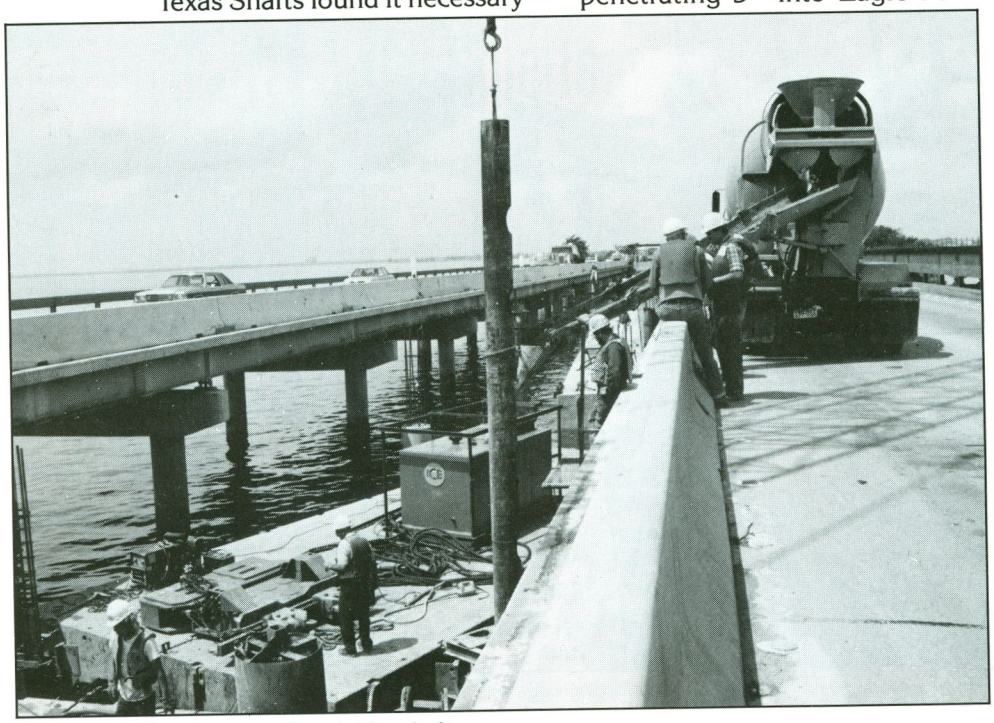
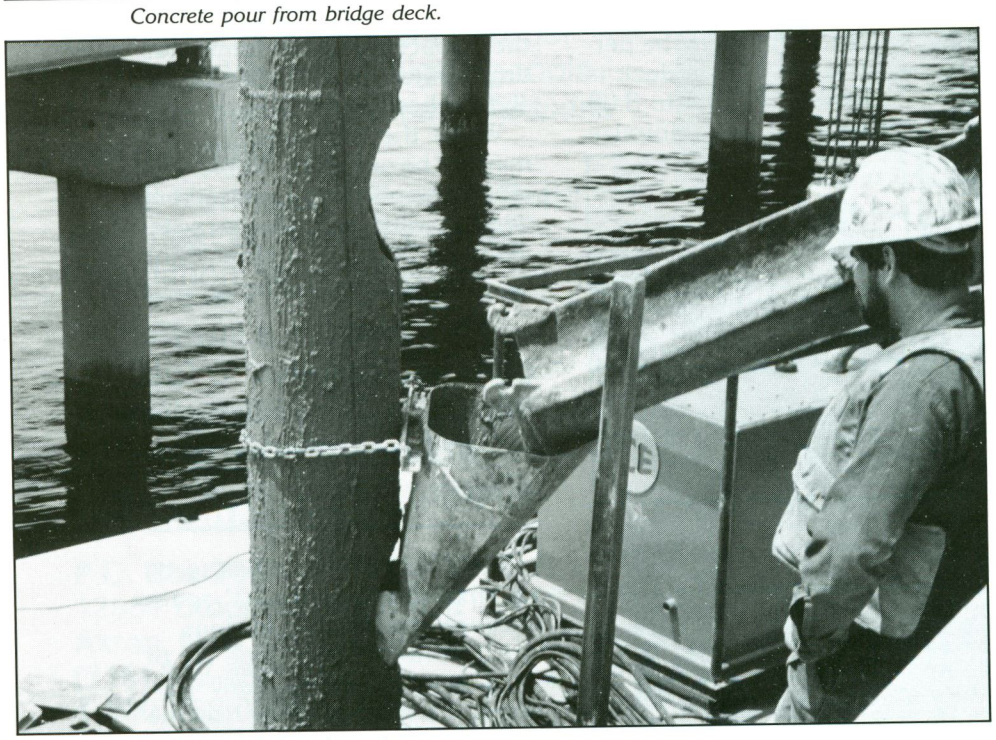
drilling platforms. Secondly, all equipment, tools, and spoils have to be continuously moved over water, to and from the site. Flotation considerations alone required some creative solutions. Add to this the ever-present lake winds (up to 40 mph) and resultant wave action and you've got one heckuva picture.

Texas Shafts found it necessary to purchase a small tugboat to move barge-laden materials. Job superintendent, "Capt." Gary Martin, ably navigates the craft in what is often very tight quarters.

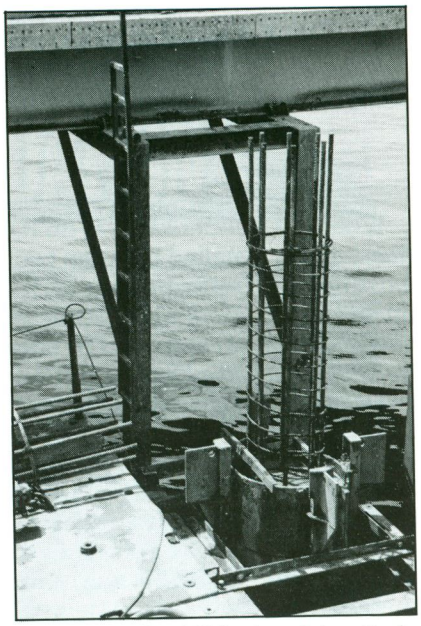
The combination skin friction and end bearing drilled shafts are being installed through 25-40′ of water, then through 40′ of clay and sandy materials, ultimately penetrating 3′ into Eagle Ford shale. The shafts are steel reinforced for full depth. Five inch slump concrete is placed through a full length sectional tremie. The full length cages include dowel cages into the top 11′ above the surface. The drilled shafts are extended as above surface columns which become piers for the bridge members.



Concrete pour from bridge deck.



Note special slotted tremie.



Centering and stabilizing templates attached to bridge deck and flotation barge.

All shafts are cased and are being installed in a unique fashion. Both an outer and inner casing is required. The job was originally designed for full length (75′) permanent casing, with 5′ of exposed formed concrete underwater and five feet above. Texas Shafts took a close look at the job and came up with an innovative alternative. Their solution was to place a split casing to the lake bottom (25-40′). This constituted a temporary outer casing. An inner casing is then driven. The concrete is poured into the inner casing. The temporary casing is then removed and concrete flows into the annular space between casings, displacing remaining water. After the concrete achieves its initial set, the split casing is removed. This creates a single concrete column to full depth, a Texas Shafts creative design revision.

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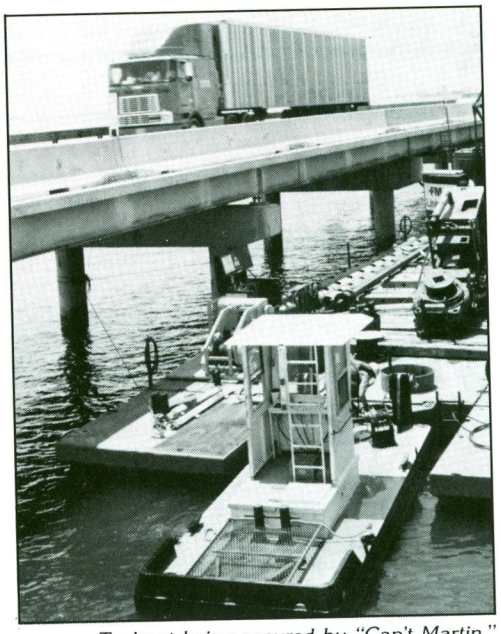

Tugboat being secured by "Cap't Martin."

The rebar cages are fabricated on land in two segments, floated out to the site, then spliced together for placement. In that the working space is only 30' wide, and there is an absolute limit on floatation capacity, there is a resultant limit on boom length. And don't forget the fact that the boom only has a maximum 30' swing radius due to the narrow work area between two existing bridges.

One may ask the question, "Where do they store all this equipment?" For the most part, it has to be transported to and from the drilling location on barges, however, in one instance Texas Shafts came up with a simple yet elegant solution. Question: What do you do with the casings? Answer: Store them on the lake bottom. Once used, the casings are attached to cable harnesses and lowered to the lake bed where they rest attached to a float. When needed, the cable harness is grabbed and brought to the surface by the barge-supported service crane.

The shortened working window (9:00 a.m. to 3:00 p.m.) causes other problems as well. Texas Shafts is able to get four holes drilled and poured each week. A pour is set for every three days, therefore coordinating the drilling and follow-up concreting requires exact scheduling. The concrete trucks use a closed bridge lane for access inside that 9-3 time frame as the pours must be made from the existing bridge deck. Combine this with the requirement that the concrete inside the split form casing needs 24 hours to set-up before exposure and you have one heavy-duty coordinating effort.

Texas Shafts is using a Stewart and Stevenson drill rig mounted on a 60 ton Link-Belt crane. The crane does double and triple duty on the overwater site.

Casing on its way to lake bottom storage. Finished drilled shaft (center right) with extended reinforcing.

ADSC Director Bobby Harris, H&H Foundation Drilling, is acting as a consultant to the project.

The project is owned and was designed by the Texas Department of Transportation. The General Contractor is Granite Construction, whose Dallas division is managing the project.

The forward thinking Texas Shafts inspired redesign and innovative construction techniques, coupled with the cooperation of the Texas Department of Transportation, and positive working relationship with Granite Construction have all made this complicated job click.

Phases two and three will be made somewhat simpler by the fact that construction will not be taking place between two existing bridges, but rather under more open water conditions. That could present another scenario for "opportunities."□