Designing for the Real World

Kleinfelder focuses on ensuring that its designs meet every stakeholder's needs while offering efficient constructability

by Craig A. Shutt

Kleinfelder's combination of engineers, scientists, and construction professionals has provided infrastructure solutions to clients since 1961. The company, which has grown in size and geographic range through a series of acquisitions and expansions, focuses on every aspect of designing and building constructable, efficient, and attractive projects.

In-House Expertise

One element of Kleinfelder's success derives from its in-house capabilities. "We pride ourselves on being able to provide in-house expertise, especially in areas like geotechnical and construction management," says Jim Frost, Kleinfelder's San Diego, Calif.,–based West regional structures manager. "We often are building below-grade structures and have the capabilities to design all types of bridges."

In the bridge world, the greatest challenges may be found below ground, Frost notes, and such challenges can greatly affect the final design and construction of the structure. "The design often is the easy part of the project," he states.

"Our geotechnical services greatly enhance our ability to collaborate easily and create efficient designs," says Robert Torres, a senior program manager who manages the geotechnical department in the San Diego, Calif., office. "We work closely with the designers, especially early in the process. It's not as complicated when you're all under one roof and not emailing and setting up meetings."

The geotechnical department provides earthquake and seismic design, engineering geology, foundation design, geotechnical engineering, and related services. The department "plays an important role in most of our work, but it often goes unnoticed," Torres says. "We deal with issues from the ground down. People never get to see what we do."

Kleinfelder conducted an extensive investigation and material evaluation on the 85-year-old North Torrey Pines Road Bridge, in Del Mar, Calif. The result was rehabilitation and a seismic retrofit featuring a new post-tensioned superstructure consisting of 80 custom-built haunched precast, prestressed concrete girders that replicated the existing structure's appearance. All Photos: Kleinfelder.

A good example of the work that this department does can be seen in the 85-year-old North Torrey Pines Road Bridge, which underwent rehabilitation and a seismic retrofit in 2015. When the sufficiency rating of the historic 550-ft-long bridge in Del Mar, Calif., had dropped to 19 by 2008, many people thought it should be replaced. However, the community wanted to save the signature bridge. Kleinfelder conducted "an exhaustive investigation and materials evaluation," says Keith Gazaway, principal engineer in the San Diego, Calif., office. The assessment included delamination surveys, material sampling and testing, and nondestructive and destructive testing. Condition evaluations, seismic retrofit solutions, and replacement options were analyzed and presented in public meetings with detailed visual simulations.

Kleinfelder's efforts resulted in the rehabilitation design of the 15-span, cast-in-place reinforced concrete T-girder bridge with a new post-tensioned superstructure consisting of 80 custom-built haunched precast, prestressed concrete girders that replicated the existing structure's appearance. (For more information about this project, see the Fall 2016 issue of *ASPIRE*®.)

"Torrey Pines was a complex project, with its history, difficulty with constructability in the area, and the number of stakeholders involved," Gazaway says. "It required a complex solution, and that's what we provided."

Another of the firm's signature services is its construction management team, which focuses on a project's constructability in all phases. "We can create a package of review that ensures an efficient, constructable design that goes from examining beneath the ground through construction," says Frost.

In many cases, construction management includes juggling various funding sources, says Gazaway. "There can be complicated decision matrices with various funding sources earmarked for specific purposes," he explains. "Some funding will cover only specific areas, and our clients want us to help their projects qualify for as much funding as possible."

Bridge Rehabilitation and Replacement Projects

Local officials often want Kleinfelder to evaluate their bridges for both deterioration and functionality. "Many bridges were built in the 1950s and need work," Gazaway says. "At the same time, population growth has boomed, putting more demand on these structures. We evaluate if bridges need to be repaired and also how they could be widened to better handle more traffic."

Usually, the firm develops several alternatives, he adds. "We present the issues [to owners] for all approaches, and let them decide based on their own agenda and needs." In some cases, Kleinfelder's evaluations lead to the rehabilitation of a structure instead of its replacement. A significant portion of the company's work involves either rehabilitating bridges (making minor repairs and upgrades) or retrofitting them (making more substantial improvements). "We do more replacement projects than rehab, but we do a lot of both," Frost says.

Owners today want to spread their funding as widely as possible, leading to more rehabilitation projects, notes Wade Brown, a principal professional in Kleinfelder's Manchester, N.H., office. "We are performing many more rehabs on the East Coast because of the challenges with the aging infrastructure and the limited funds. The trend is definitely to extend the lives of existing bridges.... [These efforts] range from small-scale projects to major rehabs and partial replacements."

Historic bridges require especially careful evaluations, says Brown. "I don't know if there is a general desire or trend to retain older bridges, but certain bridges have obvious historic value."

That was the situation with the historic rehabilitation of the U.S. Route 44 Bridge over the Quinebaug River in Putnam, Conn. Kleinfelder was the primary consultant and worked with the in-house bridge and structural-design staff of the Connecticut Department of Transportation. The 68-ft-long, single-span reinforced concrete arch bridge was constructed in 1925 as a World War I memorial. In 2016, its superstructure was rehabilitated to restore its "aesthetic and historic value," says Brown. The project includes precast concrete components with high-performance concrete for sidewalk brackets, ornamental parapets, and light posts to replicate the original appearance.

The bridge's "rehabilitation married new and old, which made it very challenging to design and construct so the new fit perfectly with the old," Brown explains. That was especially the case with the precast concrete parapets, which are highly visible and of architectural importance. "The plans and supplemental specifications included numerous very specific details and instructions to the contractor that were explicit toward establishing an accurate final product."

But Frost warns that repairs are not a panacea. "Rehabs often just push problems down the road by 15 years, which won't solve them," he states. "By that time, costs and traffic loads both will be higher. We need to be doing more life-cycle analyses on all of our infrastructure and make good decisions."

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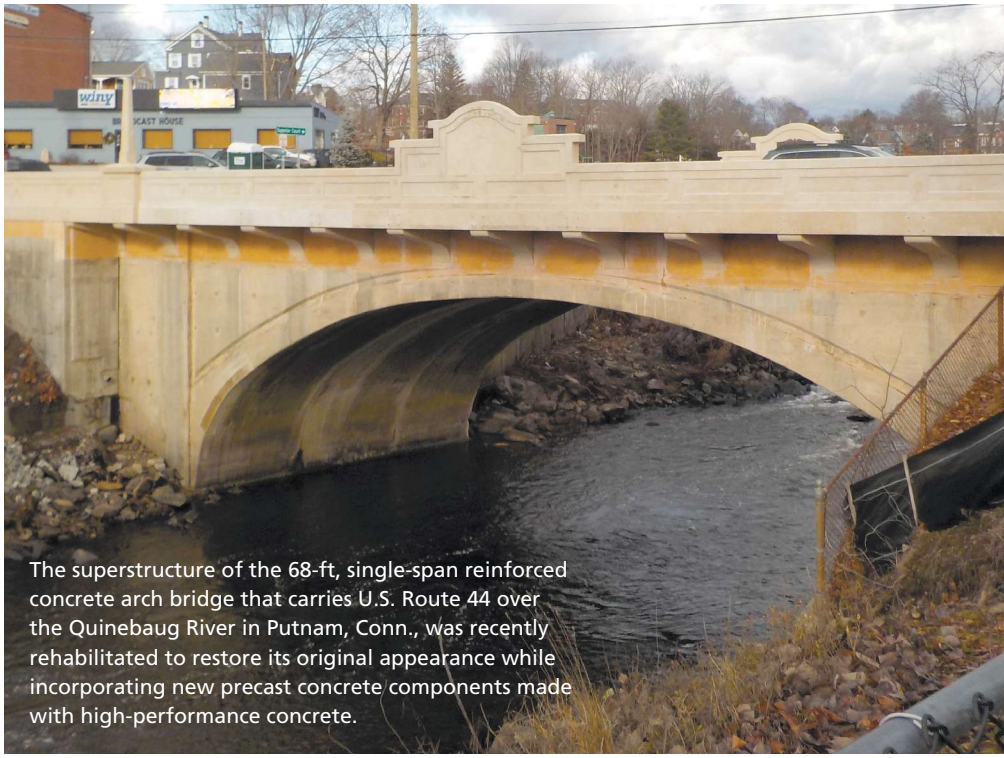
One recent technological change to Kleinfelder's evaluation process has been the introduction of drones. The firm now has a section that specializes



The superstructure of the 68-ft, single-span reinforced concrete arch bridge that carries U.S. Route 44 over the Quinebaug River in Putnam, Conn., was recently rehabilitated to restore its original appearance while incorporating new precast concrete components made with high-performance concrete.

On the Mid-Coast Light Rail Transit Project in San Diego, Calif., Kleinfelder is providing structural and bridge engineering, geotechnical, environmental, and construction management services. The $1.7 billion project includes nearly 11 miles of trolley track over multiple bridges and two elevated stations.

in using drones, notes Frost. "They [the drones] help us get a better idea of a bridge's condition in places we can't easily inspect," he says. "They also prove helpful with railroad-track inspections, to ensure the rail is in good shape throughout its length."

The firm has more it would like to do with drones, he notes. "We're not completely there yet, but it's definitely an up-and-coming area, especially for extensive projects. It's not a mainstream service yet, but it's coming."

Areas of Recent Growth

Through the years, as Kleinfelder's expertise has grown and expanded, so have the types of projects it undertakes. For example, Kleinfelder has taken on light- and heavy-rail system projects. "We've done a lot of transit and heavy-rail projects in recent years, and we expect that will continue due to the market's direction," says Frost. "Caltrans [California Department of Transportation] does most of its own design work, but we've carved out a niche in city transit work, replacing heavy-rail infrastructure and larger bridges owned by states and cities but funded in part by FHWA [Federal Highway Administration]."

One such project is the Mid-Coast Light Rail Transit Project in San Diego, Calif., where Kleinfelder is providing structural and bridge engineering, geotechnical, environmental, and construction management services. The $1.7 billion project includes nearly 11 miles of trolley track over multiple bridges and two elevated stations. "We're mainly using cast-in-place concrete box-girder bridges, but there are a few precast concrete girder bridges and concrete slabs," says Gazaway.

The geotechnical office has also been involved in this project, doing 385 exploratory borings over the 11-mile length and providing seismic analysis for design criteria on earthquake loads, site accelerations, fault studies, and other needs. "We worked closely with the structures team to determine how the design could tolerate movements," says Torres. Ultimately, 10-ft-diameter concrete piles (drilled shafts) were installed to a depth of 150 ft. "These were large foundations for a river crossing."

Another area of growth has been pedestrian bridges, which often require more aesthetic attention and community involvement. An example is the Ted Williams Parkway Pedestrian Overcrossing in San Diego, Calif., for which Kleinfelder provided environmental planning and design services. The bridge provides a direct connection over a busy intersection for children attending an elementary school.

"The project had a lot of community involvement," Gazaway explains. "Safety was at the forefront, and the community was particularly sensitive to its construction." The design features 140-ft-long precast concrete bulb-tee girders, which had not previously been used in southern California. Kleinfelder worked closely with the precaster to ensure that the 67-ton girders could be fabricated and transported safely to the site.

Aesthetics also were a key concern for

The Ted Williams Parkway Pedestrian Overcrossing in San Diego, Calif., allows schoolchildren to safely cross a busy highway. The bridge features 140-ft-long precast concrete bulb-tee girders and unique columns that match the wall structures in the neighborhood.

The Mid-Coast Light Rail Transit Project primarily features cast-in-place concrete box-girder bridges with a few precast concrete girder bridges and concrete slabs. The bridges range in length from 73 to 4600 ft.

the community, he notes. Kleinfelder coordinated the bridge's architectural treatment with the City of San Diego and the Carmel Mountain Ranch Community, leading a series of meetings and field trips with the neighborhood's architectural committee to discuss visual options and local interests. With residents' input, Kleinfelder designed the bridge aesthetics and landscaping to complement the theme of the surrounding neighborhood. This work included concrete stain, stone cladding, community icons, and decorative railings portraying familiar mountain scenes.

Looking to the Future

Projects are often being completed faster, thanks to the use of accelerated bridge construction (ABC) techniques. "Owners are more open to ABC thanks to FHWA's encouragement," Frost says. As part of that, he'd like to see more attention and encouragement put into the up-front elements of ABC, especially streamlining and accelerating the permit process.

"We need to work harder from inception to when construction begins," Frost states. "We talk about ways to build faster, but we need to talk about the five to ten years it takes to get the plans to construction. We need to get everyone focused on moving faster, including resource agencies, coastal commissions, and historical groups..."

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That's not to say they should take shortcuts, he stresses. "A lot of people need to weigh in, but many bridges we build aren't that controversial and should be able to get going quicker. We spend a lot of time studying issues to prove that point."

Frost also worries about the supply of skilled labor and materials to build infrastructure projects once they are funded. "Sooner or later, the infrastructure will have to be addressed," he says. "I'm concerned especially about having qualified engineers available to do design work as well as contractors and access to materials. There could be shortages all around."

As civil engineers retire, they will need to be replaced. "We will lose a lot of senior leadership and not have college graduates to fill in," Frost warns. "We need to convince more students to go into engineering today."

Kleinfelder wants to help resolve that issue by going into the community to promote engineering and the challenges and rewards of civil engineering careers. Staff from the San Diego, Calif., office recently took part in a high school program, in which they talked to students about seismic conditions. Their presentation included a shake table to show how earthquakes affect structures.

Like his colleagues, Torres has become involved in educational outreach. He serves on the board of the engineering curriculum at a local high school; visits classes at the elementary, high school, and university levels; and hosts student visits to his office lab.

Kleinfelder's History

In 1961, Jim Kleinfelder established Stockton Testing and Controls in Stockton, Calif., to test construction materials. In 1963, he bought out his original partners and expanded to Merced, Calif., beginning a series of expansions and mergers.

Kleinfelder is a privately held firm. It grew from 30 employees and approximately $300,000 in annual revenue by the end of the 1960s to more than 1950 employees with more than $325 million in revenues by 2010.

In 2016, George J. Pierson, formerly president and chief executive officer of Parsons Brinckerhoff, became the firm's fifth CEO. The company was listed as the 55th top design firm in *Engineering News-Record's* 2017 rankings.

"Students at all levels get very excited when we show them what we do," he says. One recent high school class saw the team test concrete cylinders to failure and examined soil core samples with various strata. "They were amazed, because they didn't know jobs like this existed."

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Torres saw how these outreach efforts can succeed when he recently received an email from a student who now attends California Polytechnical Institute at San Luis Obispo. "He thanked me for letting him visit and said it made him want to work in the field," Torres says. "He's now studying civil engineering at the university."

Kleinfelder's team will continue to balance various design needs, stakeholder concerns, constructability issues, and every element of the project from beneath the ground up. As it does, the company is also keeping an eye on the future and helping to prepare future generations for what no doubt will be even more challenging projects.