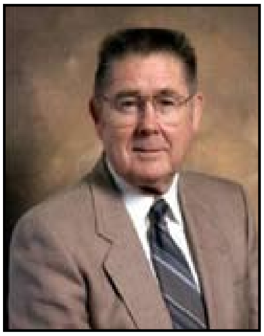
James E. Roberts.

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More Than an "Engineer's Engineer"

By Richard A. Dokken, P.E., S.E. and Matthew W. Salveson, P.E., Ph.D.

Jim Roberts held a number of significant engineering titles throughout his fifty-plus year career, including state bridge engineer for California and chief deputy director for the California Department of Transportation. He was a leader during the State's highway and bridge construction boom in the 1950s and 1960s. He is the only Caltrans employee that has ever been inducted into the National Academy of Engineering. He earned his Bachelor of Science degree in engineering from U.C. Berkeley, his Master of Science from the University of Southern California (USC), and was a registered professional engineer. His obituary labeled him as "An Engineer's Engineer," a term that was respectfully coined by a coworker. Roberts did not identify himself as an engineer's engineer, however.

It should be noted that Jim Roberts very much looked and acted the part of an engineer. He carefully maintained his flat top haircut throughout his life, and started working at Caltrans in the 1950s when strict business dress codes were the norm. He was punctual, reliable, and had a tremendous work ethic.

His professional attitude in the office carried over, in part, from his military experience. He served in active duty in the Army Corps of Engineers during the Korean conflict, and would eventually serve 33 years in the Army Reserve. He retired as a colonel.

Early Years

Jim Roberts was born in 1930 in Missouri, and moved to California with his family when he was six years old. His career at Caltrans started in 1951, as a junior engineer, before he had completed his B.S. degree from U.C. Berkeley. He later earned his master's degree while working full time as a resident engineer at Caltrans. For several years, he would log a full day at a job site in the Central Valley, and then make the 6 hour round trip to USC for evening classes. He was always the first one to the office in the morning.

After accumulating a decade of field experience, Roberts was assigned to Caltrans' bridge Design Section 2 in 1962. His mentors in the design section were engineers that would go on to be public works directors and CEO's of engineering firms. The early 60s was a time of tremendous change in bridge engineering. Engineers still spread out on large design floors, bent over their slide rules and used a Monroe calculator. But, computer horsepower had recently become available, and one of Roberts' Section 2 coworkers, Mr. Richard Dokken (one of the authors of this article), was at the forefront of computer aided bridge design. Roberts learned quickly, worked fast, and asked questions constantly. He soon mastered not only the conventional bridge design techniques of the time, but also absorbed the importance of the new computer aided wave of bridge design. Roberts' bridge projects grew in importance as his experience grew.

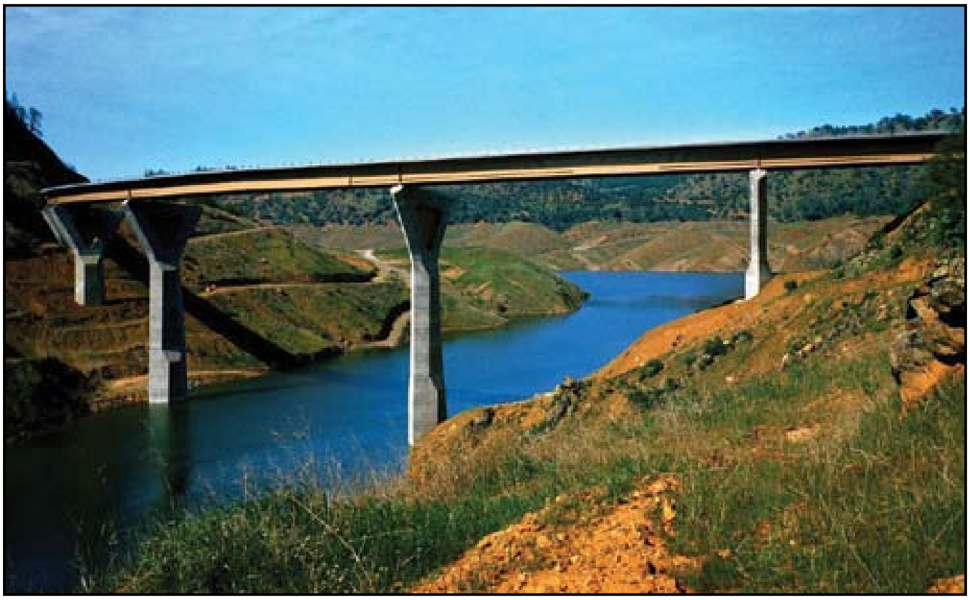
The James E. Roberts Memorial Bridge

In the 1960s, all steel bridges were straight and painted green. Curved steel bridges used short spans with straight girders flared to accommodate the highway curves. Seismic design used the equivalent static force method, with 6% being common. The slide rule was used for most design calculations. The first large bridge design that Roberts was responsible for as a senior engineer was the Tuolumne River Bridge in California's Tuolumne County. The bridge was substantially different from other steel bridges of the time. It was a 6-span, 1,400-foot long bridge on a 1,200-foot radius, with a 350-foot main span and an 8 percent super-elevation. Time was of the essence, as the bridge would be constructed over a river, but the river was about to turn into Lake Don Pedro. The water would come whether or not the bridge was complete.

The design required the engineers to think outside of the box, because the design standards of the time did not fully address many of the structural issues that this bridge presented. Research was underway nationally on curved steel girders with spans as long as 150 feet, substantially shorter then the planned spans on this bridge. Preliminary longhand calculations of the structure implied results that were substantially different from those of a traditional short span bridge, and the available design tables were completely inadequate to handle the three dimensional effects of this highly curved bridge. Caltrans had recently purchased a new state-of-the-art IBM system 360 for roadway design and accounting, complete with an IBM "customer engineer." When pressed for available software bridge applications that might be appropriate for this project, the Customer Engineer mentioned a new research program from MIT called STRUDL. A short time later, the experimental software was installed and Roberts' design team was left to figure out how to use it.

Roberts successfully lobbied to send the author back east for extensive STRUDL training. With his coaching and support, the design team successfully modeled and designed the bridge using the new three-dimensional software. The Tuolumne River bridge was the first application of the software to a bridge in the western


Bridge Design Section 2 (circa 1944).



James E. Roberts Memorial Bridge.

United States. Similar software applications for complex bridge designs have only recently become commonplace. It was unheard of 40 years ago.

Roberts' leadership was further tested during the construction of the bridge. The structure utilized hybrid steel girders, which means that, within a single plate girder, various grades of steel were used. In particular, A517 steel was used extensively to minimize plate sizes and balance the design between longer exterior girders and shorter interior girders. Midway through erection of these girders, a failure occurred during construction of the Bryte Bend Bridge near Sacramento, California. The A517 steel girders on that structure failed during the first load cycle as the concrete deck was poured. The steel for the Bryte Bend Bridge had come from the same source and same heat as the steel that had already been placed on Roberts' bridge. With flooding of the valley imminent, the design team feverishly worked out extensive field modifications to the fracture critical girders, while lawyers for State and the steel fabricator pitched their own battle (the fabricator would eventually settle).

Roberts' team argued internally over an appropriate repair strategy. Ultimately, they relied on seasoned judgment, intuition, and the new computer tools to produce an engineering work around for the substandard steel plate flanges on the bridge. It would be more then a year before enough was known about fracture mechanics to determine just how close the team might have been to losing the bridge. In 2007, a year after Roberts passed away, the structure was officially renamed the James E. Roberts Memorial Bridge.

Leading the Team

Roberts would go on to many leadership roles. He soon took over Design Section 2, and then served several years as chief engineer for the Sacramento Regional Transit's light rail system. He then moved back to Caltrans and took over as director of the Caltrans Engineering Service Center where he was oversaw the work of 2,300 engineers, architects, and support staff responsible for designing, building, and maintaining all of California's bridges. He was at the reins as the state bridge engineer when the 1987 Whittier, 1989 Loma Prieta, and 1994 Northridge earthquakes hit. He therefore supervised the renaissance in seismic retrofit design that occurred at Caltrans in the late 80s and early 90s. Because California has historically been on the cutting edge of bridge design, his leadership has not only made California's roads and bridges safer, but also much of the nation's.

Roberts would eventually serve as Caltrans' chief deputy director (while simultaneously running the bridge department) before retiring in 2001. He continued to work part time, advising bridge designers until his death in 2006. In 1996, he was inducted into the National Academy of Engineering, the engineering equivalent of winning a Nobel prize.

An engineer is someone who can confidently stamp a set of plans. Jim Roberts was responsible for design and construction of countless bridges in California. More importantly, however, he was a leader, an accomplished speaker, a man with great foresight, a mentor, and he was politically savvy. That amounts to much more than a typical "engineer's engineer".▪

Richard A. Dokken, P.E., S.E., is the founder and chairman of the board for Dokken Engineering, a transportation engineering firm in Folsom, California. Mr. Dokken was a friend of Jim Roberts and worked with him for many years, both as a coworker and as a consultant. He may be reached at ***radokken@dokkenengineering.com****.*

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