T.Y. LIN INTERNATIONAL EXCELS

Feedback from peers and community, plus partnership approach create 'grand experience' that keeps designers energized and innovative

WITH PROJECT PARTNERS' INPUT

by Craig A. Shutt

Not all designers appreciate the extensive schedule of public feedback and input being used today when new bridge projects begin. These processes can extend the design time making the schedule critical and can create demands that are challenging to balance. But designers at T.Y. Lin International (TYLI) relish those projects, as the feedback expands their horizons and generates new ideas.

"We always try to partner with those involved in the project, whether they are other designers, community leaders, or government representatives," says John Haussmann, President of the San Francisco-based engineering firm. "We like to have team involvement on all of our projects. We don't want to work behind closed doors without receiving input from others."

Design charrettes are a key element that can aid this process, he notes. "Talking with the community and all the people involved in the project while someone organizes and facilitates the process, creates a grand experience. Ideas are put on the table and discussed in an atmosphere of cooperation and communication. We promote the idea of holding charrettes, especially early in the process when all the ideas can be incorporated more easily into the design."

The Olympia-Yashiro Friendship Bridge in Olympia, Wash., completed in 2003, features post-tensioned concrete box girders and an aesthetically pleasing design for this highly visible public project. Photo: Steve Vento.

'More owners are partnering with design-build firms to achieve their design goals.'

A Concrete Future

Dr. Man-Chung Tang, Chairman of the Board at TYLI, sees a bright future for the use of concrete in bridges. "Construction technology for prestressed concrete bridges has fully matured," he told ***ASPIRE***™ "It is now absolutely possible for us to build durable concrete bridges that can last well over 100 years."

Concrete has proven itself worthy of being the dominant bridge material, he adds. "In the next century, concrete will remain the main construction material for bridges, especially for short and medium spans, which are the majority of bridges in the world."

High performance concrete is a key to providing more design solutions, he says. "We should emphasize the development of high performance concrete (HPC). It will offer new possibilities for bridge construction. If further development can improve the workability of high performance concrete, we will even be able to use concrete for very long spans." He notes that HPC with a strength of 30,000 psi is now available, but it is difficult to apply.

Designers must always continue to look at new materials and new techniques, he says. "As bridge engineers, we should not limit ourselves to the use of only steel or only concrete." As an example, he points to TYLI's design for the 330-m (1080-ft) -long span of the Shibanpo Bridge, the world's longest box girder bridge span, which features both concrete and steel. "I believe, with such hybrid combinations, we can build box girders up to 500 m (1650 ft) in length. Undoubtedly, combinations of steel and concrete can lead to a variety of combinations."

Dr. Man-Chung Tang
Photo: ©lasvegasphoto.com.

Close Cooperation

A prime example of this close cooperation can be seen in the firm's design for the Olympia-Yashiro Friendship Bridge on 4th Avenue in Olympia, Washington. The bridge crosses a waterway and an active rail line. The number of piers in the water was minimized to mitigate wildlife concerns while avoiding the foundations of the existing bridge.

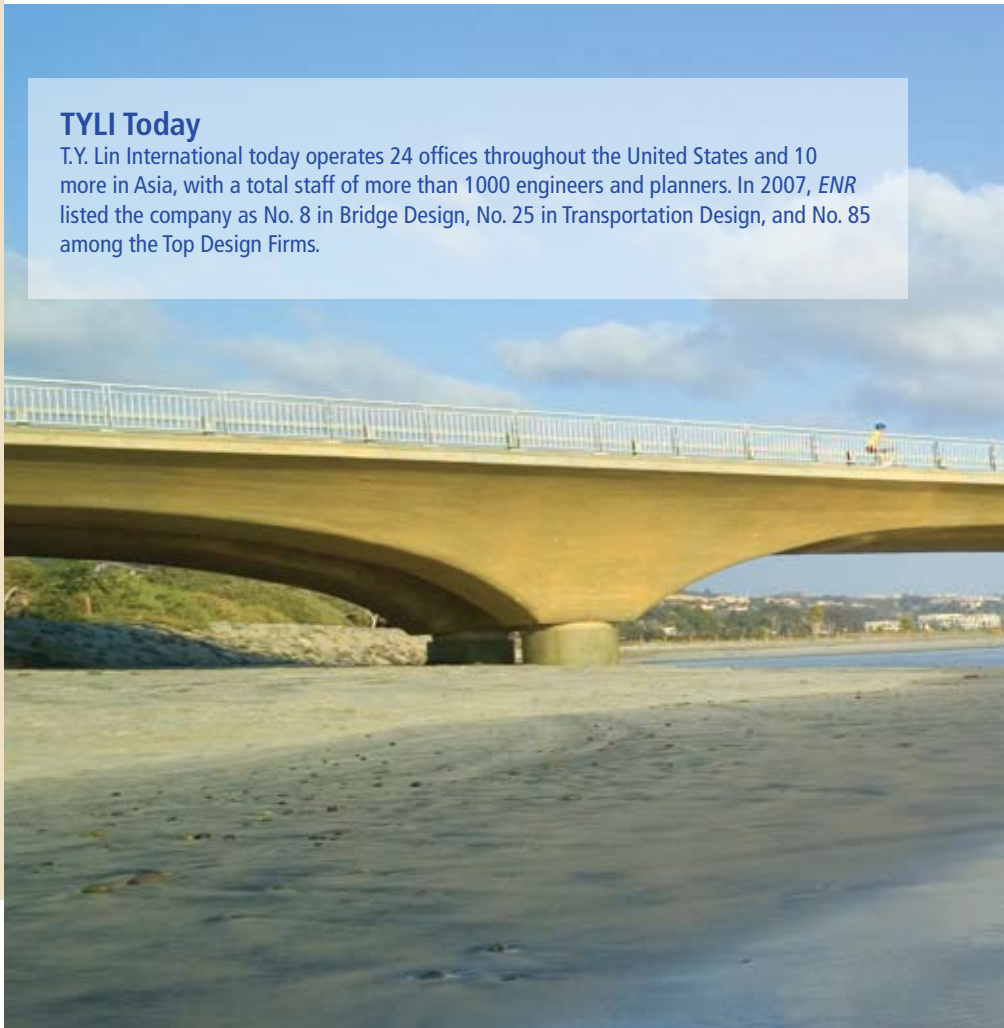
The firm led a design team of structural engineers, civil engineers, and architects to create both a replacement post-tensioned, concrete box girder bridge and corridor improvements through the downtown area. These were aimed at improving the pedestrian and vehicular experience and promoting alternative modes of transportation. "There was a high degree of collaboration between engineer, architect, and public artist," Haussmann notes.

Five structural concepts were developed that expressed a variety of aesthetic options. The selection process was conducted through an advisory panel, which was established to advise the City Council on which structure best enhanced the city. Topics of great interest included retaining characteristics of the existing structure, vehicle barrier types and locations, pedestrian railing types and locations, inclusion of public art, and expanding the waterfront walk to the bridge.

Collaboration also comes to the fore when the company serves as the owner's representative on a project, reviewing

TYLI Today

T.Y. Lin International today operates 24 offices throughout the United States and 10 more in Asia, with a total staff of more than 1000 engineers and planners. In 2007, *ENR* listed the company as No. 8 in Bridge Design, No. 25 in Transportation Design, and No. 85 among the Top Design Firms.

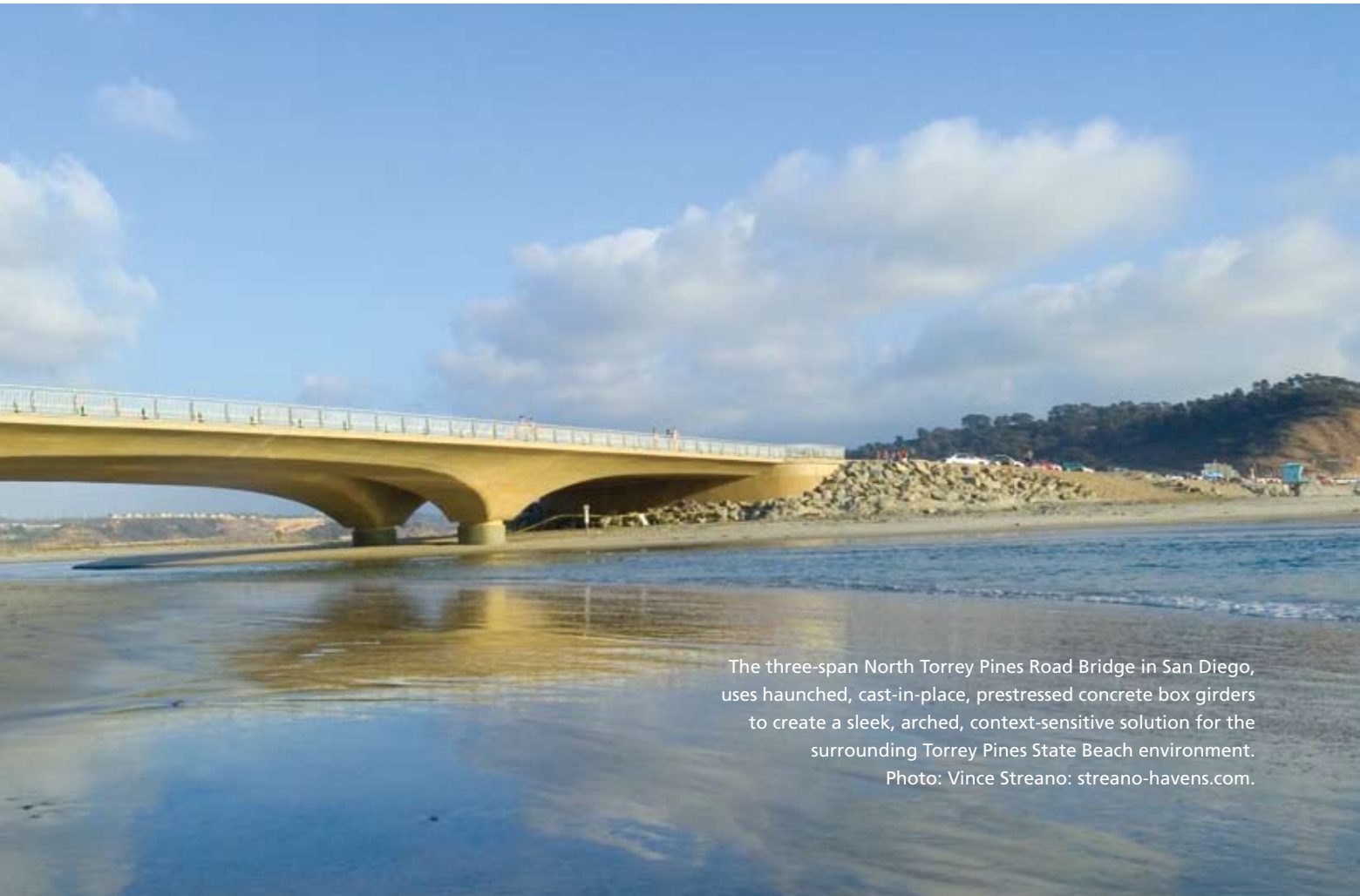


Included in the $5.5-billion San Francisco-Oakland Bay Bridge East Span Seismic Safety Project is a 1.6-mile-long twin concrete segmental skyway. The project is the largest public construction contract in California history. Photos: Caltrans.

proposals and making recommendations without doing the design work directly, he notes. "These reviews should be an open process, where we talk about assumptions and ideas upfront and have a chance to explain techniques," he says. "That cooperation helped create a successful design for The Arthur Ravenel Jr. Bridge over the Cooper River in Charleston, South Carolina." TYLI led design reviews for the South Carolina Department of Transportation, working with bridge designer Parsons Brinckerhoff in New York to create the longest cable-stayed bridge in North America.

The design features a 1546-ft-long main span with a total cable-supported length of 3296 ft. The approach structures use three types of precast concrete bulb-tee girders, AASHTO Type III girders, post-tensioned deck panels, and mechanically stabilized earth walls. The project won the award for Best Bridge Design with Spans Greater than 150 Feet in the 2007 PCI Design Awards Competition.

Haussmann expects this type of representative work to continue to grow. "We're finding that more and more Departments of Transportation and other bridge authorities are getting into projects that are larger than they've



The three-span North Torrey Pines Road Bridge in San Diego, uses haunched, cast-in-place, prestressed concrete box girders to create a sleek, arched, context-sensitive solution for the surrounding Torrey Pines State Beach environment. Photo: Vince Streano: streano-havens.com.

The new Benicia-Martinez Bridge is built of sand-lightweight concrete, cast-in-place segments with span lengths of 418 to 659 ft. Photo: T.Y. Lin International.

ever done, bigger than their in-house staff can design," he explains. "As a result, they are looking to the design community to create ideas that will solve these challenges. The fun part is the technology transfer that occurs between the bridge owners and the other designers who become part of the process. We all learn new techniques, and there's a huge amount of energy created in the discussions."

Design-Build Approaches to Grow

He also sees this communication and partnership approach growing as design-build projects become more dominant. "Design-build has proven itself to be a legitimate option as a delivery system today, especially on larger projects with specific time constraints," he says. "It has become the project-delivery system of choice in many cases, and more owners are partnering with design-build firms to achieve their design goals."

No matter the challenges it faces either as owner's representative or as engineer of record, TYLI's designers quite often design a structure that meets all of the client's needs using prestressed concrete. "We design a wide variety of concrete bridges, with steel bridges in the mix, when appropriate," he says. "We decide on each approach on a case-by-case basis. But the flexibility and economics provided by concrete today makes it a very strong choice."

That's particularly true as aesthetics become more critical, he adds. "Aesthetics are a key concern for communities, because most structures today are being placed into the built environment, where there are more concerns about appearance and impact. The footprint of the bridge and touchdown points, certainly, will affect the infrastructure, and communities are concerned about the skyline and how the projects will blend in." Concrete offers great potential for meeting any aesthetic needs required, from arched shapes to unusual textures. "The public gravitates to these designs and their unique look."

A unique look was a key consideration for the Hoover Dam Bypass Bridge now under construction between Clark County, Nevada, and Mohave County, Arizona. "The new Colorado River Bridge runs just south of the Hoover Dam and will be forever tied to that majestic landmark," explains Haussmann. As a result, its design had to complement "an internationally recognized structure nearly unsurpassed in its grandeur."

To achieve that, TYLI engineers led a team that also had to decrease traffic congestion, protect the environment,

and increase safety and security. The new 580-m (1914-ft) -long bridge will be the longest concrete arch span in the country when it is completed. The arch is not only cost effective, but it complies with the environmental impact statement commitment to minimize obstructions to the view of the nearby dam.

The arch also allows for the efficient use of materials, Haussmann notes, in that both concrete and steel are used to the best of their ability: concrete in compression and steel for tension and bending. The combination of the economical twin-rib concrete arch and lightweight steel superstructure allows rapid, efficient construction.

Appearance and environmental impact also were critical considerations for the firm's work on the North Torrey Pines Road Bridge over Los Panasquitos Creek in San Diego, California. TYLI designed a haunched, three-span, cast-in-place, prestressed concrete box girder structure with a length of 340 ft. The replacement bridge was built in two stages so that vehicular, pedestrian, and bicycle traffic could be maintained throughout construction.

The bridge crosses an environmentally sensitive coastal lagoon and is located at the Torrey Pines State Beach. As a result, the structure receives heavy pedestrian usage both on top and passing underneath. The combination of the spectacular site and high profile called for special attention to appearance. The designers commissioned the project architect and artist to provide recommendations for aesthetic treatments.

CAD Helps Visualize Projects

Presenting aesthetic designs to community and political leaders has been made significantly easier with the improvements in CAD design software and other computer presentation programs, Haussmann notes. "We can place the bridge designs into the settings where they will be located and show different options and alternatives for decks or piers. We can present three-dimensional flyovers of even basic AASHTO girder designs, and it makes a huge difference in how the designs are received. People give us an overwhelmingly positive response, because we can show how graceful and complementary the bridge will be to the surroundings."

Concrete's versatility aids that process tremendously, he adds. "Projects are becoming more costly today and take a lot of public funds, so communities want more interesting aesthetics to justify those costs. If you can provide an aesthetically pleasing design, you will gain public support."

Concrete bridges also provide excellent life-cycle costing, he notes, which adds more benefits. "Economics have changed from considering only the construction cost to looking more at maintenance needs," he stresses. "We promote concrete options when the span lengths and aesthetics provide solutions, but life-cycle costs are the biggest issue and probably the biggest reason we use so many concrete designs."

'The flexibility and economics provided by concrete today makes it a very strong choice.'

The Hoover Dam Bypass Bridge features a composite concrete deck arch that complements the nearby dam and spans the 800-ft-deep Colorado River gorge. The 1914-ft-long bridge will be the longest concrete arch span in the United States when completed. Photos: T.Y. Lin International.

'If you can provide an aesthetically pleasing design, you will gain public support.'

Concrete projects long have been a staple of the company, since its founder helped establish the precast concrete industry with his work in the field during the mid-twentieth century. "Professor T.Y. Lin was a very big proponent of concrete designs, and his knowledge and enthusiasm for the material led to a lot of innovations," says Haussmann. "He truly helped bring the industry to where it is today."

He notes that only about 60 percent of the company's revenues are derived from bridges, a point some of the firm's bridge design competitors are quick to bring up. "But we are such a large firm that even at that mix, we still design 10 times the number of bridges of many other firms." A larger number of those structures are pedestrian bridges, he adds. "Those projects lend themselves to new ideas, especially with lightweight concrete and other innovations, so there are many ways to create innovative designs for those structures. Our ideas are being well received."

New Ideas Needed

There will be a need for new ideas in the future, he adds, especially with less steel availability and stricter environmental demands eliminating some classical concepts from the available options. "Our job in the design industry is to work with organizations, material suppliers, technocrats, and academia to find solutions."

A glimpse of what that future might hold can be seen in the San Francisco-Oakland Bay Bridge's East Span Seismic Safety Project, which TYLI designed in a joint-venture agreement with Moffatt & Nichol. The design, which Haussmann calls "one of the first signature bridges of the twenty-first century," replaces the 2.1-mile eastern span of the Bay Bridge and includes the world's longest, single-tower, self-anchored suspension bridge.

The replacement arose in response to the 7.1-magnitude Loma Prieta earthquake, which caused a 50-ft-long section of the east span to collapse. Officials at Caltrans determined that rehabilitation was not sufficient, and TYLI designers competed with engineers around the world to design multiple replacement bridge prototypes during a fast-track initial concept stage.

The designs were presented to a Bay Bridge Design Task Force and a 34-member advisory panel through a process coordinated by the Metropolitan Transportation Commission. "Those groups are really the best at organizing local community leadership to gain good, effective feedback," he says. "Having a singular community task force responsible for doing that helps make it easier for the owner and design team to provide concept designs with cost estimates in place and for everyone to see what the project will look like."

The winning concept was an asymmetric, self-anchored suspension bridge with a 1263-ft-long main span and a 1.6-mile-long twin concrete segmental skyway with 520-ft-long spans. The skyway design includes cantilevered bicycle/pedestrian paths on the east side, aesthetic lighting, and provisions for future light rail (see *ASPIRE*,™ Winter 2007). The last two precast concrete segments of the skyway structure were lifted into place in December 2006, creating a significant milestone. The $5.5-billion project is the largest public construction contract in California's history.

"There are a lot of smart folks in the bridge community working to create innovative designs and solve the challenges we face," he says. "I'm positive that we'll see a lot of new things coming in the next few years that will help us address how we can produce the most economical structures for every environment, every span length, and every location. I'm confident our phone is going to be ringing."

For more information on this or other projects, visit www.aspirebridge.org.