

San Diego Airport Expands with Style *From Civil Engineering online, September, 2013*

By T.R. Witcher



The new outdoor ticket counter pavilions at San Diego International Airport are capped by large fiberglass canopies that cantilever on two sides and are supported by suspension cables. © Kiewit/Sundt

A significant expansion of the busy airport includes state-of-the-art curbside baggage handling, iconic sail-like canopies, and an easily identifiable surf-and-sea motif.

September 10, 2013—Tom Rossbach, AIA, the aviation buildings director for Kansas City, Missouri-based HNTB, has been working in aviation design for decades and has a simple theory about airports: “People travel a lot, and they want to recognize where they are, based on the feel and the culture of the city,” he says.

So when HNTB began work on a new terminal expansion at San Diego International Airport, the largest single-runway airport in the nation, Rossbach tried to take advantage of the surf-and-sea vibe associated with San Diego. From the terminal visitors can enjoy a view of San Diego Bay. Floor patterning emulates waves washing up on a beach. A stone wall material boasts a sandy color. A new atrium channels in sunlight.

HNTB—along with a joint venture of Turner Construction, PCL, and Flatiron— was awarded one of two design/build contracts for the \$1-billion project, known as Green Build. The contract included the design of the 460,000 sq ft terminal expansion as well as new airside paving, a central utility plant expansion, a “smart” check-in curb with a state-of-the-art baggage-handling system, and a new USO facility—the largest in the world. San Francisco-based URS Corporation was named the lead architect and design engineer for the other design/build contract, which also included the joint venture Kiewit/Sundt. That contract covered an elevated, double-decker roadway that separates arriving from departing passengers and a new curbside facility. Other partners in the

contract were URS also oversaw the design of a series of 50 ft tall canopies, dubbed “sails,” that create an easily identifiable image for the new departure drop-off point.



New outdoor ticket counter pavilions, at right, give departing passengers another place to check in besides the terminal and should help alleviate long queues. Courtesy of the San Diego County Regional Airport Authority

the smart curb, which features full-service ticket counters and a baggage system that extends from the interior to the curb. “They can do anything at the ticket counter they can do in the lobby,” Rossbach explains. There’s even room for tour groups to check in.

The new baggage-sorting system conveys bags through inspection screening more efficiently. And as a result of a national survey that indicated passengers’ biggest complaint in air travel is not having enough places to plug in their mobile devices, electrical outlets have been installed within reach of every seat in the waiting areas.

A new atrium dubbed Sunset Cove brings together food, beverage, retail, entertainment, and art in a large space immediately past security to provide increased convenience and comfort for passengers—and revenue opportunities for the airport.

For Rossbach, the project represents a bit of a homecoming. He was the project manager for the original terminal building in the 1990s. “I was basically completing the project I was privileged to start years ago,” he says.

San Diego International enplaned 17 million passengers in 2011, and that number is expected to increase to 33 million by 2030. The expansion, which opened in August, will accommodate that growth with 10 new gates that double the number of security lanes from 6 to 12. One of the chief innovations—and another example of taking advantage of the city’s warm weather—was the installation of

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At first the terminal was planned to be double-sided, but the gates ultimately ran along only one wall because the airport at the time didn't own the property on the other side of the site (it later procured it from the U.S. Navy).



The original design and planning called for the new addition to be separated from the existing structure by a long expansion joint, running more than

The canopies atop the new elevated deck roadway at San Diego International Airport were fabricated with Teflon-coated fiberglass, which is strong and durable as well as translucent. Photo by Sunnie House, URS Corporation

800 ft across the concourse. The buildings would be joined by two rows of columns, running down the center of the concourse, spaced only 3 ft apart. "As you can imagine, that's sort of an awkward configuration," says Steven C. Ball, P.E., S.E, M.ASCE, a principal of John A. Martin & Associates (JAMA), the Los Angeles-based structural engineering firm that engineered the terminal expansion. "I don't think I've ever seen a concourse with columns going down the center, much less two [rows of] of them."

As JAMA was bidding for the job, Ball thought it would be nice if they could come up with a better solution. "We encouraged the airport authority to let us look at the option of eliminating that joint."

The problem was that if the joint was eliminated, the structures would be tied together, and that could trigger a costly upgrade to the existing facility. A provision in the California building code allows builders to make modifications to an existing building—but they have to demonstrate that those changes would impact the seismic requirements of any existing building element by no more than 10 percent. Otherwise, the builders would have to pay the costs of seismically upgrading the entire building. The advantage of keeping the joint was that new construction would have no bearing on the existing terminal.



A new atrium dubbed Sunset Cove, part of the expansion of Terminal 2 at San Diego International Airport, brings together food, beverage, retail, entertainment, and art in a space designed to reflect San Diego's waterside location. © Marble Street Studio, courtesy of HNTB

The new addition uses moment frames because the more traditional shear walls and diagonal braces wouldn't have accommodated the architecture of an airport interior. So the solution to the expansion joint problem, Ball explains, was to "proportion the stiffness"—that is, determine the number, location, and stiffness of the new moment frames so that they would

attract more of the seismic load than the existing building. In addition, some of the floor girders that would connect to the existing building would make use of cantilevered construction to transfer even more load over to the new building.

The engineers knew that the contractors would not be able to simply remove the wall that would stand between the existing terminal and the expansion—the original terminal had to remain fully operational. So Ball and his colleagues determined the location of various structural members and then punched through the wall here and there to connect structural elements. A temporary facade covered this wall, and only when the new building was enclosed could they go in and strip off this covering and connect the two buildings.

HNTB also oversaw the design of more than 1.3 million sq ft of new apron, taxi lane, and taxiway areas, developed on a brownfield site—namely, a former navy dump. And the firm designed a storm-drainage system to prevent petroleum-based products accumulating from the taxiways from entering San Diego Bay. An aircraft-rated storm-water filtration system was installed to collect on-site pollutants. The storm water is treated as it flows through a filter medium that removes hydrocarbons, suspended solids, and dissolved metals.

On the landside, the airport authority wanted an iconic focal point for the expansion, but the facade of the structure had to match the existing terminal. That left the curbs along the new roadway as the only location for making a visual splash, says Sunnie House, P.E., a vice president of URS.



The Sunset Cove atrium opens out to an expansive glass wall with views of the airfield. © Marble Street Studio, courtesy of HNTB

GPA Architects, Inc., of Los Angeles, developed the sail motif. Gerhard Pichel, AIA, the president of GPA Architects, Inc., says the design of the terminal was based on the second-level ticketing connected to a second-level roadway, with remote check-in accessible via pedestrian bridges. That established a challenge for Pichel and his design team: “Are we just going to have an elevated road and put it on sticks and let it stick up in the air?” he asks. “That didn’t go very far.”

The sail motif atop the remote check-in pavilions developed as a solution that was functional, offering sun and rain protection, and light enough to complement the roadway without overwhelming. Plus, it was a truly Californian thing. “It would relate to what San Diego’s all about—the sun, the sea, and sails—and make it a unique experience for the passengers,” Pichel says.

Huntington Design Associates, Inc., of Oakland, California, was hired to implement the canopy design under the supervision of URS. The support columns for the canopy structures, which occupy both the upper and lower roadways, are spaced 25 ft apart, and the fabric membranes are made from a Teflon-coated fiberglass product called Sheerfill V. Craig G. Huntington, P.E., S.E., F.ASCE, the president of Huntington Design, says that fiberglass is a strong and durable material and the Teflon coating will help the sails resist dirt accumulation and provide the light reflectivity needed to keep the areas that are shaded cool.

The ground-level canopies as well as those between the ticket pavilions on the upper level are, he says, light and simple structures distinguished by arching membrane-support members cantilevering to one side and braced back to the columns above the fabric. The more dramatic pavilion canopies feature cantilevers on either side of the columns. These columns extend well above the canopies, using suspension cables that come back down to support the peaks of the canopy roofs.

The completion of the departure-level elevated roadway system, as designed by URS, required the construction of five vehicular bridges and two pedestrian bridges to connect the roadway to the terminal. To build the double-level roadway, the existing parking lot in front of the terminal had to be relocated, and the lanes for taxis, buses, and shuttles had to be shifted. The departure-level roadway spans some 1,237.5 ft and is 63 ft wide. It's a cast-in-place, prestressed, reinforced box girder bridge supported on straddled bents to allow room for a transit plaza underneath the structure.

The roadway and pavilions are structurally distinct, according to Hamid Mahramzadeh, S.E., the lead structural engineer for URS on the project, who responded in writing to questions posed by *Civil Engineering* online. While the roadway is designed like a bridge, he says, "We designed the two pavilions as structures that perform like buildings so that we had flexibility in our design to place elevators, escalators, the fabric structure, and more importantly, [any] possible future expansion."

The San Diego project represents one of the very few airfield design/build projects that the Federal Aviation Administration has approved. Both Rossbach and Ball say the design/build method worked smoothly, and Rossbach expects to see more design/build airport projects in the future.

The project has received several awards, including the 2013 Project of the Year Award from the Design-Build Institute of America's Western Pacific Region. "It's very fulfilling," Rossbach says. "It's especially fulfilling that the original concept to double load the terminal actually was implemented. It makes you feel good you did some things right the first time and second time around."