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Issue: 11/03/2014

Plotting and Welding a Golden State Gateway

10/29/2014

By *Aileen Cho* in *Anaheim*

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Text size: **A** **A**



Photo Courtesy of Tom Fox/SWA Group
Reflecting both the regional context and a transit renaissance, the ARTIC aims to be an iconic transportation gateway of the West Coast.



By Luke Abaffy
Tour ARTIC site with ENR editors.

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The city of Anaheim is home to big-ticket draws such as Angel Stadium, the Grove arena, the Honda Center sports venue and, of course, Disneyland. Now, it is home to an iconic structure that heralds the arrival of a new age of transit in traditionally auto-centric Southern California.

Located in an area called the Platinum Triangle—targeted for mixed-use redevelopment, with an emphasis on public transportation—the 120-ft-tall, 68,000-sq-ft Anaheim Regional Transportation Intermodal Center (ARTIC) also will be the first of its kind to achieve LEED Platinum, say project officials. The goal of achieving an energy-efficient structure that also would serve as a gateway to the region—a city goal from the plan's inception—informed the painstaking design and construction efforts that belie the relatively modest \$180-million cost.

"The idea was to create a great space inspired by the great rail stations of the past," says Ernest Cirangle, senior vice president with HOK, the project architect, which won a design competition in 2009 with a team led by Parsons Brinckerhoff. Unlike typical East Coast rail hubs, ARTIC's design emphasizes open views to reflect the sunny expanse of the local geography. "The city wanted an iconic building that would celebrate rail transportation in Southern California," says Cirangle.

The chosen aesthetic and environmental vision required a carefully mapped geogrid plan of unusual rigor to calculate the positions of various systems—mainly the curtain wall, ethylene tetrafluoroethylene (ETFE) roof and main entranceway, says Adam Sullivan, superintendent with general contractor Clark Construction Group. "Those enclosure systems are dictated by 15,000 geopoints [in the design model]. Each of the points has an X, Y and Z axis down to a millionth of an inch."

To maximize natural sunlight and air flows while ensuring passenger comfort despite the hot climate, the design team opted for a roof enclosure system that uses diamond-shaped pillows of ETFE. At 200,000 sq ft, the ETFE application is the largest of its kind in North America, says Michael McAlpine, project executive with STV Inc., the owner's representative.

The geometry—40 asymmetrical arches, two parabolic glass walls at the north and south ends, and metal panel walls on the sides—called for some of the most complex steel fabrication ever done by Beck Steel Inc., Lubbock, Texas, says owner John Beck, Jr. "We had to abandon

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any conventional methods of construction," he says. "Every piece and part of the shell structure is unique. We had to understand that conventional methods were out the window."

On the Grid

"The building doesn't look complicated," says Clark project executive David Burrus. "It looks like simple slopes. But every panel is a different size. There is nothing simple about this [so-called simple] job."

Why? "Basically you have a building that's curving in two directions," says David Herd, managing partner with BuroHappold North America, the engineer for mechanical, electrical, plumbing and the building envelope. "The building slopes from a high point on the north to a lower point on the south, and it curves from east to west. In addition, you've got the diamond-shaped ETFE balloons—you've got the structure for that, which sits over the structure of the steel. The steel bends in only one direction. So, effectively, it becomes an exercise in how

you optimize the number of points to satisfy that geometry and associated shapes."

The structural-steel shell consists of 14-in. hollow steel-petroleum piping that forms the 40 arches; the arches enclose a glass curtain wall hung from 7/16-in. stainless-steel cables. The cables hang from the structural-steel columns at the north and south ends. Another system, comprising 8-ft x 8-ft aluminum-metal panels integrated with a glazing system, encompasses the east and west sides from the ground level to 36 ft high. Tolerances were held to 1/8 in. At the 36-ft mark, the ETFE roof system begins, with 160 cushions attached to some 3,000 steel supports. Tolerances of interactions among members are all in tiny fractions of an inch.

Keywords: [ARTIC](#); [Clark Construction](#); [HOK](#); [PB](#); [Thornton Tomasetti](#); [STV](#)

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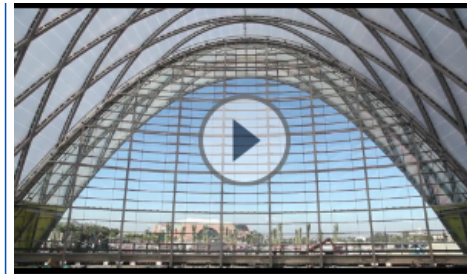
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Out of Thin Air

A close look into the Anaheim Regional Transport Center's three-layered, Ethylene Tetrafluoroethylene (ETFE) cladding system.



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The approximately 200-ft-long concourse bridge connects passengers from the center's upper level to the platforms. The six concourse supports are on cast-in-drilled-hole piles, with 10 ft diameters, 90 ft deep and 12 ft from active rail lines.

The 300-ft-long building rises 80 ft at the south end and up to 120 ft at the north, says Bruce Gibbons, managing principal with Thornton Tomasetti, the structural engineer. The goal is to optimize the natural flow of hot air up and away from the activities below. "We looked at lot of different systems—arches, shells, trusses—[during design] to see what was most efficient and would best realize the architectural solution," says Gibbons. A diagrid shell, open at the ends for passenger flow and light use, "is more efficient because, with asymmetric loads, there is a lot of bending in the vault. Exposed columns at the end walls are connected to the arch members to stop the ends from deforming under lateral loads," he adds.

Beck did scores of tests, 3D modeling and mock-ups even before the job was bid, says Beck Jr. "This was not something that could be built off conventional shop drawings. It had to be approached in 3D, with laser technology. And it's not like you could figure it out once and do it a thousand times over. Every little piece had its own set of problems," he observes.

Moreover, the team had to predict contraction and expansion during welding and on-site while meeting tight tolerances. "We spent 80,000 shop hours and 20,000 computer hours as well over two years," says Beck Jr. A Trimble survey system aided fabrication, along with constant surveying before and after welding and after installing ETFE supports. Upon arrival to the site from Lubbock, each piece was again reassembled and surveyed before and after welding.

Tunnels and Time

Clark edged out seven competitors to win the \$127-million contract. Its task was to build the 68,000-sq-ft terminal; parking for 1,000 vehicles, including a lot powered by photovoltaic cells; a railroad bridge; baggage and pedestrian tunnels; a two-sided rail-station platform; and a pedestrian concourse bridge, from the terminal to the platforms—all on 13.6 acres. The first couple of months, Clark crews stabilized the site with deep dynamic compaction, dropping a 30-ton weight 80 ft down a half-dozen times at each spot in a grid pattern, says Sullivan. "That's how we prepped the ground: We pounded it into submission."

The method saved about \$1 million over other stabilizing methods, such as stone columns, says Rudy Emami, Anaheim capital programs manager, noting that the city went through three value-engineering exercises during design and with the contractor. Clark offered \$5 million in potential savings through construction changes, including tweaks to the HVAC system, and the city accepted about \$1.4 million, says Burrus. The savings will be split with Clark.

The base concrete slab for the terminal required two pours of 2,400 cu yd of concrete each. Each eight-hour pour required 300 trucks to deliver concrete from batch plants within 90 minutes, says Sullivan.


Crews also had to replace a bridge over Douglas Road and build pedestrian and baggage tunnels mere feet from active railroad tracks. All these were done over the course of six 50-hour windows. That work "had its own world of complexities," says Burrus. With the help of a 500-ton crane, crews removed the existing through-girder railroad bridge to make way for a new 92-ft-long, steel-plate-girder bridge, which makes room for new station platforms.

After taking one track out of service, crews built the two tunnels by excavating down 15 ft, setting 4,500-lb precast tunnel sections in place. "We waterproof them, slurry, backfill, asphalt the top and put the rail back," all in time for the Monday commuter rush, says Burrus.

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Clark worked with its subcontractors for more than six weeks to develop a detailed, hour-by-hour schedule. The team mapped out the plan weeks in advance for each 50-hour window. "We broke down what was happening every 15 minutes," says Sullivan. The first time, crews got the track back up with minutes to spare. "By the sixth shutdown, we were 10 hours ahead of schedule," he adds.

Clearing the Air

Orange County, Calif., loses an estimated \$20 billion per year due to traffic congestion. With an eye on transit alternatives and mixed-use development, Anaheim, which receives 20 million of the county's 40 million annual visitors, began envisioning ARTIC about two decades ago. Voters in 2006 approved an extension of a 0.5% sales-tax increase to fund projects under the jurisdiction of the Orange County Transportation Authority (OCTA). Almost half the project cost comes from that measure's extension.

Buying a 16-acre site from OCTA, the city of Anaheim began to plan a center that would link various transit users to the nearby attractions, says Emami, the city's public-works capital programs manager. "There was a lot of permitting and agreements, but everyone saw the vision and the need."

The design process went through a wrinkle, says Virginia Tanzmann, project manager for PB. "The building was going to be much larger," she says. But initial bids came in too high, so a redesign began in January 2012, with a scramble to be ready for rebids in June. "We spent an intense spring in non-stop meetings to complete the redesign documents for bidding without compromising the schedule," Tanzmann says. The much-larger footprint had been based on a projected ridership of future high-speed rail. "The solution is that we've made a place where [the high-speed-rail authority] can [someday] build a terminal for themselves, congruent with this design," Tanzmann says.

In the meantime, as of December, visitors coming off the 57 Freeway—or by bike off the trail near the Santa Ana River—will pass through a meticulously landscaped approach. "We did super-fine grading to make sure egress was as flat as possible yet allow for water drainage," says David Gal, principal with landscape architect SWA. "We did grading maps with contours that were within a tenth of a foot. We had to take into account events today and in the future—what could happen with additional transit coming into the station. It's in a key location for the city. You've got to get it done right the first time."

When visitors enter the main lobby from the north, they can head straight for bus bays and bike lockers or ascend the stairwell to a second floor of retail and restaurants. Glass cladding, maple finishes and stainless-steel trim complement the ETFE roof and terrazzo floor. A third floor functions as if it were an airport gate, with Wi-Fi, seats and more concessions. Then, it's off to the platforms for an expected 10,000 daily boardings.

"It's up, over and down," says McAlpine.

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