IDEAS² 2015 awards

AISC IS PROUD TO PRESENT the results of its annual IDEAS² Awards competition. This program is designed to recognize all team members responsible for excellence and innovation in a project's use of structural steel.

Awards for each winning project were presented to the project team members involved in the design and construction of the structural framing system, including the architect, structural engineer of record, general contractor, detailer, fabricator erector and owner. New buildings, as well as renovation, retrofit or expansion projects, were eligible. The projects also had to display, at a minimum, the following characteristics:

- ➤ A significant portion of the framing system must be wide-flange or hollow structural steel sections.
- ➤ Projects must have been completed between January 1, 2012 and December 31, 2014.
- ➤ Projects must be located in North America.
- ➤ Previous AISC IDEAS² award-winning projects are not eligible.

The judges considered each project's use of structural steel from both an architectural and structural engineering perspective, with an emphasis on:

- ➤ Creative solutions to the project's program requirements
- ➤ Applications of innovative design approaches in areas such as connections, gravity systems, lateral load resisting systems, fire protection and blast
- ➤ The aesthetic and visual impact of the project, particularly in the coordination of structural steel elements with other materials
- ➤ Innovative uses of architecturally exposed structural steel
- ➤ Advances in the use of structural steel, either technically or in the architectural expression
- ➤ The use of innovative design and construction methods such as 3D building models, interoperability, early integration of steel fabricators, alternative methods of project delivery and sustainability considerations

A panel of design and construction industry professionals judged the entries in three categories, according to their constructed value in U.S. dollars:

+ Less than $15 million
+ $15 million to $75 million
+ Greater than $75 million

Both national and merit honors were awarded in each category. The jury also selected one project for the Presidential Award of Excellence in recognition of distinguished structural engineering.

INNOVATIVE DESIGN in ENGINEERING and ARCHITECTURE with STRUCTURAL STEEL

2015 IDEAS² Awards Jury

William B. "Brad" Bourne III is the current president and CEO of AISC Member fabricator Universal Steel, Inc., in Lithonia, Ga. He has served on the AISC Board of Directors since 1999 and was Chairman from 2011 through 2013.

Ashley Carey is a former field engineer with Skanska Koch (she recently joined Stonebridge Steel Erection). As a student at Stevens Institute of Technology, she interned at Skanska Koch in the engineering department, assisting with projects such as the rehabilitation of Brooklyn Bridge and the new Oculus Transit Hub at the World Trade Center.

Paul D. Endres, S.E., FAIA, is a principal with Endrestudio, which has offices in Emeryville, Calif., and Chicago. His three decades of experience include more than 1,000 buildings and structures. He is also an associate professor and prior Morgenstern Chair at the Illinois Institute of Technology in Chicago.

Nancy L. Gavlin, S.E., P.E., is AISC's director of education, where she is responsible for AISC's university relations and continuing education activities, and was previously a visiting lecturer at the University of Illinois at Urbana-Champaign.

Nasser Heydari is a doctorate civil engineering student at Louisiana State University in Baton Rouge. He was a team leader of the University of Tehran Steel Bridge Team in the 2012 International Steel Bridge Competition at Bogaziçi University (Turkey), where his team finished in second place.

Peter G. Lynde, P.E., is vice president and corporate director of Albert Kahn Associates, Inc., in Detroit. He currently serves as a principal and business development leader in Kahn's industrial market segment, overseeing the firm's efforts in manufacturing, research, testing and alternative energy facility design.

Michael McCall, AIA, is vice president of project and development services with JLL. He is currently working on the Focal Point Community Campus project, an urban mixed-use project totaling 1.5 million sq. ft, on the southwest side of Chicago.

Cathleen McGuigan is editor-in-chief of *Architectural Record*, as well as editorial director of Dodge Data Analytics' *GreenSource* and *SNAP*.

▲ **The 2015 AISC IDEAS² Awards jury, from left:** Ashley Carey, Michael McCall, Peter Lynde, Cathleen McGuigan, Brad Bourne, Nancy Gavlin, Paul Endres, Nasser Heydari and Larry Flynn, AISC director of industry marketing.

GREATER THAN $75 MILLION **NATIONAL AWARD** Anaheim Regional Transportation Intermodal Center, Anaheim, Calif.

THE ANAHEIM REGIONAL TRANSPORTATION INTERMODAL CENTER (ARTIC) is the present and future of transportation in Orange County. A hub for rail, bus, auto and bike travel, ARTIC is also ready for high-speed trains and street cars, the region's next-generation transportation systems.

The facility, which opened in December, includes a 68,000-sq.-ft terminal building beneath a soaring exposed steel structure. Rising from a height of approximately 80 ft at its southern end to 115 ft at the main entrance and public plaza, the structure is approximately 250 ft long and 184 ft wide and also includes a Metrolink/Amtrak concourse pedestrian bridge.

The terminal's tapering vault of crisscrossing parallel arches spans 184 ft over a three-story interior housing retail, ticketing, offices and other amenities. The special concentrically braced frames of the interior structure provide a stiffened base for the shell arches.

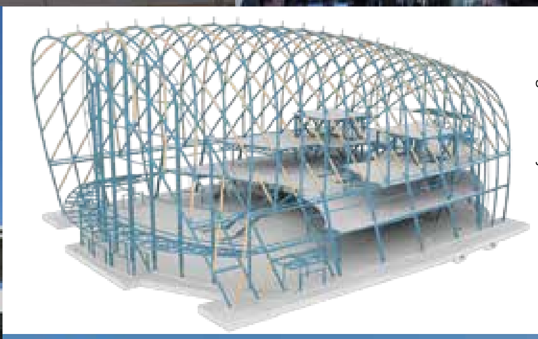
The roof's sculptural form is a high-tech take on the simple lines of old airship hangars and the light-filled grandeur of historic train stations. The thin shell's curved geometry is optimized so that the amount of bending and deflection experienced under non-uniform environmental and seismic loads is minimized. The diagrid shell design has inherent structural redundancy and provides continuous load paths to transfer both gravity loads and lateral loads to the base.

The structural design for the roof employs long pieces of 14-in.-diameter curved, interlocking steel pipes that form the complex yet efficient structure's diagrid shell. Due to the inherent reliance of the shell's performance on its form, structural engineer Thornton Tomasetti collaborated closely with architect HOK to define its geometry, and a segment taken from a torus based on a catenary cross-section was selected as the most efficient shape to enclose ARTIC's large interior volume. The team developed the design to define the arches as a series of compound curves, which made the steel easier to fabricate.

The steel shell is clearly visible through the façade, creating a variety of impressive visual effects, particularly when lit at night. The terminal is clad in translucent "Teflon-like" material known as ethylene tetrafluoroethylene (ETFE), and ARTIC is the largest single installation structure enclosed with ETFE in North America.

The northern and southern end walls are glass structures that curve outward supported by tapering, built-up box section masts. These elements double as structural members, acting like bicycle-wheel spokes to stiffen the edge of the roof shell, which would otherwise deflect wildly at the significant end-discontinuities. The glazing system is highly transparent and hangs from the roof via steel cables, which are laterally supported by horizontal girts formed from rolled steel elements and steel armatures connected to the masts. The north end-wall masts also support the cantilevering entrance canopy, which in turn acts as a horizontal truss to laterally brace the masts.

ARTIC's unique design required constructability considerations from an early stage of the project, and the team developed a sequencing plan that required temporary shoring only at the first arches installed; the rest of the roof was self-supporting during erection. In addition, an adjustable



all images courtesy of Thornton Tomasetti

backing plate was designed for the complete joint penetration (CJP) welds that connect the intersecting steel pipes of the roof shell. The construction sequence made traditional internal ring plates impractical since they would get in the way of infilling arch pieces, so the team designed an internal ring plate that would telescope back into the pipe to allow placement of the infill sections. The design also included a screw and block to allow for the tolerances of the pipe fabrication while maintaining continuous contact between the plate and the interior pipe surface.

The terminal's third level provides access to the new concourse bridge, a 262-ft-long covered pedestrian crossing that spans the existing tracks and provides elevator and stair access to the new rail platforms. The steel-framed bridge is supported by elevator shafts at its southern end and uses buckling restrained braces (BRBs) to resist lateral forces. At the northern end, groups of raking steel pipe columns with nested BRBs provide vertical and lateral support.

The entire design team relied heavily on integrated building information modeling (BIM) for design exploration, analysis, team communication, documentation and coordination during design and in the field, and the model will be used by the owner for ongoing operations and maintenance. In addition, the facility is expected to achieve LEED Platinum certification. And through its iconic design, it will transform travel and deliver memorable experiences while providing convenient access to destinations across Southern California.

For another look at ARTIC, see "Cruising through the OC" in the February 2015 issue, available at ***www.modernsteel.com****.*

Owners
City of Anaheim Public Works, Anaheim, Calif.
Orange County Transit Authority, Orange County, Calif.

Owner's Representative
STV, Inc., Los Angeles

Project Manager
Parsons Brinckerhoff, Orange, Calif.

Architect
HOK, Culver City, Calif.

Structural Engineer
Thornton Tomasetti, Los Angeles

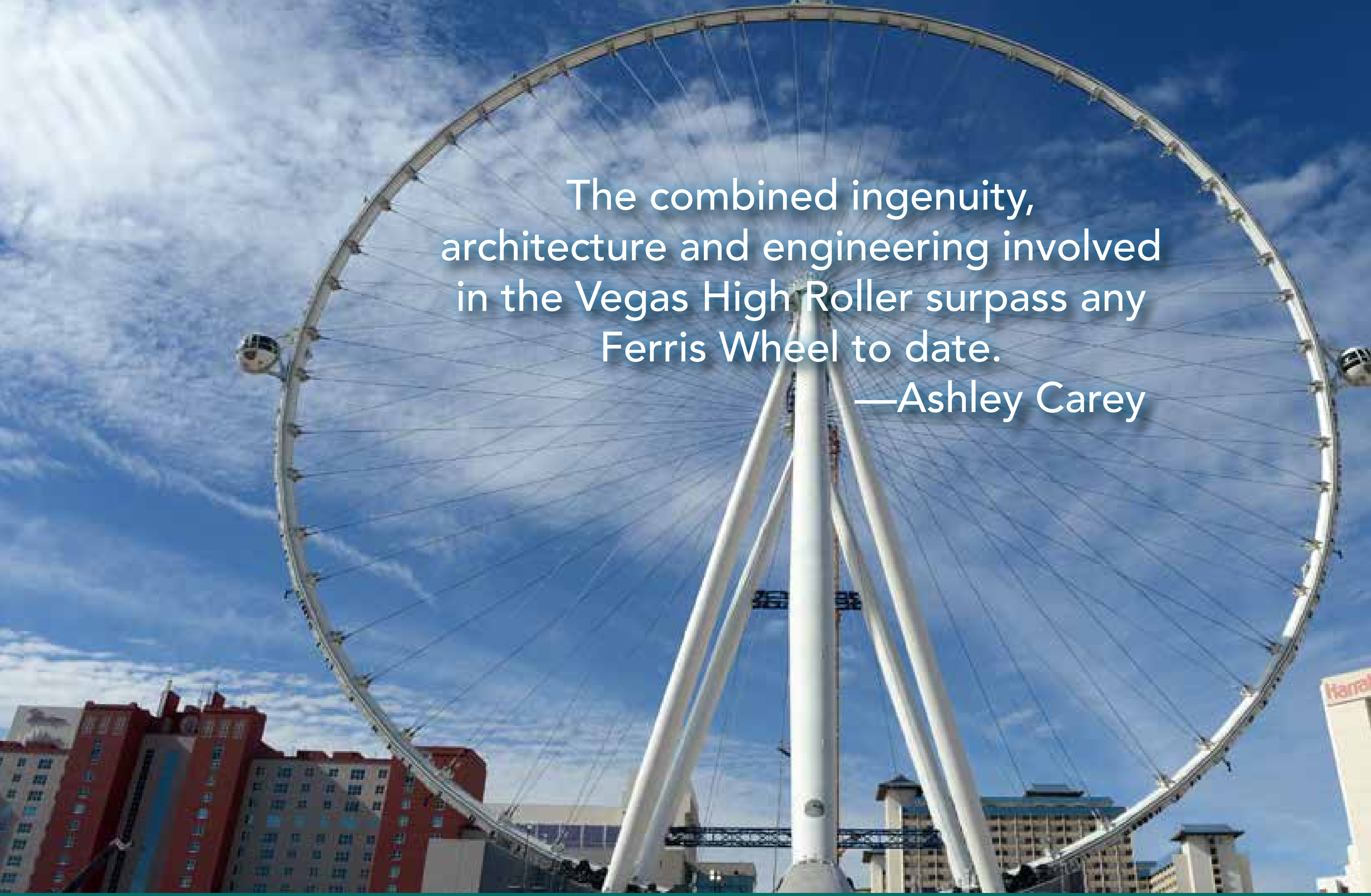
General Contractor
Clark Construction Group, Irvine, Calif.

Steel Team

Fabricator
Beck Steel, Inc., Lubbock, Texas

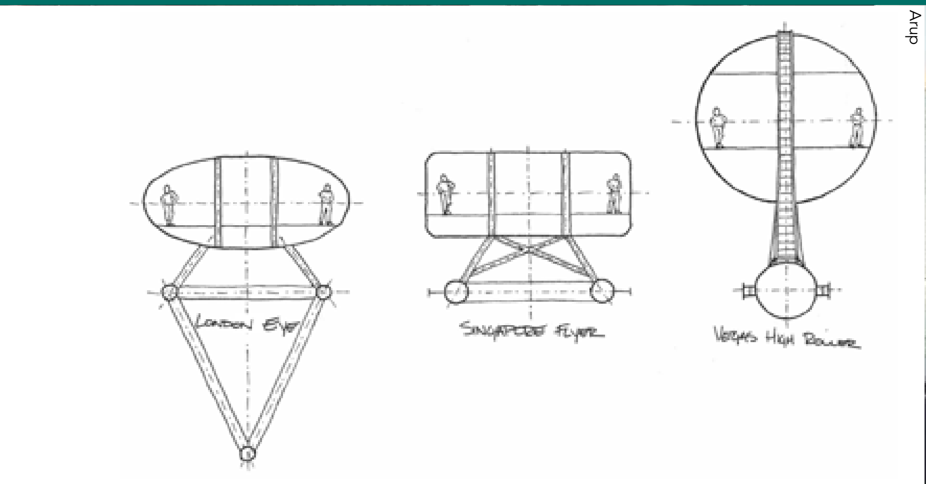
Erector
Bragg Crane & Rigging Co., Long Beach, Calif.

Bender/Roller
Whitefab, Inc., Birmingham, Ala.



The combined ingenuity, architecture and engineering involved in the Vegas High Roller surpass any Ferris Wheel to date.
—Ashley Carey

GREATER THAN $75 MILLION **NATIONAL AWARD** The Vegas High Roller observation wheel, Las Vegas



Arup

American Bridge

D Truscello

D Truscello

Arup

VEGAS DOES EVERYTHING BIG.

At 550 ft tall and a cost of $300 million, the Vegas High Roller, which opened in March 2014, is the largest observation wheel ever built.

Caesars Entertainment—the owner—wanted its observation wheel to not only be the largest in the world, but also to offer guests the best experience.

"Vegas demands audacity and 'over-the-top,'" said Greg Miller, senior vice president of development for Caesars Entertainment. "The High Roller is so much more elegant and beautiful than any other wheel. The creative intent was to have it appear to be lightweight, without a lot of structure."

This desire guided a structural scheme with minimal visual impact, affording passengers a "floating sensation" and sense of space, which was achieved with a single rim element and single cabin support bearing. Previous observation wheels, including the London Eye and Singapore Flyer, had wider truss rims and dual cabin bearings, restricting views from the cabin and making passengers more conscious of the structure supporting them.

To ensure passengers would have a stable, comfortable ride, structural engineer Arup carried out a wind time history analysis, modeling the spatial correlation between gusts of different intensities and the lateral stiffness afforded by the pre-load in the cables. As there are no codified acceptance criteria for wind-induced accelerations for observation wheels, the predicted movements of the wheel were simulated on a custom motion platform for Caesars to experience. Through this intuitive and tangible experience, Caesars was able to choose a level of acceleration that would be acceptable and determine how frequently it would be willing to shut the wheel due to high winds. This criteria was subsequently used to determine the level of added damping required to provide a smooth ride.

The rotation of the wheel generates cyclical stresses in the structure and thus introduces fatigue degradation. Every structural steel component and connection was assessed for fatigue to ensure its projected life met the 50-year design life. In most instances, checks were done according to the local code. However, where the geometry was particularly complicated and the stress flow more difficult to determine, detailed finite-element analysis was used to determine the stress ranges and a more rigorous "hot-spot" analysis was undertaken.

When it came to the cables, published fatigue data relates primarily to axial stresses—but since the wheel clearly rotates, the cables are subjected to bi-axial bending and the published data was therefore not directly applicable. A unique analytical approach was developed to assess the cables, and the results were validated with accelerated fatigue tests on cable specimens that mimicked the expected bending. Through this process, it was determined that spherical bearings were required at the cable ends to meet the intended design life of the wheel.

The rim tube is rolled from structural steel plate; the hub and spindle have forged steel ends welded to structural steel midsections; the bearings are made from high-performance steel subjected to high-contact stresses; and the anchor bolts to the foundations provide ductility in the event of a Maximum Credible Earthquake. Of course, the entire structure is exposed; all of the connections can be seen up close, and the bolts and welds are clearly visible from within the cabins. At night, thousands of LEDs wash the steelwork (painted white) with programmable changing colors, creating a multitude of dynamic patterns.

Many of the tolerances exceeded those typically associated with steel structures, and the unusual interfaces required careful management—most notably the interfaces between the static elements (boarding platform and drive equipment) and the moving elements (rim and cabins). To coordinate these interfaces, a detailed 3D Navisworks model was developed. This started with the 3D structural steel model, and then the subcontractors' components were imported—cabins, drive equipment, electrical equipment, lighting and all of their associated nuts, bolts and brackets.

Many of the final structural components for the High Roller were physically too large and heavy to transport economically to the site. Through a detailed analysis of the reference design, optimal locations for bolted splices—in order to enable shipping, trucking and lifting operations—were identified and then fed back into the detailed design process of the permanent works undertaken by the structural engineer. This collaborative approach allowed for the temporary and permanent works to be designed in parallel and led to a more efficient structural design tailored to the contractor's preferred fabrication and erection methods.

Owner
Caesars Entertainment Corp., Las Vegas

Architects
The Hettema Group, Pasadena, Calif.
Klai Juba Architects, Las Vegas

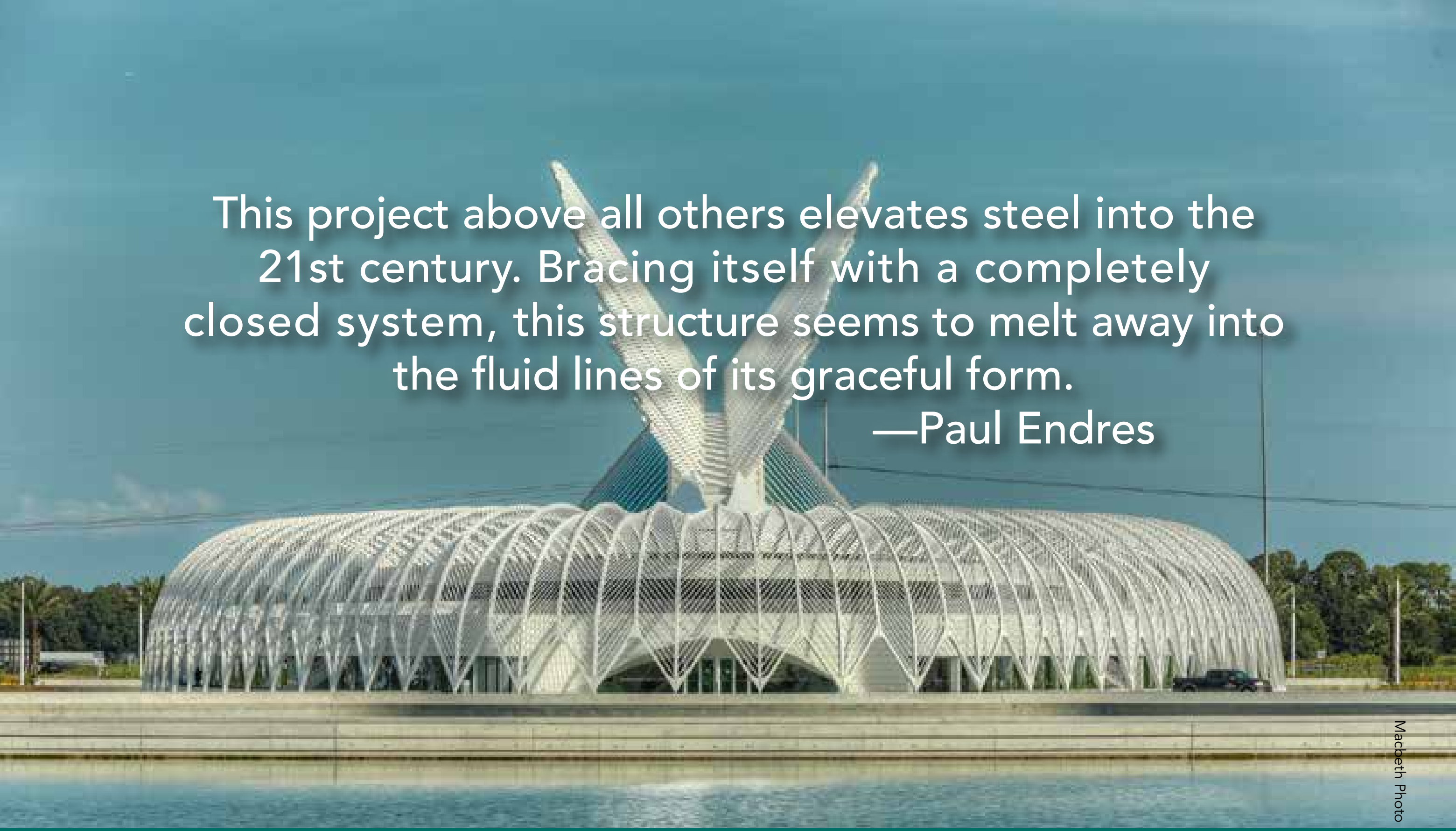
General Contractor
W.A. Richardson Builders, LLC, Las Vegas

Structural Engineer
Arup, San Francisco

Steel Fabricator and Erector (base)
SME Steel, West Jordan, Utah

This project above all others elevates steel into the 21st century. Bracing itself with a completely closed system, this structure seems to melt away into the fluid lines of its graceful form.

—Paul Endres



Macbeth Photo

$15 MILLION TO $75 MILLION **NATIONAL AWARD** Florida Polytechnic University IST Building, Lakeland, Fla.

Skanska

Skanska

Macbeth Photo

Calatrava

FLORIDA POLYTECHNIC UNIVERSITY is the state's newest university and the only one dedicated solely to a curriculum of science, technology, engineering and math.

Founded in 2012, FPU started its new campus building program with the 162,000-sq.-ft Innovation Science and Technology IST Building designed by Santiago Calatrava.

This two-story reinforced concrete structure's signature element is the 250-ft long glass atrium shaded by 94 operable louver arms, all of which are supported by structural steel boxed plate assemblies spanning up to 72 ft. These assemblies are designed to carry not only the load of the glass atrium but also the extreme loads of the shading system's operable louvers arms, which are up to 62 ft long and move during the day to act as sun shades. The arms are attached to a structural steel plate stanchion that is field welded to the structural steel plate box assembly. The load is transferred by the box plate assemblies and network of internal plate stiffeners to the foot assembly and then to a reinforced concrete ring beam.

The structural steel box assemblies were shop fabricated, then most were shipped in two pieces due to length and joined in the center at the job site. The lower portion of the plate assemblies are AESS and exposed to view from the grand hall below.

Owner
Florida Polytechnic University, Lakeland, Fla.

Owner's Representative
Lighthouse Advisors, Tampa, Fla.

General Contractor
Skanska USA Building, Tampa

Architect
Santiago Calatrava, New York

Structural Engineer
Thornton Tomasetti, Newark, N.J.

Steel Team

Fabricator
E & H Steel Corp., Midland City, Ala.

Erector
Midwest Steel, Detroit

Detailer
Dowco Consultants Ltd, Surrey, B.C.

CENTRAL ARIZONA COLLEGE isn't just adding a new building but rather an entire new campus.

Master-planned for significant growth in the next 20 years, this new ground-up satellite campus in Maricopa is expected to add over 700,000 sq. ft of building space on 200 acres at full build-out. The initial phase consists of three academic buildings and a central plant constructed on 28 acres.

Totaling over 76,000 sq. ft, this first phase includes teaching laboratories, classrooms, a café, a bookstore, a library, a learning center, interactive distance learning classrooms, student services, administration offices and a multipurpose community room. This community room bookends the main entry with the library, acting as a beacon for the greater community and promoting education.

Rustic natural colors and weathering steel allow the buildings to blend with their surroundings, and long cantilevers highlight the steel design, providing both shade and outdoor student gathering spaces. Wide-flange steel shapes are tapered at the ends to provide an elegant and sleek look, and canted walls give the buildings a natural aesthetic while strategically blocking the southern sun exposure. Clerestory windows on the north side of the buildings allow natural light into the interior spaces, as do four large light scoops in the classroom and lab areas.

Steel roof framing was constructed with a layered approach in mind to give the spaces a light and airy feel. HSS were placed on top of sloping wide-flange steel girders to give the effect of the roof deck floating above the main structure, while allowing the metal deck flutes to run parallel to the main structure. This layered approach allowed the use of long continuous members, thereby reducing the number of connections and associated welding. Connections were carefully designed to accomplish both functional load requirements while providing an appealing aesthetic appearance. Bolted slip critical moment connections were used to connect the sloping roof girders to the canted columns in a clean, aesthetic manner. Steel moment frames are used throughout the structures to resist wind and seismic lateral loads, eliminating the need for shear walls or cross bracing members and enhancing the open inviting feel to the spaces. The main walkway is covered by a 30-ft cantilevered roof canopy, constructed of sloping wide-flange steel beams supported by canted steel columns, and provides visual continuity between the buildings.

Weathering steel and rammed earth create the primary exterior aesthetic and eliminate the need for long-term maintenance, and unpainted structural steel and galvanized acoustical decking create the main interior volumes. A new campus language is born out of its unique desert context, a model for the campus of the future. Each building strategically turns its back to the harsh desert southern sun, while harvesting northern daylight and creating a continuous shaded arcade on the south that connects the campus' classrooms end to end. Rolling barn doors and minimal wall partitions organize interior volumes that are planned to be modular and easily removable when expansion and renovation occur in the future.

Owner
Central Arizona College, Coolidge, Ariz.

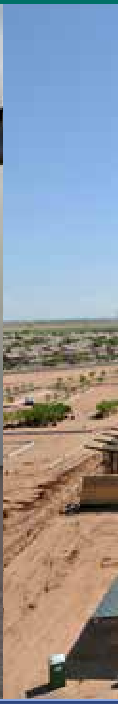
General Contractor
CORE Construction, Phoenix

Architect
SmithGroupJJR, Phoenix

Structural Engineer
PK Associates, LLC, Consulting Structural Engineers, Scottsdale, Ariz.

Steel Fabricator and Erector
S & H Steel Co., Gilbert, Ariz.

Liam Frederick



Bill Timmerman

Liam Frederick

Bill Timmerman

$15 MILLION TO $75 MILLION **MERIT AWARD** Central Arizona College, Maricopa Campus, Maricopa, Ariz.

SmithGroupJJR

A sterling example of architecture in harmony with its environment made possible through the elegant expression of ordinary structural steel shapes.

—Peter Lynde

Liam Frederick

$15 MILLION TO $75 MILLION **MERIT AWARD** Pomona College, Studio Art Hall, Claremont, Calif.

ART IS MEANT TO INSPIRE. And buildings dedicated to art should do the same.

Such was the goal of the designers of Studio Art Hall at Pomona College. The new 35,000-sq.-ft building replaces the century-old Rembrandt Hall, which housed the college's art program. Because the art department not only caters to art majors but also the entire student population, the college needed a space that would influence and captivate anyone who steps through its doors.

The layout is designed to inspire interaction, discussion and socialization while moving through the studios and public areas. The monumental staircase draws visitors into the space and provides an informal seating area to meet or socialize. With sweeping views of the San Gabriel Mountains and historic oak grove framed through floor-to-ceiling windows, Studio Art Hall reflects its surroundings in Claremont, Calif., and draws inspiration from the expansive natural views.

Built to LEED Gold standards, the $29-million design-assist project was designed with a green, minimalist approach by remaining open and airy with free flowing spaces and external hallways. The central courtyard is open to the sky, providing ample lighting and yet another connection to nature and the elements. Six sloped roof skylights with vents allow natural lighting and airflow throughout the studios.

Prior to designing the hall, wHY ARCHITECTURE held ideas workshops for the Art Department faculty and students where the entire art program and site was reimagined. From these sessions, a common thread was the need for cross-pollination of ideas, which resulted in wHY's use of semi-public "grey spaces" such as the open courtyard in the heart of the building. Input from the art department did not stop there. When steel framing mock-ups for the roof were created on-site, faculty voiced their opinions of how the secondary wood framing would alter their vision for the aesthetics of the roof.

wHY and structural engineer Thornton Tomasetti went back to the drawing board and created a different design that stayed true to the faculty's and wHY's vision. From foundation to finish, the entire construction process was streamed live for viewers to watch as the construction progressed over the course of almost two years (a time-lapse YouTube video is available at **http://tinyurl.com/oq7d79w**).

Jeremy Bittermann

Jeremy Bittermann

Hamilton Construction

Jeremy Bittermann

The arching steel and wood roof appears to float above the building, mimicking the ebb and flow of the surrounding mountains. To create an undulating shape, most of the steel used in the roof's framing was set at 45° angles with respect to the column grids. The curvature in one direction was developed by straight lines of beams at a constant elevation within the same line; in the perpendicular direction, the curved geometry was achieved by faceted beam lines. The result is a steel diagrid with sawn-lumber joists spanning between the beams to support the roofing system.

A more common approach to designing the roof would have been to curve all the steel members, but angling the steel allowed for a minimum amount of curved members and reduced fabrication cost and time. Angling the beams did require custom connections to accommodate multiple beams (up to eight in some areas) meeting at one connecting point in the diagrid. Some segmented beams have moment connections to support cantilever conditions or longer spans where additional stiffness was needed by using two-way action.

The complex geometry of the roof canopy was rationalized and documented using Grasshopper, a parametric toolbox incorporated in Rhino that enables designers to define and manipulate the intricate geometric shapes. The overall design of the building was a 180° turn away from the campus' existing traditional Spanish mission-style structures, making it a signature building on campus for students, faculty, alumni and the public to visit for years to come. Every detail of the building was thoughtfully and carefully designed and constructed to create an iconic structure that is sure to inspire all who walk through its doors.

Owner
Pomona College, Facilities and Campus Services, Claremont, Calif.

General Contractor
Hamilton Construction, Pomona, Calif.

Architect
wHY Architecture, Culver City, Calif.

Structural Engineer
Thornton Tomasetti, Los Angeles

Steel Fabricator
Anvil Steel Corp., Gardena, Calif.

Jeremy Bittermann

$15 MILLION TO $75 MILLION **MERIT AWARD** University of Oregon Hatfield-Dowlin Football Performance Center, Eugene, Ore.

> This aggressively fearless design elevates the cantilever to structural tour de force defying logic by hanging the offices below hovering over the main floor.
> —Paul Endres

Eugene Sandoval

THE UNIVERSITY OF OREGON DUCKS football team had quite a year. Not only did they make it to the national championship game, they also saw the opening of the 145,000-sq.-ft Hatfield-Dowlin Football Performance Center on the school's campus in Eugene.

The complex, adjacent to the team's Autzen Stadium, provides training, teaching and nutrition services to the team and staff, plus a weight room, coaching staff offices, team meeting theaters, position-specific training rooms, locker rooms, practice fields, dining facilities, a "war room" and a players' lounge. The offices and lounge are housed in the three-story "Office Bar" structure, which cantilevers over a plaza some 40 ft below. The 235-ft-long, 35-ft-wide building is supported only by two steel-clad stair cores with plan dimensions of 22 ft × 12 ft and 22 ft × 17 ft, occurring near the ¼ point from each end, with cantilevers of 50 ft and 40 ft extending out at the north and south ends, respectively, and a central span of almost 120 ft. The primary structure is composed of a pair of full-story deep steel warren trusses located along the east and west edges of the uppermost level. Exposed W12 truss diagonals create a pattern along the full length of the player's lounge, and the lower two floors are hung from the trusses via high-strength steel rods, allowing for column-free space throughout the building.

A "sunglass wall" on the building's west face is composed of a series of intermittent exterior glass panes alternating position in three planes, creating an attractive focal point while also providing sun-shading to occupants. This wall is separated from the main building by several feet and hangs from cantilevered HSS beams extending from the roof.

Imagine Group

Jeremy Bittermann

A 24-ft-wide steel sky bridge connects the east side of the Office Bar to the adjacent "Teaching Box" building at levels four through six. The five-story Teaching Box is approximately 100 ft by 160 ft and houses a lobby, a dining hall, media and scouting facilities, a locker room, position classrooms, meeting room and the team theaters. The building features a two-story-tall 28-ft cantilevered portion at levels four and five on the east side, hung from 5-ft-deep custom steel plate girders at the roof, and the upper three levels of the building are framed primarily with composite steel beams and columns

For more on the Oregon Ducks' Hatfield-Dowlin Football Performance Center, see "Flying High" in the July 2014 issue, available at ***www.modernsteel.com****.*

Owner
University of Oregon / Blue Ribbon Sports, Eugene, Ore.

General Contractor
Hoffman Construction Company of Oregon, Portland

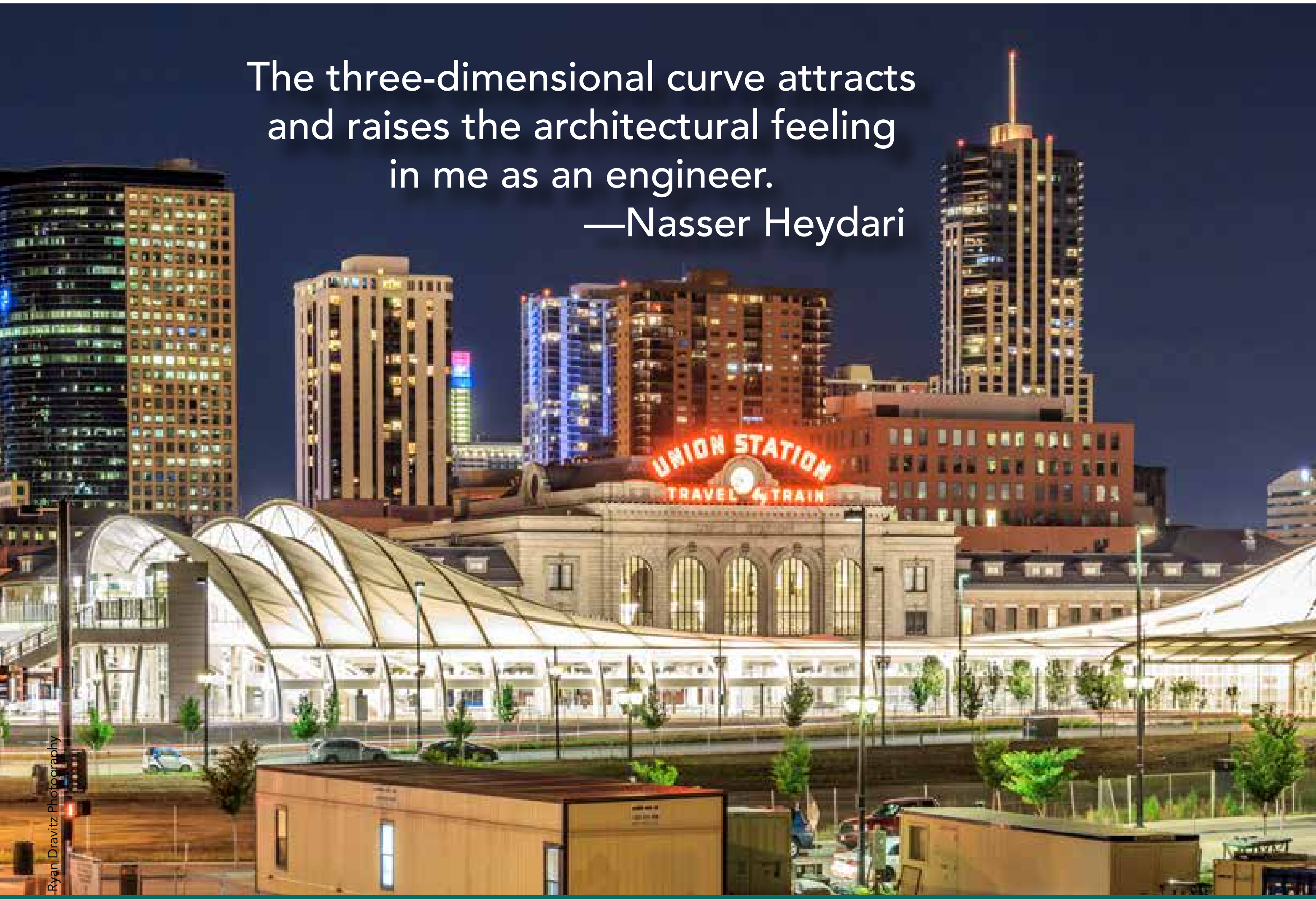
Architects
Zimmer Gunsul Frasca Architects LLP, Portland, Ore.
Firm 151, Portland

Structural Engineer
KPFF Consulting Engineers, Portland

Steel Team

Fabricator
Metals Fabrication Co., Airway Heights, Wash.

Detailer
Tru-Line Drafting Services, Surrey, B.C.



LESS THAN $15 MILLION **NATIONAL AWARD** Denver Union Station, Denver, Colo.

DENVER'S HISTORIC UNION STATION is a Beaux Arts landmark located on the edge of the city's central business district and has served Amtrak and other trains for years. Its role has expanded as it is now the center of the $11,000,000 Denver Union Station Intermodal Hub, which opened in the spring of 2014.

The new Train Hall structure is the focal point of Union Station and was conceived as an efficient and formally expressive means of clear-spanning 180 ft across multiple railway tracks. An ovular steel-and-fabric canopy rises 70 ft at the head end platform, descends in a dynamic sweep to 22 ft high at the center and then rises again at the far end over a pedestrian link across the site. The primary structural system consists of 11 steel arch trusses spanning nearly 180 ft from a single large-diameter pin connection atop 18-ft-tall arched column supports; in the central area of the train hall, the arch-trusses are replaced by cantilevered trusses, and the trusses are stabilized by bracing struts between them. Each truss is supported about 20 ft above the ground by a series of steel "kick stands," which support vertical loads and horizontal thrust, and each "kick stand" is rigidly connected to the foundation with heavy anchor bolts. All of the trusses support a tensioned PTFE fabric.

Though the overall geometry of the train hall is a complex, seemingly free-form series of curves, the realization of this geometry was achieved by using only members curved to one circular radius. The curving tube members forming the complex shape of the inner oculus, for example, are comprised of tubes curved in single plane and then rotated in space to form a more complex three-dimensional curve. The geometry of each arch truss, likewise, is defined by just two radii, which allowed it to be conveyed in simple two-dimensional plans and elevations, without the need for either three-dimensional work point schedules or exchange of electronic models.

Further cost reduction was achieved by responding to the fabricator's concerns regarding the blanket designation of architecturally exposed structural steel (AESS), primarily HSS, that would usually be applied for structures of this type. Rather than simply applying this requirement to all of the exposed steel, the architects and engineers identified only those aspects of AESS that were critical to the project's success, and defined "exposed painted structural steel" (EPSS) requirements specific to the job. Remarkably, all the architectural steel at Denver Union Station was fabricated and detailed no differently than conventional structural steel.

DUS Construction

Robert Polidori

Ryan Dravitz Photography

SOM

Ryan Dravitz Photography

All structural connections were fully designed by SOM's engineers, and every structural connection and member is both a load-carrying and architecturally expressive element. As such, SOM engineers took great time and care to fully detail all members and connections in the contract drawings in order to fully control the design and evaluate aesthetics prior to the shop drawing phase. This work had the additional benefit of eliminating fabricator connection engineering time and cost. To keep the design within budget, SOM engineered the exposed connections to use only conventional structural steel fabrication techniques and materials but took great care to shape the connections to be aesthetically minimal and consistent. All exposed structural steel is painted white with a high-performance coating system consisting of a shop-applied zinc-rich primer and a Polysiloxane finish coat, and all steelwork was blast cleaned to ensure the longevity of the coating system. The resulting design conveys a clean, modern, machine-like aesthetic, without the use of custom castings.

Owner
Denver Union Station Project Authority, Denver

Owner's Representative
Trammell Crow Co., Denver

General Contractor
Kiewit Building Group, Inc., Englewood, Colo.

Architect and Structural Engineer
Skidmore, Owings and Merrill LLP, New York

Steel Fabricator
Schuff Steel, Phoenix

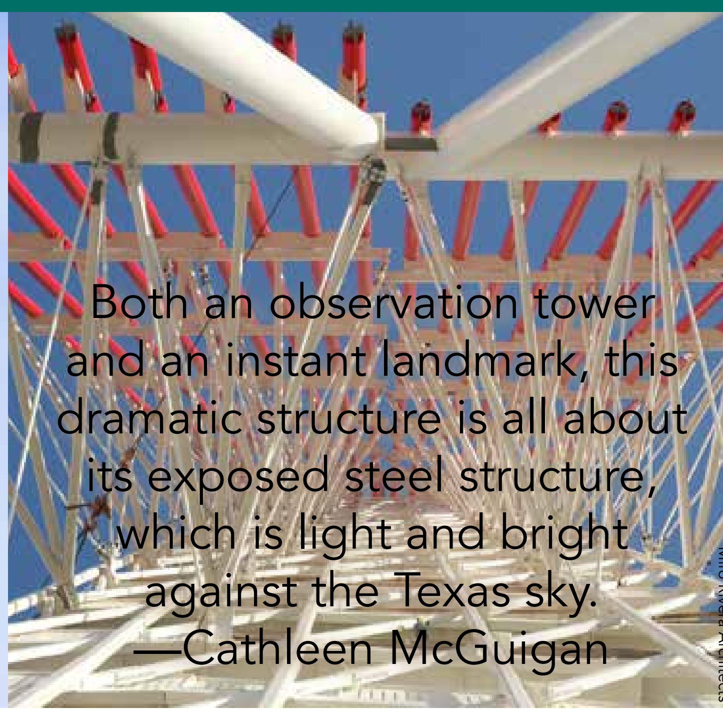
Miró Rivera Architects

Walter P Moore

Miró Rivera Architects

LESS THAN $15 MILLION **MERIT AWARD** Circuit of the Americas Observation Tower & Austin360 Amphitheater, Austin Texas

Miró Rivera Architects



Miró Rivera Architects

> Both an observation tower and an instant landmark, this dramatic structure is all about its exposed steel structure, which is light and bright against the Texas sky.
> —Cathleen McGuigan

Ted Parker Jr.

THE CIRCUIT OF THE AMERICAS Observation Tower provides a new perspective on racing and a dramatic new landmark for Austin, Texas.

The 250-ft-tall tower looks down on the Circuit of the Americas (the first purpose-built Formula 1 racing facility in the U.S.) and was conceived as a visual finale to the central Grand Plaza as well as a dramatic and memorable backdrop to the adjacent Austin360 Amphitheater. The amphitheater is the largest outdoor stage in central Texas, with 6,671 fixed seats and a total capacity of over 14,000 people.

Inspired by the image of red streaks of glowing light that tail lights leave behind in the dark, a fan of red steel tubes over the amphitheater stage converges to form a veil that sweeps up and over a central elevator shaft wrapped by a stair. While code requirements required an enclosed shaft, the elevator core is gypsum and provides no structural support. The entire structural system is steel and is exterior to the shaft. Seemingly suspended from this pipe steel canopy is a viewing deck that offers a sweeping panorama of the entire track, downtown Austin and nearby Hill Country.

Taking advantage of code egress requirements, the designers arranged the two access/egress stairs in a double-helix configuration; by using continuously welded plate for the treads and risers, each stair run was effectively transformed into a helical continuous diaphragm. The resulting stiff backbone allowed for a layered diagrid of HSS tubes at the perimeter of the tower to be employed as a combined gravity and lateral load system. Inside the stairs, a standard cold-formed steel and gypsum board system frames the elevator shaft. The filigree-like diagrid perimeter consists of multiple small, distributed members that contribute the necessary overall strength by number rather than individual brawn. Immediately outside of the stair stringers is a layer of diagonally-oriented HSS3×3 members, and stacked outside of these diagonals is a layer of vertical HSS4×4 columns. The diagonal and vertical HSS layers combine with the stair stringer diaphragms to form a fully-braced tube. Eccentricities between the layers are handled by resolving a couple into the interior stringer through carefully-detailed steel connections. By dissolving the diagrid frame into multiple small members, demands on individual connections are limited and can be handled with economical details.

At the top of the Observation Tower, the side faces of the diagrid skeleton extend outward to form a deep cantilever truss that supports a 900 sq ft viewing deck. The entire balastrude and a portion of the floor are made of structural laminated glass, allowing more daring visitors to look 230 feet straight down below their feet. From above this level, the veil of closely-spaced round HSS8.625 tubes cascades down the front of the tower. Not only a striking visual feature, the veil is also an outrigger column for lateral load resistance via a series of struts and rods that connect it to the main tower.

The veil extends over the amphitheater stage to form the top chords of the nine primary trusses of the amphitheater stage roof. The stage is covered by a transparent single-layer ETFE membrane with integral stainless steel cables just above the plane of the truss top chords. Between each truss chord are two additional infill pipes to match each member of the tower veil and enable the veil to extend out over the stage. The infill members are connected to the truss top chords by a checkerboard of HSS6×4 that both support the infill members and develop a horizontal Vierendeel diaphragm. The primary structure supports a 70-ton concert rigging grid integrated at the bottom chord level of the trusses and accessed via a front of stage catwalk system.

Final approval for the tower concept was granted less than a year before the first race, and if the tower was going to be built, it had to be completed before the first race. Structural engineer Walter P Moore (WPM) worked with the steel team to establish preferred strategies, shop module sizes and connection details, and because of the tight schedule and the complexity of the structure, traditional paper drawings were not a practical solution as a final deliverable for construction. WPM produced a fully-connected Tekla model (BIM LOD 400) that was then transferred to the detailer, who produced fabrication shop drawings directly from the model; general contractor Austin Commercial estimated that this process saved three months over traditional delivery methods.

For more on the Circuit of the Americas Observation Tower, see "On the Fast Track" in the August 2013 issue, available at ***www.modernsteel.com****.*

Owner
Circuit of the Americas, Austin

Owner's Representative
MBC Consultants, Terrell, Texas

General Contractor
Austin Commercial L.P., Austin, Texas

Architect
Miró Rivera Architects, Austin

Structural Engineer
Walter P Moore, Austin

Steel Team

Fabricator
Patriot Erectors, Inc., Dripping Springs, Texas

Erector
Patriot Erectors, Inc., Dripping Springs, Texas

Bender/Roller
Chicago Metal Rolled Products, Chicago

LESS THAN $15 MILLION **MERIT AWARD** Hilton Columbus Downtown High Street Bridge, Columbus, Ohio

This creative skeletal steel structure fully integrates environmental systems within its spine—just one of many creative solutions to the project's challenges.

—Peter Lynde


HOK


HOK


HOK

THE HILTON COLUMBUS DOWNTOWN high street Bridge makes the walk from the city's new Hilton Columbus Downtown hotel to the adjacent Greater Columbus Convention Center a lot more scenic.

The 105-ft-long enclosed glass walkway is entirely supported by a single overhead steel tube and suspended ribs, and the all-glass design emphasizes physical and material lightness and visual transparency, intentionally avoiding the external, heavy-truss pedestrian bridge aesthetic found throughout the city. In fact, glass is employed as the primary material for the floors, walls and entire enclosure of the bridge. The unitized module of the $4,500,000 bridge was fabricated and shipped as small components that were then assembled and glazed on site prior to lifting the entire structure into place. All building services, including air, water and lighting, are delivered through the overhead 48-in. steel tube or discreetly within the glass walkway, which maximized the height of the interior space.

The design team studied several options for the bridge before developing an efficient form that the team, client and city of Columbus would agree upon. A series of bent "fin" frames hang down from a central pipe spine atop the walkway to support a glass floor with light steel framing; this central pipe spans from a haunch on the new hotel to an inverted A-frame added to the existing convention center, on a new caisson.

The team carefully analyzed local stresses at the fin-to-pipe connections and detailing pipe-end connections for large forces and required movements. In fact, the bridge design was controlled by limiting movement and deflections. The 48-in.-diameter pipe resisted vertical loads and worked together with diagonal cable bracing in the glass floor plane to resist lateral and incidental torsion.

The 138-ton bridge spans 105 ft across High Street, the main thoroughfare through downtown Columbus, so an extended closing of the roadway was not an option. The design and construction team came together to develop an alternative method of construction, which involved the bridge being pre-assembled, pre-painted and pre-glazed at an adjacent site prior to hoisting. The hoisting operations took place over one weekend and the shutdown of the roadway was limited to two days, greatly minimizing the impact to city traffic flow.

Owner
Franklin County Convention Facilities Authority, Columbus, Ohio

Owner's Representative
Strategic Advisory Group, Duluth, Ga.

General Contractor
Turner/Smoot joint venture, Columbus

Architect
HOK, Chicago

Structural Engineer
Halvorson and Partners, Chicago

LESS THAN $15 MILLION **MERIT AWARD** Landscape Evolution Observatory at Biosphere 2, Oracle, Ariz.

THE LANDSCAPE EVOLUTION OBSERVATORY (LEO) at Biosphere 2, just north of Tucson, Ariz., does science projects on a mega-scale.

This $6.7 million facility features world's largest weighing lysimeter (which measures the amount of water released through evapotranspiration by changes in weight; there are two types, weighing and non-weighing). The facility is used to study the interaction of water, temperature, soil and vegetation, amongst other environmental elements, on three full-size-scale hill slopes that will allow it to quantify interactions among hydrologic, geochemical, geomorphic ecological, microbiological, and atmospheric processes associated with incipient hillslope development. The three slopes are built from large steel planting tray structures and reside in a space-framed greenhouse that was previously used for intensive agriculture. Each hill slope consists of:

1) A 38-ft-wide by 100-ft-long by 3.3-ft-deep *tray*, a steel box that slopes 10° in the longitudinal direction with a changing transverse slope along the tray's length to form the ridges and a valley channel that simulates a hillslope. Each tray is clad on the bottom and all four interior sides with 3-in.- deep steel N-deck, fiber-reinforced cement board and a special waterproofing membrane to contain a layer of finely crushed basalt, irrigation water and a complex array of 2,847 different sensors per tray.
2) A *substructure*, a system of wide-flange beams and double angle steel braces that connect to 10 HSS columns aligned directly over existing concrete columns of the basement structure, supporting the *tray* through ten load cells centered on the top of each column.

Ruben Ruiz Paul Ingram, University of Arizona

Ruben Ruiz Paul Ingram, University of Arizona

Ruben Ruiz Paul Ingram, University of Arizona

3) A *personnel transporter*, a mobile steel structure similar to a gantry crane for human transport that traverses over the *tray*, covering its full width and length, and allowing scientists to monitor LEO without disturbing the soil.

Laser scanning was used to recreate a model of the existing building and determine available space, which helped enormously in finding possible clashes and designing items such as the personnel transporter. There is only one entrance into LEO, measuring 10 ft wide by 12 ft high, which required most of the field connections to be bolted for ease of field construction as well as to set a limit on the size and weight of pieces that were transported to the construction site.

For more on the University of Arizona's Landscape Evolution Observatory, see "Under the Dome" in the November 2014 issue, available at ***www.modernsteel.com****.*

Owner
The University of Arizona-Biosphere 2, Oracle, Ariz.

Owner's Representative
University of Arizona, Planning Design and Construction, Tucson, Ariz.

General Contractor
Lloyd Construction, Tucson

Architect
M3 Engineering and Technology, Tucson

Structural Engineer
M3 Engineering and Technology, Tucson

Steel Team

Fabricator and Erector
Parsons Steel Builders, Tucson AISC CERTIFIED FABRICATOR

Detailer
M3 Engineering and Technology, Tucson AISC DETAILER

A NEW MEMORIAL ON THE STATE CAPITOL GROUNDS in Saint Paul honors the sacrifice of Minnesota firefighters killed in the line of duty. The memorial houses the Minnesota Fallen Firefighters Memorial Statue, previously on display at Minneapolis-Saint Paul International Airport.

The basic design requirement was that the site needed to be a living memorial—in its materiality, organization and pattern of use—and the state desired a place to honor its fallen fire fighters while providing a place for contemplating the nature of the fire service. The entire construction period was five months from contract award to final completion (from May to September 2012).

Approaching the monument, the ground rises to present visitors with a cast stone-faced wall inscribed with names of fire departments from throughout the state. A large steel monolith hovers above the focal point of the site where the statue stands, forming a pavilion to mediate between the monumental scale of the Capitol grounds and the life-scale of the statue. A field of several light steel columns supports the weight of the monolith above, and names of the fallen are inscribed on the columns. Visitors move in the shadow of the monolith through the multitude of columns to encounter the statue, bathed in light from a mirrored void in the monolith above. Outside the pavilion a wood bench provides a comfortable place for reflection.

The weathering steel of the monolith presents a rich patina, evolving in a slow process analogous to the rapid oxidation of fire. The organizing grid of 100 potential columns embodies a century of years—10 decades by 10 years per decade. Currently, an incomplete constellation of 86 columns are present, recording the years in which Minnesota firefighters have died in the line of duty. Over time the assemblage will accumulate additional inscriptions, and new columns will appear as future firefighter deaths occur in years not yet plotted. The increasing multitude reflects the ongoing sacrifice of Minnesota firefighters.

The column-to-monolith connection contained a pipe-sleeve that joined the upper and lower faces of the monolith. This sleeve allowed the column to support both surfaces and also joined the two surfaces, and the slender columns were made stable by designing the base and the top connection to be fixed. The foundation was designed as a mat slab to accommodate the nontraditional column layout, which further accommodated a fixed base plate connection with pre-tensioned bolts. The sleeved connection at the top of the column allowed fixity in that it accommodated a spanning knife-plate, and the plate's short span, in conjunction with the sleeve's engagement of both planes, was stiff in both bending and torsion.

One aspect of the project where technology enabled success was in providing ongoing updates to the list of names to be memorialized. As the researcher discovered more about specific line-of-duty deaths and confirmed public records and fire department histories, the list of names grew and many spellings changed. The design team was able to take a "living" Excel spreadsheet and incorporate it into the design on the fly through a link with BIM, enabling the verification process to proceed in parallel with the overall design.

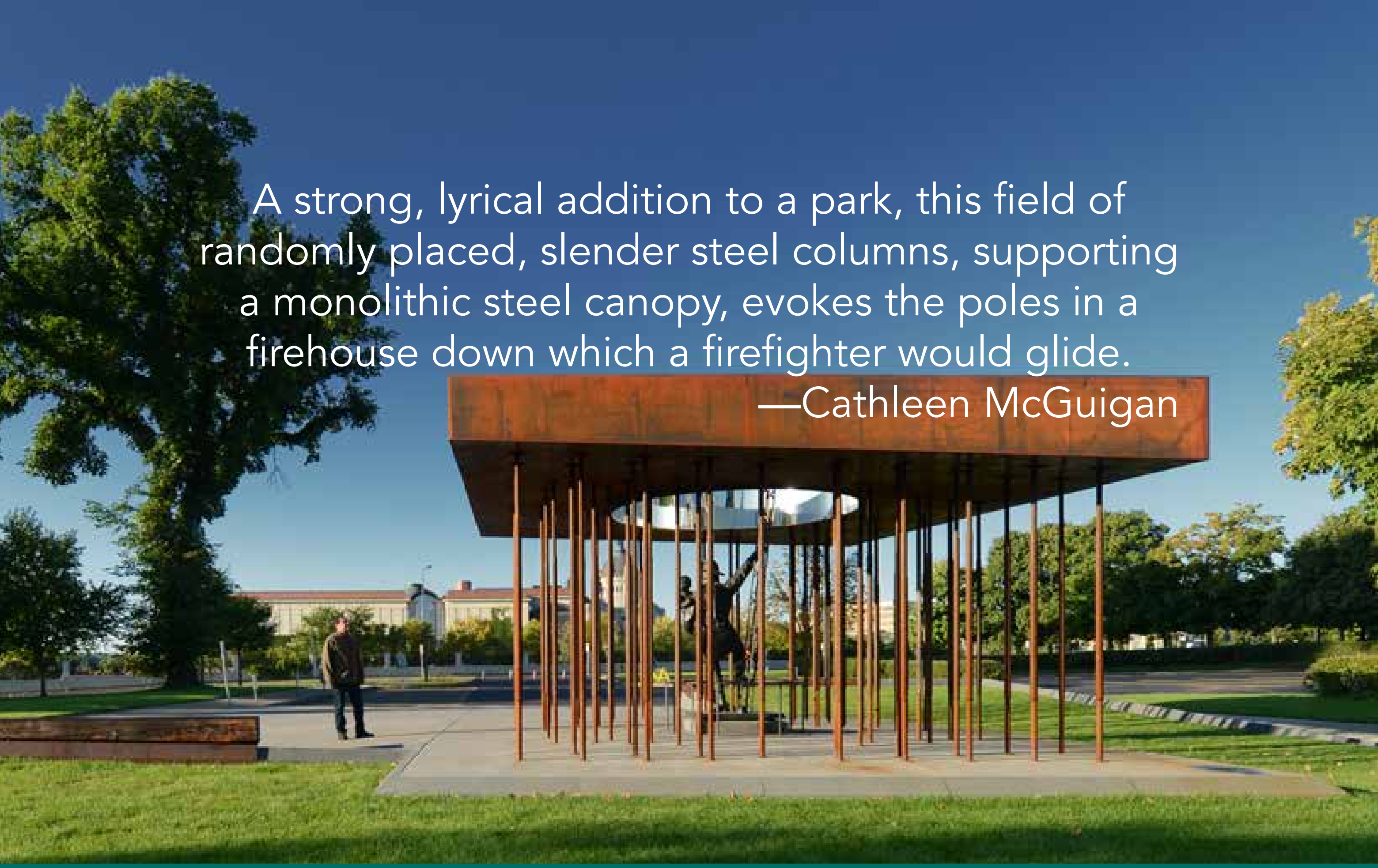
*For another look at the memorial, see "In the Line of Duty" in the September 2014 issue, available at **www.modernsteel.com**.*

Owner
Minnesota Fire Service Foundation, Eden Prairie, Minn.

General Contractor
Meisinger Construction, South St. Paul, Minn.

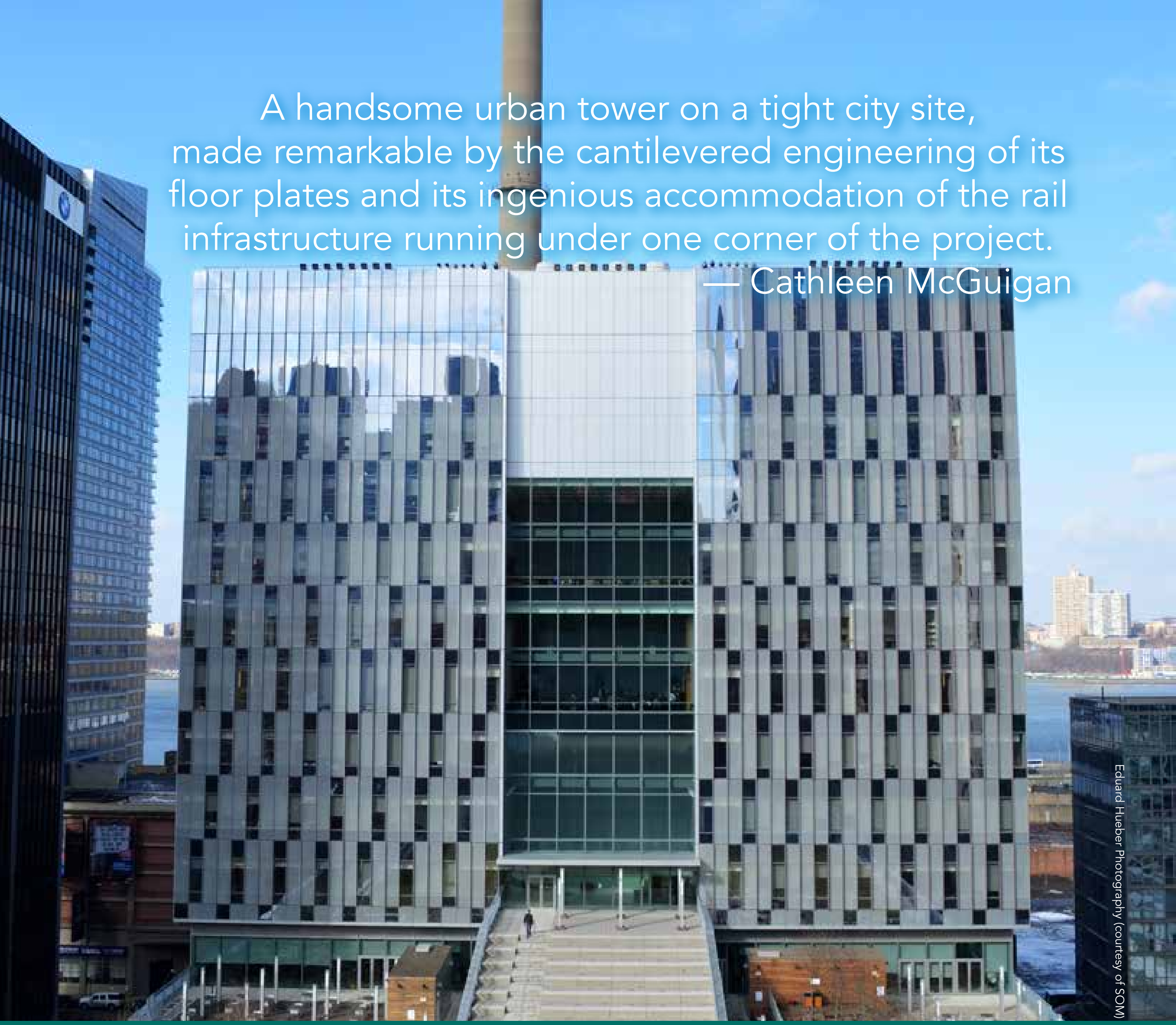
Architect and Structural Engineer
Leo A. Daly, Minneapolis

A strong, lyrical addition to a park, this field of randomly placed, slender steel columns, supporting a monolithic steel canopy, evokes the poles in a firehouse down which a firefighter would glide.
—Cathleen McGuigan



LESS THAN $15 MILLION **MERIT AWARD** Minnesota Fallen Firefighters Memorial, St. Paul

A handsome urban tower on a tight city site, made remarkable by the cantilevered engineering of its floor plates and its ingenious accommodation of the rail infrastructure running under one corner of the project.
— Cathleen McGuigan



Eduard Hueber Photography (courtesy of SOM)

PRESIDENTIAL AWARD OF EXCELLENCE IN ENGINEERING (GREATER THAN $75 MILLION)

JUSTICE HAS A NEW HOME in New York.

The John Jay College School of Criminal Justice expansion project is a new 625,000-sq.-ft, $400 million academic building in Midtown Manhattan. The City University of New York (CUNY) facility consists of a 15-story tower on 11th Avenue and a four-story podium with a garden roof that connects to the college's existing Haaren Hall on 10th Avenue.

However, there is a nearly two-story change in grade between 10th and 11th Avenues. To design for this condition, the perimeter columns—in an area that supported heavy loads from the building's rooftop garden—were eliminated and an entrance on 59th Street was pulled back to allow room for the steps and ramps. Story-deep trusses were fit inside the walls of the fourth-floor classrooms to efficiently accomplish the 40-ft cantilever out to the tip of a V-shaped tapering canopy.

In response to a shallow Amtrak tunnel that cuts through a corner of the site, the building's structural system is distinguished by a grid of rooftop trusses that hang the perimeter of the building eight floors below.

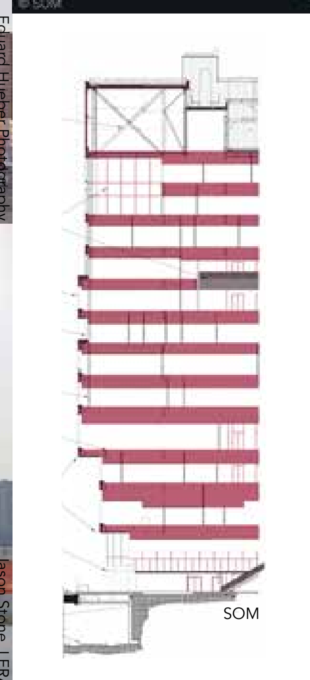
Two layers of structure were provided to effectively isolate the building from the train vibration and noise: 1) the main building structure cantilevers over and behind the train tunnel and 2) the tunnel was enclosed with a hollow core precast plank ceiling and concrete crash walls.

The hanging system was continued around the full perimeter to balance the weight, complete the column-free aesthetic and take advantage of the thin plate hangers which could fit inside standard partition walls instead of traditional column enclosures. To maintain efficiency, the hanging system was stopped where the structure over the tunnel could accommodate conventionally framed floor

Eduard Hueber Photography


© SOM


Jason Stone, LERA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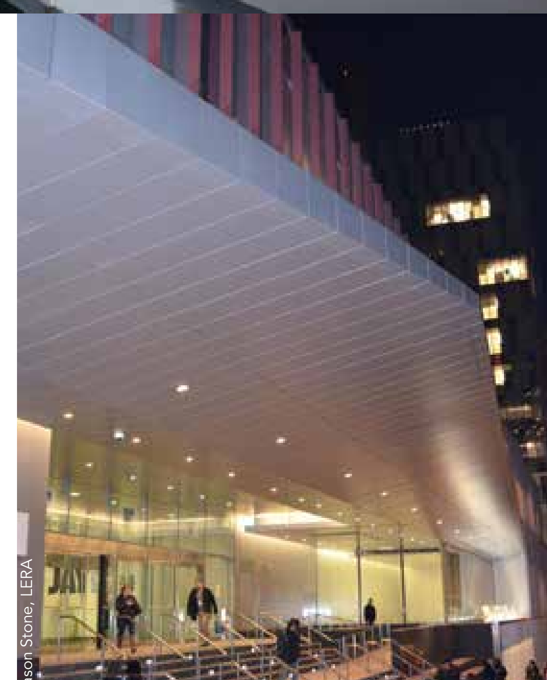
Jason Stone, LERA

John Jay College of Criminal Justice expansion project, City University of New York

weight. In coordination with the architect, the fifth floor was chosen for this transition, allowing the column-free floor to align with the podium roof garden. The design accounted for temporary columns at the fifth floor around the tower perimeter and temporary angles bolted to the plate hangers above the sixth floor in order to stiffen these elements during erection. Once the truss assembly was finished, jacks at the temporary columns slowly lowered the building and engaged the trusses, and the temporary columns and angles were removed. ■

*For more on the John Jay College expansion project, see "Justice is Served" in the September 2014 issue, available at **www.modernsteel.com**.*

Owners
City University of New York
Dormitory Authority of the State of New York

General Contractor
Turner Construction Co., New York

Architect
Skidmore, Owings and Merrill LLP, New York

Structural Engineer
Leslie E. Robertson Associates, New York

Steel Team

Fabricator and Detailer
Owen Steel Co., Inc., Columbia, S.C.

Erector
Cornell and Co., Westville, N.J.