2013 IDEAS² awards

INNOVATIVE DESIGN in ENGINEERING and ARCHITECTURE with STRUCTURAL STEEL

THE DESIGN AND CONSTRUCTION INDUSTRY recognizes the importance of teamwork, coordination and collaboration in fostering successful construction projects today more than ever before. In support of this trend, 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, 2010 and December 31, 2012;
- Projects must be located in North America;
- Previous AISC IDEAS² award-winning projects were 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 specialty contractors such as steel fabricators; alternative methods of project delivery; sustainability considerations; or other productivity enhancers.

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

2013 IDEAS² AWARDS JURY

- **Paul Dannels**, FAIA, is a founding principal of sdi structures, Ann Arbor, Mich., where he develops innovative structural systems for buildings on behalf of numerous aspiring and accomplished architects. His designs have received several awards and recognitions, including three AISC IDEAS² awards. His completed projects include the Broad Art Museum at Michigan State University, the Law Commons at the University of Michigan and the Lamar Corporate Headquarters in Hudsonville, Mich. Dannels is the 2013 President Elect of AIA Michigan and has served in leadership roles with several nonprofits, including Habitat for Humanity of Huron Valley and the Center for Faith and Scholarship. He studied engineering and architecture at the University of Michigan and worked as a construction engineer in northern Michigan before founding sdi structures with his business partner, Andy Greco, P.E.

- **Anne Lewison**, AIA, senior architect and senior design leader with Snøhetta, New York, was initially drawn to the city to focus on social housing and pursued subsequent opportunities for institutional buildings, including the Children's Hospital of Philadelphia and NYU's Vanderbilt Hall Law School with Kohn Pederson Fox. In her early years in New York, she specialized in waterproofing repairs for existing buildings, a technical skill that has remained influential in all subsequent projects. From 1989 to 2000 she worked on the United States Holocaust Memorial Museum. Prior to Snøhetta, Anne worked with Santiago Calatrava on the PATH Station for the WTC Transportation Hub. In addition, she serves on the Board of cultureNOW, which has produced the downtownNOW MAP of art and cultural institutions for Lower Manhattan as well as the Manhattan ARTNOW. She is currently working on apps for cultural mapping across the U.S. and in Canada.

- **Chris Olson** is chief content director of BUILDINGS Media, Cedar Rapids, Iowa, where he focuses on digital and print content for facilities professionals who operate commercial and public buildings. He has more than 22 years of experience in the facilities management and nonresidential architecture/engineering/construction industries. He

The 2013 AISC IDEAS[2] Awards jury, from left: Chris Olson, Charles Porter, Mark Simonides, Brian Raff, Paul Dannels, Anne Lewison, Dave Olson and Jacob Schueller.

graduated with a B.A. and M.A. from the University of Michigan and a Ph.D. from Northwestern University.

- **Dave Olson's** career with AISC member fabricator Olson Steel, San Leandro, Calif., began in 1970 as a project manager and estimator. He progressed to the position of COO in 1995 and in 2002 became president and CEO as well as the sole owner of the company. His career has included founding and/or leading several corporations engaged in diverse businesses, including real estate and shipyards. During the last 15 years, Olson has served as director and trustee of organizations including the Tahoe Maritime Museum, the Tahoe Yacht Club Foundation, the Ironworkers International Apprentice Trust, the Western Steel Council, Orinda community fundraising committees and the San Leandro Vocational Education Committee. He holds a B.S. degree in business administration from California Polytechnic University in San Luis Obispo.

- **Charles C. Porter** is principal and cofounder of Development Management Associates, LLC, Chicago, a developer and property manager of regional retail and mixed-use centers. With more than 30 years of leadership experience in real estate development and construction, Porter has played a primary development role, working as an owner and on behalf of client owners, for several properties, including the 900 N. Michigan Ave mixed-use project, the Houston Galleria expansion and renovation, the Tabor Center redevelopment in Denver and expansion work at the Old Orchard Center in Skokie, Ill. He holds a Bachelor's degree in architecture from the Illinois Institute of Technology and is a member of the International Council of Shopping Centers (ICSC), the Council on Tall Buildings and Urban Habitat (CTBUH), the Urban Land Institute (ULI) and the Chicago Architecture Foundation (CAF). As an adjunct professor at Northwestern University, he teaches a course in commercial real estate development for the Master of Project Management program.

A panel of design and construction industry professionals judged the entries in three categories, according to their constructed values in U.S. dollars:
- ✓ Less than $15 million
- ✓ $15 million to $75 million
- ✓ Greater than $75 million

- **Brian Raff** is the marketing director for the National Steel Bridge Alliance and is responsible for providing strategic leadership and executing the national marketing program that builds market share for steel bridges. Raff worked as a structural engineer before joining AISC in 2005 as its certification manager of business development. He received his Bachelor's degree in architectural engineering from Penn State University and his MBA in entrepreneurship and economic business strategy from DePaul University.

- **Jacob Schueller**, a senior in the civil engineering program at Marquette University, has been interested in structural engineering since early childhood. Now specializing in structures, one of his primary focuses at Marquette has been Engineers Without Borders. He has made three trips to Guatemala with the program, most recently to construct a 270-ft suspension bridge. This past year, Schueller tried his hand in research for the first time by determining the classification, rot sensitivity and strength characteristics of Guatemalan lumber with Marquette professor Chris Foley and fellow classmate Tim Lewis.

- **Mark Simonides** joined Turner's Chicago business unit in 1982, where he has served as project engineer, superintendent, project manager and project executive on several of Chicago's premier projects. He currently serves as vice president and operations manager for Turner's Great Lakes Region. In this role, he oversees the operations for the Illinois, Indiana, Michigan and Toronto offices and is responsible for the oversight and management of the region's 300 professional personnel.

National Award—Greater than $75 Million

NASCAR HALL OF FAME, CHARLOTTE, N.C.

> **“Totally bewitching,** it grabs hold of your senses long before you find the words to articulate what it has accomplished.”
>
> —Paul Dannels

The challenge of designing a Hall of Fame for NASCAR? Capturing the essential spirit of NASCAR racing in architectural form. In exploring the possibilities for expressing speed and spectacle, the architect and structural engineer were drawn to the arena of action, the racecourse, where fans and race teams come together each race week for the experience of race day. Curving, sloped forms are evocative not only of the dynamic and changing sinuous shape of the racetrack but also the perception of speed, which, of course, is at the heart of any race.

The expression of these forms could only have been achieved through the use of steel, both as cladding and structure, encompassing several long-span and architecturally exposed structural steel (AESS) elements and employing innovative approaches to connections, detailing and the interface of structural steel with stone, glass and steel as a finish material.

The Hall of Fame consists of four basic elements:

- A large glazed oval shape forming a Great Hall serves as the symbolic core of the Hall of Fame
- A rectangular volume houses visitor services, including entry and exhibit space on upper floors
- A Hall of Honor is situated as an iconic element within the Great Hall
- A broadcast studio enlivens the Hall of Fame Plaza, the sweeping forecourt that welcomes visitors

Design explorations of speed and spectacle evolved into an architectural element, the Ribbon that envelops the full-block building in a form that speaks to the imagery and spirit of NASCAR. Beginning as a curved, sloping exterior wall enclosing the building, the Ribbon twists in a free span over the main entry to form a welcoming canopy. Long, thin incisions in the metal skin, which are animated by running lights in colors that represent those of recent race winners, are analogous to the blur of a car racing past the spectator at tremendous speed. Within the Great Hall, a signature element of a curved, banked ramp leads the visitor from the main floor to exhibit levels above. The ramp contains a display of race cars frozen in a moment from a race, capturing in another way the speed and spectacle that is the essence of the sport.

The selection of material for the Ribbon was critical to realizing the design intent. The team drew on another aspect of the world of NASCAR—its technology—and was inspired by the process of shaping raw sheet metal to form the body of the race car. This fundamental element has underlain all NASCAR race cars since the beginning of the sport. From a design point of view, metal imparts a light and airy feeling to the architecture. As the cladding material the stainless steel softly reflects light and accentuates the dynamic aspect of the Ribbon as its sculpted form changes around the building.

Technically, there are tremendous benefits to the use of steel. Its lightness as a cladding element allows structural support to be minimized and makes it possible to achieve the great span over the main entry. The lightweight sub-panels are easily assembled into unique shapes following computer-generated geometry, and the shingled application of the finished stainless skin panels are a natural solution to the complex problem of installing a durable finish on a curvilinear, warped surface.

The Ribbon takes the form of a mobius, a continuous closed surface with only one side, formed from a rectangular strip by rotating one end 180° and joining it with the other end. The Ribbon is constructed using 165 prefabricated sub-panels and more than 5,000 stainless steel skin panels. At the twisting canopy over the main entry, the Ribbon free-spans 158 ft and weighs 157 tons, with a 4-ft-diameter, 1½-in.-thick internal support pipe with W-shape cantilevers

serving as its backbone. At the ends of the twisting free-span, significant reactions result from the action of gravity, wind, snow, ice and temperature. At one end the Ribbon is anchored to the braced frame at the perimeter of the Great Hall. At the other it is anchored to a concrete shear wall through a large embedded plate with closely spaced deformed bar anchors and shear studs. At the top half of the embed plate, four $1\frac{3}{8}$-in. Dywidag post-tensioned rebars provide a clamping force between the embed plate and the concrete wall. Developing the underlying structure, coordinating it with the primary structure of the building and resolving issues of deflection, thermal expansion and construction tolerance were achieved through an intensive design and engineering process that used the latest in BIM technology. Close coordination among the architect, structural engineering team and design-build contractor of the Ribbon was critical to success. The result is a unique iconic form, emblematic of the sport it celebrates, and the defining symbol of the facility.

The structure's significant spans were achieved with structural steel trusses:

- A set of trusses spanning 175 ft achieve a grand column-free ballroom
- A 100-ft-long, bi-level footbridge, supported by a pair of one-story-deep trusses, links the ballroom with the existing Charlotte Convention Center
- Two- and three-story-high trusses cantilever 30 ft over the broadcast studio.

One of the most significant AESS elements in the project is the Vierendeel frame supporting the glass façade of the Great Hall. The lateral-load-resisting system at this façade also functions as the braced frame that supports the Ribbon.

The structural bid set was issued six months before the 100% CD set. The steel tender was divided into multiple packages to enable detailing and fabrication of portions of the project to proceed before the full design was complete. A 3D Tekla model was used in the steel detailing to identify and resolve potential conflicts in the field. These efforts and effective team communication allowed the long scheduled public opening to occur on time.

Owner/Developer
City of Charlotte; NASCAR Hall of Fame, Charlotte, N.C.

Owner's Representative
NASCAR, Charlotte

Architects
Pei Cobb Freed & Partners LLP, New York
Little Diversified Architectural Consulting, Charlotte

Structural Engineer
Leslie E. Robertson Associates, RLLP, New York

General Contractor
BE&K Building Group, Charlotte, N.C.

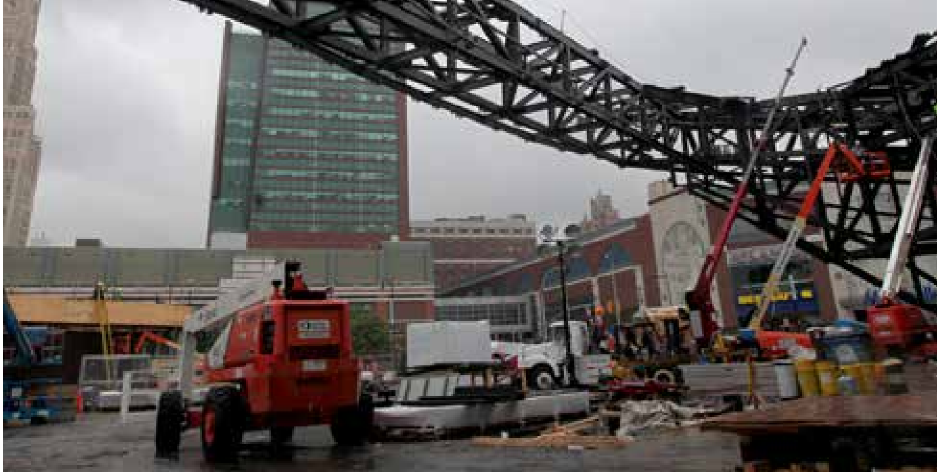
Design-Build Contractor for Ribbon
Zahner, Kansas City, Mo.

Steel Fabricator and Bender/Roller
SteelFab, Inc., Charlotte (AISC Member/AISC Certified Fabricator)

Steel Detailer
Hutchins & Associates, Clemmons, N.C. (AISC Member)

Steel Erector
Williams Erection Company, Smyrna, Ga. (AISC Member/AISC Advanced Certified Erector)

Photographs
Paul Warchol Photography, Inc.



Merit Award—Greater than $75 Million
BARCLAYS CENTER, BROOKLYN, N.Y.

"This is the kind of bold design that becomes an **instant landmark**."
—Chris Olson

The new 675,000-sq.-ft Barclays Center, home of the NBA's Brooklyn Nets, seats 18,103 and will host more than 200 sporting and cultural events annually (seating capacity increases to 19,000 for concerts). It features 95 luxury suites, four party suites, two conference suites, four bars/lounges, four clubs, a restaurant and several street-level retail stores.

The arena is in a tight urban setting near a subway station and train terminal, presenting unique challenges for the foundation system. The building was designed with a pair of truck elevators feeding a below-grade loading dock with a large truck turntable to facilitate turning. Columns in this region were transferred using large plate girders spanning over the dock.

The dominant feature of the arena is the weathering steel lattice that wraps the structure. Rows of steel panels envelop the exterior, including an entrance canopy that cantilevers 85 ft over the plaza. The façade design, with 12,000 pre-weathered steel panels, and the canopy were added a month after the GMP package was released and two months before the first steel mill order was due, requiring the team to develop the façade design while keeping pace with the original schedule. Nearly 1,000 tons of steel were added to support the façade, which also became a prominent design feature.

Another major structural feature, the distinctive arched roof, spans more than 380 ft and is supported by a pair of 350-ft tied arch trusses spanning the long direction of the arena. The roof system geometry was further complicated by the additional loads imposed by the outer façade system. As such, the building lateral system and diaphragms were designed to resist thrust forces from the roof arches, which were minimized by use of the tension tie.

The primary load-carrying members of the canopy are a pair of box trusses cantilevering 85 ft beyond the column supports along the Atlantic Avenue face to the north and the Flatbush Avenue face to the southwest. Each box truss consists of a pair of planar trusses ranging from 8 ft to 12 ft deep and laced together with horizontal bracing. The planar trusses have W14 chords turned web-horizontal to maximize out-of-plane stiffness with W14 braces and verticals shop welded to the chords. Field splices between trusses consist of bolted flange plate connections. Another box truss spans at the leading edge of the canopy between the tips of the Atlantic and Flatbush trusses. Three planar trusses frame out an inner "oculus" in the center of the canopy. Supplemental steel is provided within the oculus and at the perimeter to support the latticework façade. Additional supplemental steel hangs below the truss structure to create the supplemental framework to support the "pouch." The structural engineer, Thornton Tomasetti, provided Tekla models, connection samples and full connection design, which allowed the team to produce models quickly, store large quantities of information and coordinate with the entire team. Even from its initial design, the project constantly pushed the limits of BIM and educated staff about the use of several different programs and ways to link and automate processes. The complex geometry of the façade and the shortened schedule meant that the team needed to coordinate in a 3D environment and provide the information to the contractor in this format as well.

Thornton Tomasetti's team consisted of staff members across multiple offices and practice areas. Teams in Kansas City and New York designed the roof and bowl and then these two components had to be integrated. Construction support services teams worked on the Tekla models, model delivery and connection design; erection engineering was performed in the Chicago office. The firm maintained staff on-site full-time to accommodate changes and oversee work, and weekly coordination meetings helped to identify issues early on and develop solutions proactively.

Owner/Developer
Forest City Ratner Companies, Brooklyn, N.Y.

Architects
AECOM, Kansas City, Mo.
SHoP Architects, New York

Structural Engineer
Thornton Tomasetti, New York

General Contractor
Hunt-Bovis joint venture, Indianapolis

Steel Fabricator
Banker Steel Company, Lynchburg, Va. (AISC Member/AISC Certified Fabricator)

Steel Detailer
WSP Mountain Enterprises, Inc., Sharpsburg, Md. (AISC Member)

Photographs
Bess Adler

Merit Award—Greater than $75 Million

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY, SPRINGFIELD, VA.

Situated on the outskirts of the Capital Beltway adjacent to the Accotink Creek stands the National Geospatial-Intelligence Agency's (NGA) 2.4 million-sq.-ft campus, known as New Campus East (NCE). The facility was not only designed to enhance the agency's capabilities as one of the leading intelligence organizations in the world, but also to achieve a unifying, cultural transformation. This effort is expressed in the design of the nine-story main office building. Composed of two curved 900-ft-long overlapping bars around a 500-ft-long central atrium and elliptical auditorium, the building's overall form is in the shape of a lens—a fitting metaphor for NGA, which serves as the nation's eyes, the primary source of geospatial intelligence for the purposes of U.S. national security, defense and disaster relief.

This defining architectural expression was accomplished primarily due to the benefits of structural steel. Steel facilitated the large bay size needed for program flexibility of the typical office; reinforced the architectural concept and imagery expressed in the transparent atrium roof, west end wall and exterior V-columns; and accommodated the constraints of the highly complex technical Anti-Terrorism Force Protection (ATFP) criteria as well as a demanding schedule.

Managed by the U.S. Army Corps of Engineers – Baltimore District, the project has its origins in the 2005 Base Realignment and Closure Act (BRAC). RTKL Associates, Inc., and KlingStubbins formed a joint venture to provide design services, including master planning and full architecture, engineering, interiors, site/civil, landscape and technology design.

At 2.2 million sq. ft, the nine-story main office building is the second largest single-occupancy building in the world (after the Pentagon) and the largest federal building in the world to achieve LEED Gold certification from the U.S. Green Building Council.

To fill the central atrium and interior of the building with light, the west end wall of the atrium was glazed with a curtain wall system and the roof of the atrium was covered with a transparent fabric membrane. The west end atrium wall consists of a 135-ft-tall by 140-ft-wide curtain wall backed by a round HSS steel space frame. AESS requirements were incorporated into the design, fabrication and erection of the space frame structure, which served several functions. In addition to supporting the gravity loads of the curtain wall, it supports atrium roof gravity and wind loads and meets all mandated ATFP criteria. It also acts as a pedestrian bridge at several levels, providing access and circulation between the towers.

The atrium roof is more than 500 ft long, with an area of 45,000 sq. ft, and consists of AESS arched HSS members supporting an air-filled ethylene tetrafluoroethylene (ETFE) fabric roof. Although it appears clear, the custom silkscreen pattern and air-filled ETFE system provide significant daylight while minimizing solar gain. Being extremely lightweight minimized ATFP-related effects and aided in reducing the tube structure size and tonnage; 18-in. by 12-in. built-up HSS was used for the arched roof members, which vary in span along the tapered atrium, with a maximum span of 125 ft and a 75-ft rolled radius. The roof arches span between the office towers and were designed as "springs" to accommodate independent movement of the two wings under lateral and thermal loads.

The two 900-ft wings are configured to focus on the central atrium. This dramatic space and the atrium's light-filled amenities create a "Main Street" for the office building community. Enhancing this effect are the west end atrium wall and the atrium roof structure.

The unique exterior design of the main office building was achieved as a coordinated partnership between the

architect and structural engineer. Signature V-columns spaced at 40 ft on center are featured along the first- and second-floor perimeter, providing a separation between the visually solid base and the triangulated precast façade of the upper six floors, while also continuing the diagonals of the upper façade. In addition to providing a strong aesthetic statement, the V-columns participate in the lateral load resisting system and accommodate alternate load path/progressive collapse design. Removal of any V-column leads to loads above being shared between transfer girders at the fourth floor and roof levels.

Owner/Developer
National Geospatial-Intelligence Agency, Springfield, Va.

Owner's Representative
U.S. Army Corps of Engineers – Baltimore District, Fort Belvoir, Va.

Architect and Structural Engineer
RTKL/KlingStubbins joint venture, Baltimore

General Contractor
Clark/Balfour Beatty joint venture, Bethesda, Md.

Steel Fabricator and Detailer
SteelFab, Inc., Charlotte, N.C. (AISC Member/AISC Certified Fabricator)

Consultant
Hinman Consulting Engineers, San Francisco

Photographs
James West, J West Productions
Paul Warchol Photogaphy, Inc.
David Whitcomb (RTKL)

National Award—$15 Million to $75 Million

CITY CREEK CENTER RETRACTABLE ROOF, SALT LAKE CITY, UTAH

"Having a roof spanning two city blocks that can be transparent and open and close is amazing." —Charles C. Porter

Beginning in 2003, the Church of Jesus Christ of Latter-day Saints developed plans to transform two Salt Lake City "mega-blocks" just south of the town's Temple Square into a 5.5 million-sq.-ft, mixed-use development featuring retail, residential, office and parking space. The centerpiece would be a man-made replica of the area's historically significant City Creek that would meander for two blocks and be surrounded by walkways and a six-acre public park. Developers wanted an urban, open-air setting but also needed the assurance that retail businesses would be protected during inclement weather. After studying many skylight possibilities, structural engineer Magnusson Klemencic Associates (MKA) produced a retractable roof concept that would fully meet the developer's needs. Uni-Systems was selected as the design-build contractor, with MKA as their structural engineering sub-consultant, and Ducworks as the steel fabricator. The resulting retractable, barrel-vaulted roof is configured in two sections, each spanning one city block.

Each section is 240 ft long and 58 ft wide, with an S-shape that echoes the curve of the signature creek below. The precision-sculpted steel and glass transparently shields patrons when closed and disappears from sight when open, connecting nature with the areas below.

For each block, the retractable roof is comprised of three pairs of glass-covered, arching panels that cantilever 33 ft from the adjacent structures over the retail concourse. When closed, all six panels seal together and create an air- and water-tight barrier. To open, the panels part in the middle and retract onto the building structure as the panels bow down out of sight from below. Key to the bowing action are innovative whalebone-shaped ribs that support the glass roof. Each roof panel is comprised of three parallel whalebones made of curved and tapered welded steel box girders that run from the tip of each panel's arch to the end of its backspan. The glazed portion of the three whalebone arches are joined by four purlins made of 8-in. A106 Grade B pipe and one purlin of HSS10¾×½-in. ASTM A500 Grade B tube.

The purlins are designed with concealed connections that are invisible from below and provide attachment points for 6-ft, 4-in.-sq. panes of glass. A typical roof panel is glazed with 72 panes of glass, each weighing approximately 300 lb, although the size of each panel varies because of the roof's curvature. The three whalebone backspans are connected with rectangular HSS ASTM A500 Grade B tubing in a K-brace configuration to provide shear stiffness between them. In order to meet special finish and detailing requirements, the side and bottom whalebone girder walls were ground and filled to produce perfectly flat plane surfaces, and a Tnemec Fluoronar paint system gives the whalebones

and purlins a high-quality metallic finish. The whalebones were built at Ducworks' fabrication facility in two sections using custom-designed fixtures and joined with a plate-welded connection to accommodate the unique geometry. The pre-assembled rail girders and whalebones were hoisted onto the roof, and the panels were assembled in place.

Each 10½-ton whalebone is supported by a 27-in. double-flanged steel wheel located at the bottom of the arch and two guide rollers located at the end of the backspan. The wheel follows one geometric path on top of the rail girder, and the guide rollers ride an inclined track along the bottom of the rail girder. As the guide rollers travel up the incline, the roof's cantilevered front edge dips down, causing the roof to bow down, with the wheel as the vertical rotation point. The guide roller track surface is a heat-treated, hardened plate welded to the A572 Grade 50 steel rail girder. A custom welding procedure was developed to join the two elements to avoid damaging the hardened plate. The flanges on the center wheel closely surround the center rail and act as wheel guides. The flanges on the two outer wheels leave a slight gap around the rails to accommodate lateral movement between the three rails caused by construction tolerances and structural and thermal movement. Locking pins mounted to the whalebones automatically engage the rail girders when the panels reach the open or closed end of travel. With the pins engaged, the roof panels can accommodate differential movement from potential seismic activity.

An industrial computer located in a remote control room operates the retractable roof, which travels up to 8 ft per minute and opens or closes in approximately six minutes. Each panel has a unique operating sequence to prevent the panels from interfering with one another as the seals engage and disengage. Because the S-shaped curve of the roof causes the three panels on one side to converge when opening, the center panel on that side remains in the raised position when opening, rather than bowing down, to prevent collisions. The roof's curvature, along with the complex seals and intersecting panels, made the control system the most complicated ever developed by Uni-Systems.

Owner
City Creek Reserve, Salt Lake City

Architect
Hobbs + Black Architects, Ann Arbor, Mich.

Structural Engineer
Magnusson Klemencic Associates, Seattle

General Contractor
Jacobsen Construction, Salt Lake City

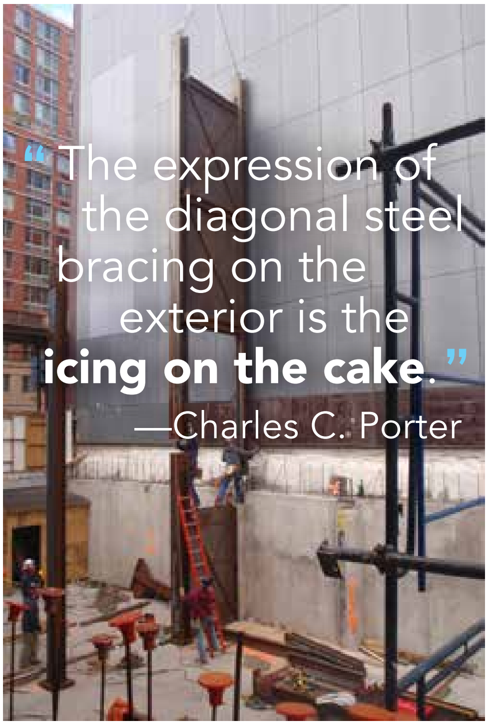
Steel Fabricator
Ducworks, Inc., Logan, Utah (AISC Member/AISC Certified Fabricator)

Steel Erector and Mechanization Consultant
Uni-Systems, Minneapolis (AISC Member)

Photographs
Michael Dickter, Magnusson Klemencic Associates
Uni-Systems

National Award—$15 Million to $75 Million

HL23, NEW YORK, N.Y.



Located in Manhattan's West Chelsea District at the corner of 23rd Street and 10th Avenue, HL23 creates a new 14-story, 42,395-sq.-ft ultra-luxury residential building. In total, the project houses 11 condominium units, 3,585 sq. ft of ground-floor gallery space and an elevated terrace/garden area. The floor plate of the building, which is smaller at the base than at the top, owes its uniqueness to the existing elevated exposed High Line—retrofitted into a city park facility (see "Elevated Experience" in the 08/2009 "What's Cool in Steel" section)—located at the eastern portion of the building lot. The primary steel structure is clad with a mega-panel glass and stainless steel curtain wall system. The mega-panel system is located on the north, south and part of the east façades, with the remainder of the east façade clad with an all stainless steel system.

The project's distinct form comes from the dramatic sloping of the south and east façades, creating a dynamic and undulating 3D composition. As a result, many of the steel beams have axial loads to hold back the outward sloping steel columns to the main lateral resisting system in addition to the bending moments due to gravity loads. As an added level of redundancy, steel reinforcement bars were placed inside the concrete slab above the metal deck at specific locations to hold the columns back to the steel plate shear walls (SPSWs). In some cases where it was difficult to achieve direct load path, two V-shaped 1½-in. steel tension rods inside 2-in. full-length PVC sleeves were used inside the concrete slab above the metal deck and anchored the outward sloping column to the SPSWs.

The building slopes east from bottom to top, creating a large, destabilizing cantilever over the High Line. This leaning gravity cantilever was stabilized by tying down the west side net tension columns into the foundation system and installing twelve 1⅜-in. double corrosion-protected high-strength steel rock anchors into the 3-ft raft foundation at specific locations.

The building's dual-lateral support system is the most intriguing element of the structure. The SPSW system is located at the elevator and stairs in combination with a full-building perimeter braced frame system. As a true sign of synergy between form and function, the architect incorporated the perimeter lateral pipe braces into the final interior aesthetic of the residences. This required special care during the design of the exposed connections of the perimeter steel diagonal braces to perimeter steel beams. It was achieved by replacing the traditional use of multiple-bolt gusset plates with end plates hidden in the concrete metal deck slab for intermediate diagonal braces and with pin-end connections for end braces.

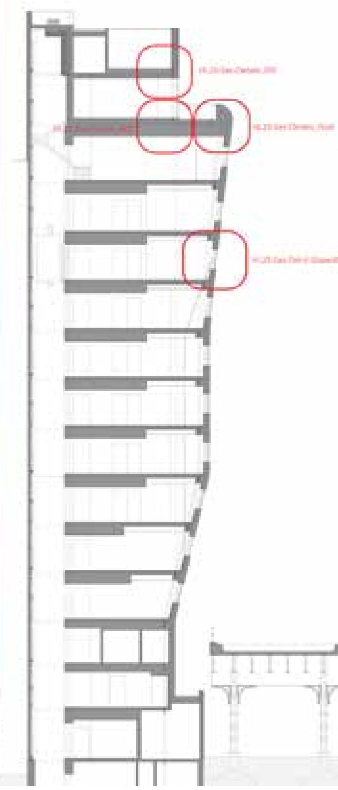
Architectural requirements played a large part in the final structural layout. The use of structural steel was driven by three primary factors: minimizing the overall weight of the structure for the capacity of the raft foundation, minimizing the amount of interior columns and providing the perimeter diagonal architectural expression. The SPSW system provided the project with the benefits of increased stiffness and smaller dimensions—both tremendous benefits for this site.

In New York City, many residential buildings are designed using a cast-in-place reinforced concrete flat plate system. However, due to the unique geometry of the building, the sprawling architectural layouts, the quality of the soil and the hybrid gravity and lateral load system on the perimeter of the building, steel was the more economical and efficient material of choice for HL23. Floor beams are composite with the concrete slab-on-deck; however, all of the intermediate steel beams were removed to increase headroom in the living areas. This was achieved by using shored construction in

many areas with a slab thickness between 6 in. and 7 in. and varying metal deck properties throughout the floor. At the upper floors, the maximum beam/girder span was nearly 30 ft-0 in.

Due to the building's modest height, a SPSW system was considered both structurally effective and visually attractive. The east-west dimension of the building is very tight, and any reduction in dimension of structure was beneficial to the floor layouts. Using ⅜-in.-thick plates instead of wide-flange brace members freed up an extra foot of useable floor area between the columns for each wall of the system. This 2-ft savings was an enormous achievement in a building that is 38 ft wide. In addition, the SPSW system adds a considerable amount of stiffness over a braced frame. The extra capacity was critical for this building with its gravity overturning characteristic; SPSW systems typically slow down the erection process compared to braced frame systems. The team developed a system where the perimeter of the plate was continuously welded, with three of the four sides shop welded. Prefabricated shear wall panels, with integral columns and beams, were shipped to the site and spliced in the field. This process ultimately saved a considerable amount for erecting the SPSW system.

The second part of the dual lateral system is comprised of perimeter braced frames on each of the elevations. In addition to lateral loads, the perimeter braced frames in many locations are part of the gravity system as well. The braced exoskeleton members are 8-in.-diameter extra-strong pipes at the north, south and part of the east façades; HSS10×5 on the west façade; and 6×4 back-to-back angles on the remainder of the east façade. All of the pipe elements are primary architectural features and are exposed on the façade and in the residences; therefore, the detailing of these elements was heavily scrutinized. In addition to standard AESS specifications, the nodes of the system have been designed with an exposed single 1½-in.-diameter pin connection. The final building aesthetic merges the strength and beauty of steel into a composite whole.



Owner
23 High Line, LLC, New York

Architect
Neil M. Denari Architects, Los Angeles

Structural Engineer
DeSimone Consulting Engineers, New York

General Contractor
T.G. Nickel and Associates, Ronkonkoma, N.Y.

Photographs
Rinze van Brug Photography
DeSimone Consulting Engineers
Neil M. Denari Architects

Merit Award—$15 Million to $75 Million

UC BERKELEY CALIFORNIA MEMORIAL STADIUM PRESS BOX, BERKELEY, CALIF.

"An overwhelming confluence of **functional and structural** challenges solved with the boldest single stroke possible—nothing timid about it."
—Paul Dannels

Built as a memorial to fallen alumni of World War I, the University of California, Berkeley's Memorial Stadium has endured as one of the most picturesque venues in college football from its opening in 1923 for the "Big Game" versus Stanford to the present day. After it was discovered that the stadium was at particular risk in the event of an earthquake, which is further exacerbated by the fact that it sits above the Hayward Fault, the university undertook a large project to seismically retrofit as well as modernize the stadium. As a part of this project, the western stadium bowl was seismically retrofitted and modernized with new concrete seating bowl framing while keeping the existing historic perimeter concrete wall in place.

The "crown jewel" of the project, however, is the new long-span two-story structural steel press box that floats atop the new west portion of the stadium. One of the main architectural design goals was to achieve a floating effect to the press box by reducing the number of supports to a bare minimum. The resulting structure is 375 ft long with two 100-ft-long main spans and end-span cantilevers of 33 ft. The press box arches to follow the curvature of the existing exterior wall and is supported by four concrete cores (two at each end) and four center structural steel columns. The press box is two stories, with the first floor housing print, radio and TV media functions and the second floor housing a club space with views and seating facing the field, as well as a dramatic 25-ft cantilevered balcony with a glass deck that faces the campus and provides panoramic views of San Francisco Bay and the Golden Gate Bridge. The areas of the levels are 10,200 sq. ft and 12,500 sq. ft, respectively. The main structure of the press box consists of a story-deep space truss that is comprised of radial trusses that are supported by primary trusses that span between the concrete cores and center columns. The occupant load for the entire press box is approximately 1,700 people, and more than 1,350 tons of structural steel were used in its construction. The overall construction cost for the project was $215 million, with the press box portion being $40 million.

Due to the stadium's location above the active Hayward Fault, the design of the press box and supporting concrete cores used several design innovations to allow for increased seismic performance. The concrete cores that support the press box provide the main vertical access to it. These tall, slender support elements, with the lumped press box mass at the top, create a dynamic incompatibility with the surrounding bowl structure. If this incompatibility had not been properly addressed, a major seismic event could potentially cause substantial damage to the concrete cores directly below the support points for the press box. To avoid this scenario, the cores and press box structure were seismically separated from the surrounding bowl and allowed to move completely independent of the main bowl structure. The concrete cores were designed to rock at their bases to alleviate the seismic demand on the cores, which were also vertically post-tensioned to provide stability and a restoring force when rocking. Fluid viscous dampers (shock absorbers) that link to the cores were added within the bowl structure, providing a mechanism to dissipate seismic energy and to control movements and accelerations in the press box. Sixteen dampers were used in the design of the stadium, each with 220-ton axial force capacity.

As the core wall system rocks in the event of an earthquake, the large drift angle of the cores would cause large bending and shear forces in the press box above. In order to alleviate these forces and economize the design, the press box was supported on steel pins at the center of each core. These pins allow the press box to pivot on the cores and minimize damage to the steel structure. Each 7-in.-diameter high-strength steel pin is sandwiched by five 100-ksi steel gusset plates. The entire press box structure is supported on twelve of these high-strength pin assemblies.

The top-level cantilevered balcony is also a space truss comprised of numerous small-diameter pipe sections. This balcony truss system, which includes seismic and out-of-plane bracing, has several multi-member joint connections with some joints connecting up to eight pipe members. Due to the complexity of these joints, coordination had to take place in a 3D platform (Revit and Tekla) between the fabricators and design team.

Thanks to the complex nature of the site and surrounding neighborhood, there was limited space on-site to allow for erection and construction of the press box. To address this issue, fabricator Herrick and general contractor Webcor Builders enlisted the help of one of the largest crawler cranes in the country (a 750-ton Liebherr crawler crane with a 276-ft boom and 65-ft counterweight extension) to erect the main press box truss in five large segments. The main space truss of the press box was assembled and welded on the playing field, adjacent to the seating bowl. Carefully selected splice locations were determined to ensure each of the five truss segments would be within the crane's capacity for weight and reach. Each of the five segments exceeded 75% of the crane's capacity and therefore were considered critical picks. The largest pick of the five segments was 165 tons at a 160-ft reach, which took the crane to over 95% of its capacity.

The stadium reopened on time for the 2012 football season.

Owner
The University of California, Berkeley, Calif.

Architects
HNTB Architecture, Inc., Los Angeles
STUDIOS Architecture, San Francisco

Structural Engineer
Forell/Elsesser Engineers, Inc., San Francisco

General Contractor
Webcor Builders, San Francisco

Consultant
Hassett Engineering, Inc., Castro Valley, Calif.

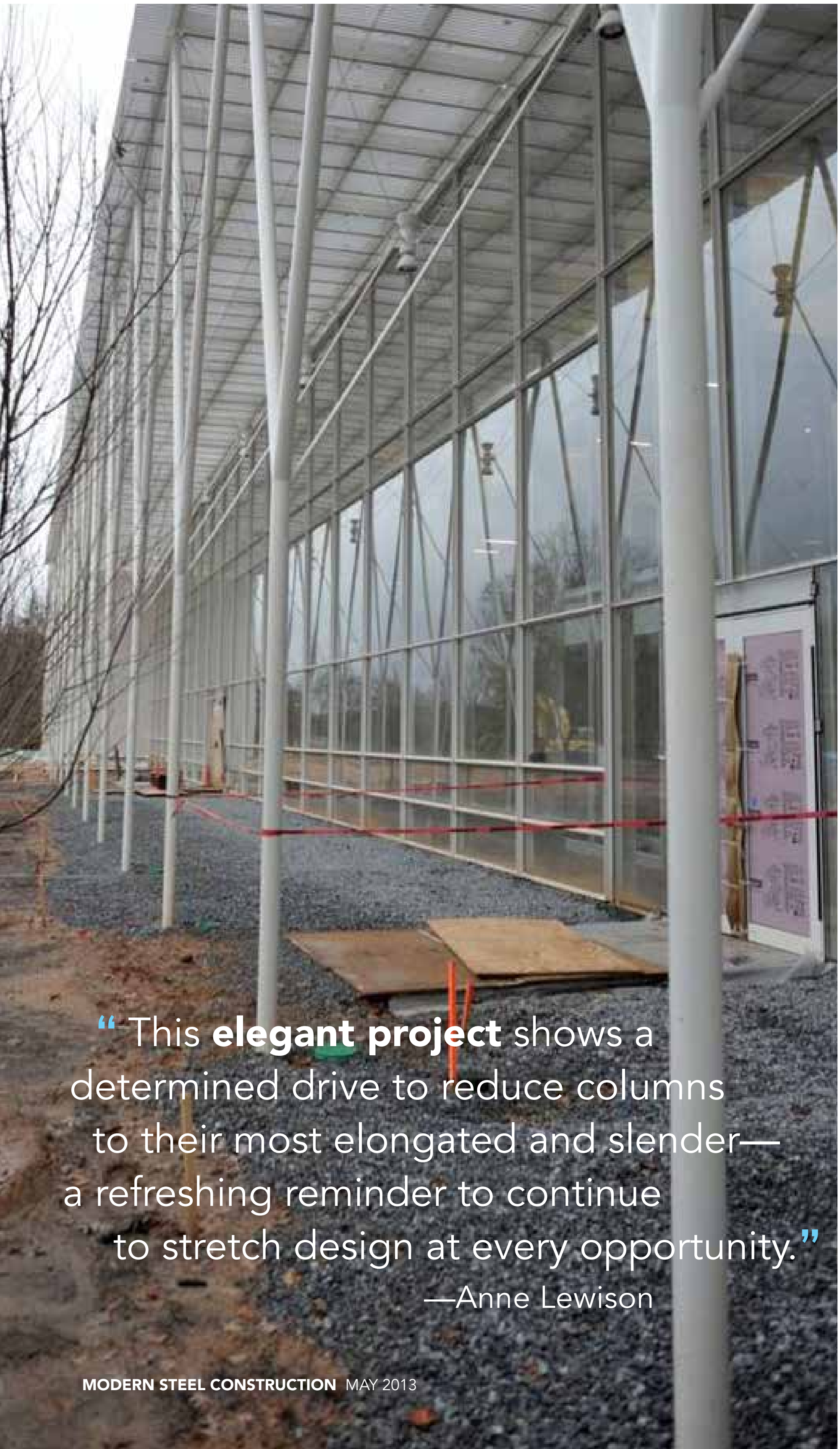
Steel Fabricator and Erector
The Herrick Corporation, Stockton, Calif. (AISC Member/ AISC Certified Fabricator and Erector)

Steel Detailer
SNC, Compton, Calif. (AISC Member)

Photographs
Tim Griffith

Merit Award—$15 Million to $75 Million

LEE HALL III—CLEMSON UNIVERSITY, CLEMSON, S.C.



> "This **elegant project** shows a determined drive to reduce columns to their most elongated and slender—a refreshing reminder to continue to stretch design at every opportunity."
>
> —Anne Lewison

Lee Hall III is a 55,000-sq.-ft addition to Clemson University's College of Architecture, Arts and Humanities in Clemson, S.C. The building houses academic programs in architecture, art and planning, faculty offices and student workspace. Conceived as "a building that teaches," Lee Hall III encourages informal learning through observation of its energy efficient design and exposed functional and structural systems. The building was awarded LEED Gold certification by the U.S. Green Building Council and won an American Institute of Architects' 2013 National Honor Award.

Nearly all of the structural steel components in Lee Hall III are the direct manifestation of the architectural expression. The building is an open, double-height space (35 ft tall) housing a secondary internal structure of mezzanines and bridges. The structure's roof is comprised of a lightweight composite concrete deck structure supported by exposed W14 steel beams. The roof rises 4 ft in a gentle arc to drain a planted green roof, which is punctuated by 25 7-ft-diameter skylights directly above the "column trees." These assemblies consciously draw attention to the structural steel; they are comprised of 10¾-in.-diameter seamless steel pipes with 1-in.-thick walls and four curving "arms" built out of flat 1¼-in.-thick and 1-in.-thick steel plate. The unusually thick-walled pipe columns (ASTM A106 pipe typically used in oil and gas construction) allow remarkably slender columns and enhance their dramatic elegance. The four arms at the top of each column tree support lines of continuous W14 steel beams and allow the roof directly above each column to open into a skylight.

The north and south façades of Lee Hall III are comprised of a custom insulated low-iron glazing, which spans floor to roof. The engineer worked closely with the architects to detail the support system for the glazing out of W6 structural steel members spanning up to 33 ft. The W6 window wall steel incorporates exposed C6 and WT3 exposed steel framing to support operable windows and doors. By directly supporting the glazing on structural steel members (in lieu of conventional aluminum extrusions), the designers developed window walls of exceptional slenderness with minimal and elegant detailing that is consistent with the aesthetic of the primary structural steel frame.

The lateral systems for Lee Hall III consist of exposed "X"-braced pre-tensioned cables on the north and south façades and back-to-back WT ordinary braced frames in the east and west walls. The WT bracing is hidden in the east and west brick walls, but the cable X-bracing is a prominent architectural feature. The cable connections were detailed to be exposed to view just above the finish floor and are offset to pass one another just behind the W6 window wall steel.

Beyond the window walls on the north and south faces of the building, a row of super-slender "Y"-columns supports a steel trellis of exterior exposed W6 steel beams and perforated metal panels. The exterior Y-columns are reminiscent of the 25 interior column trees but are flattened into a two-dimensional plane. Each Y-column is fabricated from 4.5-in.-diameter HSS steel tubes and is up to 35 ft tall. Although the geometry of each Y-column is different, the castings connecting the vertical base of the Y to the branching arms are identical; repetition of the same casting geometry made the connections cost-feasible.

At the north and south ends of the east and west walls, brick walls hover beyond the building enclosure in an 18-ft double cantilever with no lateral support bracing. These cantilevered brick "wing walls" shade the ends of the north and south window walls in a subtle but dramatic extension of the brick surface. The cantilevering steel structure resists vertical brick loads and lateral wind and seismic loads, not unlike an airplane wing.

A two-story level of mezzanines and connecting bridges comprises a nearly independent structure within the main Lee Hall III structure. The shafts of some column trees pass through holes in the mezzanine deck and do not support the framing, emphasizing the independence of the two structures. The mezzanine level is supported by W10 and W16 steel beams and HSS5×5 square tube columns. Its structural steel columns and beams were precisely coordinated and offset to align with architectural glass, wood and concrete surfaces.

Nearly all of the structural steel in Lee Hall III functions as both a load-carrying functional system and a sculpturally expressive medium. What is arguably most remarkable about its use of structural steel is that the highly and expressive character was achieved without any expensive or unconventional fabrication techniques, special finishes, exotic connections or the higher-tolerance AESS designation typical of this type of construction. Instead, the team worked closely to refine conventional, simple connections and fabrication techniques that could be built by any steel fabricator without undo expense. All connections were fully detailed in the structural drawings so that the alignment, appearance and architectural character could be evaluated and refined prior to the shop-drawing phase, thereby eliminating the fabricator's connection engineering time and costs. Although the structure features a curving, warped roof, no curved steel was used in the building's frame; the geometry is a series of simple faceted arcs that nearly match a true curve. Variation in arc radii requires the metal deck to warp slightly as it spans. The structural drawings clearly and simply convey the geometry in simple 2D plans, elevations and details without the need for 3D modeling or the use of digital files.

Each of the 25 column trees has its own unique geometry due to the changing curvature of the roof, but all column tree arms were fabricated entirely out of flat plate, the geometry of which was determined from simple geometric rules. The realization of complex, organically inspired free-form shapes from the careful assemblage of flat plate and straight pipe was key to the project's success.

Further cost reduction was achieved by responding to the fabricator's concerns regarding the blanket designation of AESS. Rather than simply applying this requirement to all of the exposed steel, the architects and the engineer identified only those aspects of AESS that were critical to the project's success and defined exposed painted structural steel requirements specific to the job.

Owner
Clemson University, Clemson, S.C.

Architect
Thomas Phifer and Partners, New York

Structural Engineer
Skidmore, Owings & Merrill LLP, Chicago

General Contractor
Holder Construction Company, Atlanta

Steel Fabricator
Steel LLC, Atlanta (AISC Member)

Steel Erector
Williams Erection Company, Smyrna, Ga. (AISC Member/ AISC Advanced Certified Erector)

Photographs
Scott Frances Photography

National Award—Less than $15 Million

EL DORADO CONFERENCE CENTER, EL DORADO, ARK.

Successful architecture tells the unique story of a specific place, combining history with future aspirations to create a timeless quality.

The El Dorado Conference Center (EDCC) tells the story of El Dorado, Ark., home to the world's eighth-largest oil company, which was created with the discovery of oil in southern Arkansas near the beginning of the 20th century. With oil came the timber industry to pine country, propelling El Dorado into the South's original "boom town."

As oil in Arkansas was exhausted and related industries branched out globally, a city that reached 40,000 people had shrunk to 19,000 in recent years. Murphy Oil implemented a stunning proposal, the "El Dorado Promise," guaranteeing every high school graduate with good grades a free college scholarship. The new influx of families due of the promise created the need to attract industry and a climate for renewed civic pride—a new Boom Town. The community implemented a series of public projects to increase exposure, including the El Dorado Conference Center, which is half public meeting space, half college student services center. Drawing from its greatest industries of past and present to the educational advancements of tomorrow, the EDCC creates a memorable architecture intended to help propel El Dorado into a regional meeting destination.

The unique nature of community ownership—public, business and education—demanded an architecture that would blend the three seamlessly together, creating a place for all to interact and learn. With three constituent groups came different desires for architectural style; all agreed, however, that the building should exude a timeless quality. Instead of relying on the cliché of past historic building styles, the design focuses on the rich story of place and the industry that put El Dorado on the map. Located between a historic, thriving downtown square and South Arkansas Community College, the site links "town to gown," connecting the two great sources of public pride. The square and college also influenced the building of two naturally lit public halls, one on the path to downtown, the other to the College Academic Quad. These interior streets work like the town square, lined with a café, bookstore and public/college meeting rooms, while serving as galleries for the college and art center. The great halls' intersection serves as the living room of the community as well as "college central" for student services.

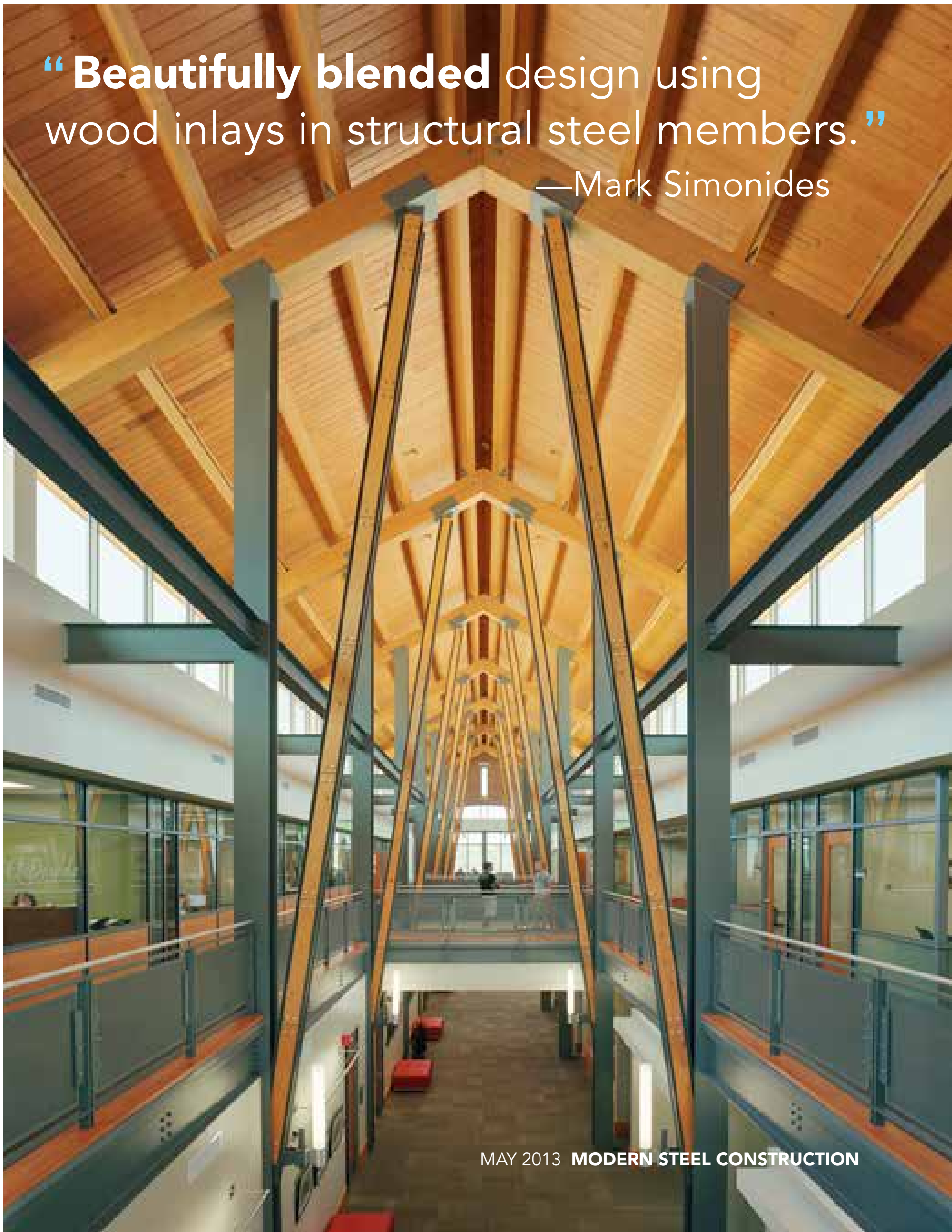
The key component of a design philosophy of celebrating industry is the honest expression of the steel structure and the craft of its detailing as opposed to the typical applied ornamentation. Every steel column, beam, bolt, and connection is exposed in the same functional fashion as would be seen on oil derricks and the steel bracing and platforms that adorned them. Student lounges float on upper-level platforms, with catwalk-like bridges connecting departments; students can see and be seen sitting above the public paths. The main public hall is a repeating cross section of a derrick's shape and bracing, creating a soaring cathedral-like space, capped with a wood shed that recalls the long timber mills of this forested region. The repeating structural rhythm and vertical thrust of the naturally lit space is a subtle nod to El Dorado native son architect Fay Jones; the spirit is there without attempting to replicate the master's work. Steel plates and channels are carefully layered to create memorable elements in a collegiate gothic manner. Wood is inlayed in bracing channels as stiffeners, creating an elegant yet simple expression of function.

The EDCC's large masonry wall planes act to honor the adjacent college campus' legacy without the adorned 1900's detailing. The true story of industry bleeds through the masonry openings, expressed in thoroughly modern cantilevered steel and glass bay windows and monumental stair landings overlooking the town's activity. A great brick arch that spans the entire café/bookstore sits adjacent to the actual steel structure, like a masonry ruin held in place by the preeminent construction method of today—a steel structure. The space opens to a new lawn for student and public use that is aligned with the heart of the campus. The site is master planned for a future amphitheater with the goal of creating an arts district to further extend the feel and activity of downtown to the college.

A large steel bridge arch that runs the length of the Public Hall supports the suspended auto court canopy, reflecting the steel arched roof of the campus gymnasium (an old armory) across the street. What appear to be limestone columns like those of the town square's courthouse are actually sun control fins, stopped short of the roof to honestly express the lighter steel structure beyond, which allows the roof to float above. Where wood beams are used, they are still clearly supported by the steel structure. The unique design of the large multipurpose room, Murphy Hall, allows an indoor/outdoor north stage for public events, such as the yearly music festival. The room is purposely on axis with the landmark dome of the First Baptist Church to the north, which is visible from the space. The room can be lit 100% naturally, a rare feature in meeting facilities and a key sustainable strategy for the facility as a whole. Clerestory windows are protected by extended top cords of trusses capped with galvanized steel grates, used as sun control shades.

The park-like setting along Southwest Avenue channels students to appropriate street crossing points while creating a beautiful entrance to downtown and the campus. One of the project's most important steel elements sits as a focal point of the main lawn as a reminder of the events of 9/11. A piece of the World Trade Center steel is an integral part of the Arkansas 9/11 memorial, which honors four Arkansans lost. The portal structure is built with existing granite slabs salvaged from a local natural gas industry drilling process.

The El Dorado Conference Center weaves time, place and story together, closing a gaping hole in the urban fabric between town and college while serving as a beacon for the renewal of Arkansas' original boom town.



"**Beautifully blended** design using wood inlays in structural steel members."
—Mark Simonides

Owner/Developer
El Dorado Economic Development Board, El Dorado, Ark.

Architect
Polk Stanley Wilcox Architects, Little Rock, Ark.

Structural Engineer
TME, Inc., Little Rock, Ark.

General Contractor
CDI Contractors, Little Rock, Ark.

Photographs
Timothy Hursley

> “Rarely does low-income housing **push the limits** of architecture or structural engineering, yet this one did.”
> —Jacob Schueller

Merit Award—Less than $15 Million

SIERRA BONITA MIXED-USE AFFORDABLE HOUSING, WEST HOLLYWOOD, CALIF.

Sierra Bonita is a 50,000-sq.-ft, five-story, mixed-use, affordable housing structure located in West Hollywood, Calif. Commissioned by the non-profit West Hollywood Community Housing Corporation (WHCHC), the building is the pilot project for the city's Green Building Ordinance—a local alternative to LEED and one of the first programs of its kind in the nation.

There is parking at the basement and ground-floor levels, and the ground floor also provides space for WHCHC and other non-profit groups such as AIDS Project Los Angeles. The building's 42 one-bedroom apartments are set aside for low-income residents with special needs, including the elderly, disabled and those diagnosed with HIV/AIDS.

The perimeter columns of this 112-ft by 100-ft building are spaced at 20 ft. To allow for its various uses, the building was designed with only four interior columns from the ground floor up. At the courtyard, floor beams connect to 60-ft-long girders, which carry the forces back to columns at the corners.

Zoning restrictions limited the building height to a maximum of 50 ft. Typical apartment floor slabs are 1½-in. metal deck with 4½-in. normal weight concrete slabs which span 20 ft and work compositely with the W24 steel beams. These beams are cambered and span 43 ft, from the courtyard to the perimeter walls, and the slab has extra reinforcing to allow the steel beams to align with partitions between units, resulting in apartments with higher ceilings. The deck was shored to control deflections under the wet weight of the concrete. The roof framing is lighter as the deck supports no concrete, minimizing seismic loads and material use.

The ground- and second-floor slabs are more traditional 3-in. metal deck with 3½-in. normal weight concrete slabs spanning up to 11 ft to composite beams and girders. The second floor supports an outdoor bamboo garden and apartments while the ground level includes offices, retail spaces and parking.

In a sector that is accustomed to cutting corners and settling for boilerplate design, Sierra Bonita successfully integrates affordability, sustainability and style. This integration is most apparent in some of the building's visually striking elements such as the courtyard's eccentric pink fiberglass wall.

The wall at the entrance of the courtyard resembles a series of intersecting shards and is in fact based off of the eccentrically braced steel frame. This frame forms a component of the lateral resistance system in the north-south direction. It uses a variety of wide-flange beams and tube steel bracing to adequately express the randomness desired for the architecture.

In addition to the eccentrically braced frame, for north-south stability a concentrically braced frame runs along the east façade, while two segments of a concentrically braced frame run along the west façade. The concentrically braced frames are comprised of W16 beams, W12 columns and HSS braces ranging in size from 6×6 to 12×8.

For east-west stability, moment frames along the north and south faces of the building utilize W18 girders spanning 20 ft to the strong axis of W14 columns.

Canopies, framed with HSS, at the roof cantilever out and down past the north façade to support photovoltaic panels, which provide energy for the building. Recycled steel is used throughout the project, and steel framing with long-span deck is used to accommodate the parking grid below and to minimize floor-to-floor heights.

Owner
West Hollywood Community Housing Corporation, West Hollywood, Calif.

Architect
Tighe Architecture, Santa Monica, Calif.

Structural Engineer
Gilsanz Murray Steficek, New York

General Contractor
Parker/Sarg Industries, Pasadena, Calif.

Consultant
Castle and Gray International, Inc., Malibu, Calif.

Photographs
Art Gray Photography

"It's a product that could go into immediate production and be **used everywhere** to the benefit of many."
—Anne Lewison

Merit Award—Less than $15 Million

SOLAR CANOPY, CHICAGO, ILL.

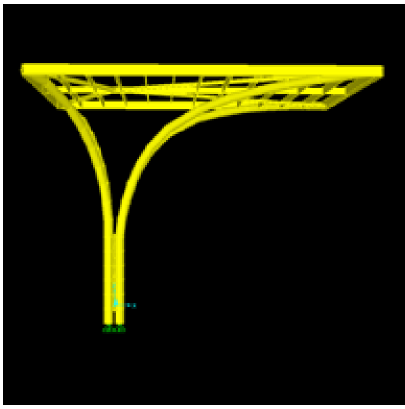
The Solar Canopy is an 11-ft-tall prototype structure consisting of 3 tons of AESS and is designed to harvest solar energy for use in powering electric/hybrid vehicles. Conceived by Carbon Day Automotive to promote sustainability initiatives in Chicago, the structure was unveiled in a temporary location in Douglas Park as one of the focal points of the International Olympic Committee's visit to the city. Owned by the Chicago Park District, the Solar Canopy found its permanent home on Northerly Island in 2010 and has been actively charging electric vehicles ever since.

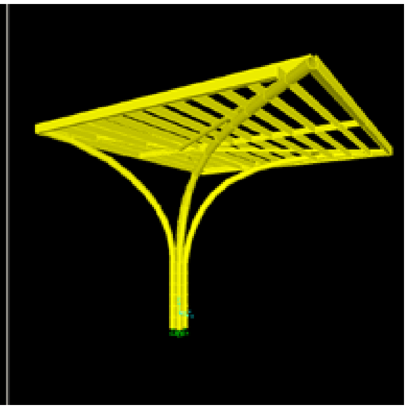
With a construction cost of $67,000, the structure employs a cost-efficient, aesthetically pleasing and sustainable design that was achieved through integrated structural solutions, streamlined fabrication and simplified coordination.

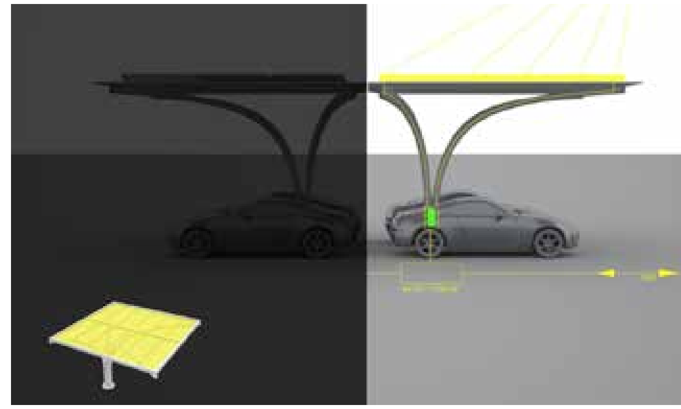
Designed by Adrian Smith + Gordon Gill Architecture, the Solar Canopy seamlessly blends into the background of any park and artistically complements a neighboring building. The elegant design includes a tree-like steel superstructure that can support up to 900 lbs. of solar equipment, a 300-sq.-ft canopy featuring photovoltaic panels and a subterranean concrete foundation anchoring the structure to the ground. The prototype design is adaptable to integrate a range of photovoltaic technologies at varying orientations, providing sustainable solutions to any location around the world. The team aimed to create a flexible design that could accommodate a single structure or multiple structures linked back-to-back, creating a shaded corridor for users in the interstitial space. In large-scale applications of the Solar Canopy, parking lots can be converted into giant plug-in charging stations, with the possibility of surplus energy being donated to the power grid. Bolstering its sustainable appeal, the structure has the potential to collect, store, filter and reuse rainwater to irrigate adjacent agricultural or park lands.

As the structural engineer of record and steel detailer, Thornton Tomasetti designed all of the Solar Canopy's components and connections, providing a cost-efficient structural design without compromising the architectural aesthetics. To achieve this solution, the smallest diameter pipes possible were bent with compound curves. The slender pipes were visually preferred both for a graceful appearance and to limit encroachment on parking spaces. The firm used 3D CAD and 3D analysis to design the complex curves that give the structure its tree-like form. Since an integrated conduit is required to transfer energy from the photovoltaic panels to an underground battery pack, small access holes were provided at the top and bottom of the pipes to conceal the electrical wiring as well as to drain water.

Bolted connections were minimized in favor of welds to achieve the architectural design intent. Because of the increased use of welds, the team sought to decrease field work







by performing as much of the fabrication in the steel shop as possible. This process helped to reduce costs and allowed for better quality control of the end product. The canopy was shop fabricated as seven pieces that were limited in size to fit on a standard truck bed, streamlining shipping. Once on-site, the base was set and the columns erected. The roof structure was delivered as two pieces and connected on the ground. The solar array was then installed and the roof lifted into position and set on the bolted seat connections found at the tops of the columns, and the connections were designed so that the roof structure concealed the bolts from view.

Located on Chicago's lakefront, the Solar Canopy's design accommodates the wind and snow loads of the city's infamous weather while providing an imaginative addition to the landscape. Creating the appearance of sprouting from the ground, the canopy is anchored to a concrete foundation located 1 ft, 4 in. below grade. The base connection and foundation were designed to resist a significant permanent overturning moment created by the unbalanced sprouting columns that asymmetrically cantilever from the base. To diminish deterioration of the structure, the concealed foundation allows for the heaviest of parking lot wearing surfaces, and hot-dip galvanized steel prevents corrosion to the components exposed to the elements.

Extensive collaboration was necessary among a team consisting of nine firms to realize the unique architectural design of the Solar Canopy while still achieving a cost-sensitive, functional structure. With only three face-to-face meetings, the majority of communication was accomplished electronically. Team members shared ideas and designs effectively through virtual communication methods, creating an efficient design process. From concept to working prototype, the Solar Canopy design was completed in 25 days. As a prototype structure, the Solar Canopy is not only versatile with its ability to integrate multiple applications at a variety of sites, but is also unique in its striking yet simplistic appearance.

Owner
Chicago Park District, Chicago

Architect
Adrian Smith + Gordon Gill Architecture, LLP, Chicago

Structural Engineer
Thornton Tomasetti, Inc., Chicago

General Contractor
Carbon Day Automotive, Chicago

Steel Bender-Roller
Chicago Metal Rolled Products (AISC Member), Chicago

Photographs
Steinkamp Photography

Missoula architect Eric Hefty grew up in the logging center of western Montana, and one of his first summer jobs was making glulam beams and drafting shop drawings for the beams and stress skin plywood panels at a local mill. With this hands-on experience with systems and materials, he grew to appreciate steel as a complete material and one that can be used for both structure and finish.

Adding to Hefty's appreciation of steel was a visit he made years ago to Bannack, a celebrated Montana ghost town, where he saw a steel-clad side wall on a building, which had weathered to a beautiful rusty patina. This was in contrast to the monochrome grey color of the rest of the community; when originally built, it is doubtful that this light-gauge, rusty façade would have been the goal of the builders.

But it was very much Hefty's goal for the Corner Condominiums, a zero-lot-line urban infill project he designed for a triangular site near downtown Missoula. It is a fitting capstone at the end of the linear commercial area known as the "Hip Strip."

Because of the constraints of the site, bordered by two main arterials, and a program that required every inch of allowable height, the team did not even consider any structural system other than steel. Some additional factors that contributed to this obvious choice were:

- A complex triangular building shape
- Having longer spans and restrictive column spacing for the underground parking and juxtaposing a triangular building on top of a rectangular parking grid
- Multiple staggered floors and changes in floor elevation going from three levels to five and back to three levels
- Using very basic erection equipment and not being allowed to encroach on the two adjacent arterials. (This was simplified with accurate steel fabrication and mostly bolted steel connections.) The steel structure was built "around" a wheeled crane, which eliminated traffic disruption
- The extensive glazing of the exterior walls combined with the

Merit Award—Less than $15 Million

THE CORNER CONDOMINIUMS, MISSOULA, MONT.

narrow building profile required the use of three moment frames and four rigid frames

- The height limit imposed by the City required the team to squeeze the floor-to-floor height to 8 ft, 10 in. at the five levels of bedrooms. The steel frame allowed the design to incorporate "coffered" ceilings to gain height. Even with that tactic, the ceilings were within a couple inches of the maximum allowed height
- Green roofs with heavy dead loads required structural steel framing. Heavy planter loads on the courtyard over parking required heavy structural beams

Using split levels allowed high ceilings in the living, dining and kitchen spaces, with lower ceiling heights in the bedroom and bath areas.

The use of green materials was of the utmost importance for the project, and structural steel contributed heavily to the green requirements of the project with its high level of recycled content and capability to be reused or reclaimed and recycled into another product of equal or greater strength or quality at the end of its useful life. The use of 25,000 board ft of reclaimed African mahogany, fir and pine for doors, flooring, cabinets, trim and other architectural elements reinforces the green goals of the building.

The sculptural aspects of the steel frame have always been a part of architectural expression that has been lost or diminished during the cladding process of most steel-framed buildings. It was the designer's goal to allow the beauty of the raw structure to be expressed within the requirements mandated by code and envelope. As this goal was developed and combined with the weathering steel siding, the building became much more interesting and alive. The patination of the steel adds great life and interest to the building as it develops its color in the arid Montana climate.

Owner
Eric & Cheryl Hefty, Missoula, Mont.

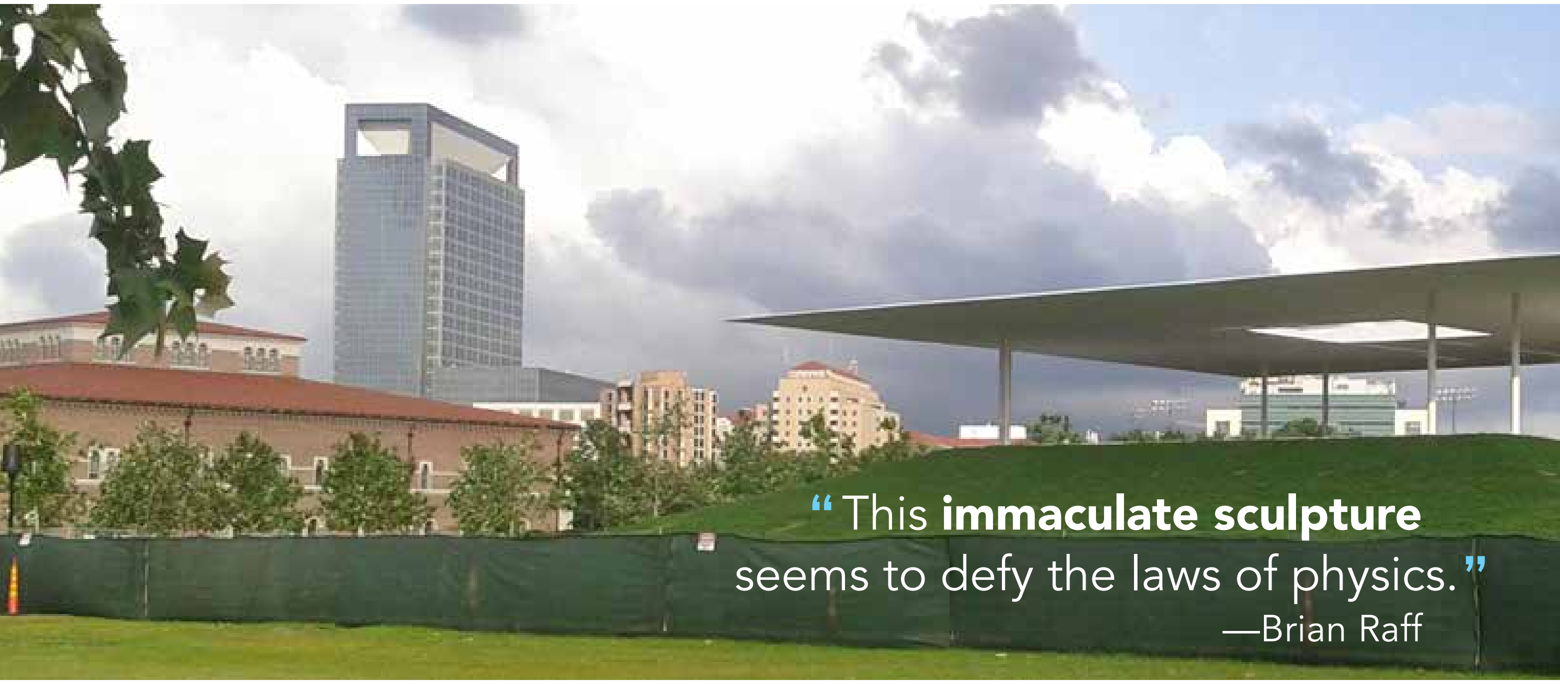
Owner's Representative, Architect and General Contractor
Eric Hefty & Associates, Missoula, Mont.

Structural Engineer
Apex Engineering Services, Inc., Missoula, Mont.

Photographs
Mark Bryant Photographics and Eric Hefty & Associates

Merit Award—Less than $15 Million

TWILIGHT EPIPHANY (JAMES TURRELL SKYSPACE AT RICE UNIVERSITY), HOUSTON, TEXAS



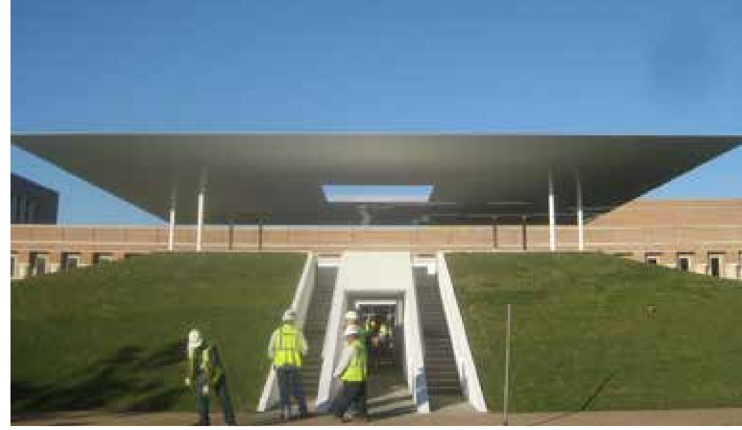
"This **immaculate sculpture** seems to defy the laws of physics." —Brian Raff

The James Turrell Skyspace at Rice University (a.k.a. "Twilight Epiphany") is a permanent outdoor experiential art installation consisting of a 72-ft by 72-ft outdoor roof atop a berm-like, two-level, below-ground viewing gallery. The Skyspace was conceived by artist James Turrell to create an atmospheric experience integrating light, sound and space that complements the natural light present at sunrise and sunset. Additionally, the Turrell Skyspace is acoustically engineered for musical performances. Visitors experience the Skyspace initially from a distance and later by passing through tunnels into the main lower viewing area, where they can sit on granite benches and peer through the bottom surface of the roof. The lower roof surface serves as a palate upon which ever-changing hues of light are projected to alter one's perception of the surrounding sky as viewed through a 14-ft by14-ft oculus in the center of the roof. The project has received widespread critical acclaim and, perhaps more importantly, inspires delight and wonder in its visitors.

The structural system for the James Turrell Skyspace is comprised of a 72-ft by 72-ft octa-symmetric, tapered, cantilevering frame supported by eight slender, 6-in.-diameter HSS cantilevered (flagpole) columns. Two concentric rings of steel girders support a series of tapered double cantilevers that reach out to the inner and outer roof edges. The lateral system consists only of the eight cantilevered columns. The tapered steel roof framing is fabricated from deconstructed (then built-up and tapered) W18 and W24 sections, HSS5×3 perimeter tubes and tapered stiffener plates that reach beyond the primary beams out to the edges of the roof.

Minimizing the depth of the roof framing and aggressively tapering the steel was critical to the project, as the artist carefully calculated sight lines to ensure that none of the top roof surfaces are visible when viewed from the ground. The fixed restraints on the framing depth and profile, together with the large cantilevers (nearly 25 ft along the diagonals), made designing and detailing the steel framing a challenge. The tapered steel beam geometry was perfectly determined to follow the upper and lower roof slopes, with a consistent and small offset from the final surface. In addition to tapering the steel wide-flange sections longitudinally, the top flanges of the beams perpendicular to the roof slope are canted at the same angle as the top roof surface; the steel was squeezed within a very tight architectural package, with very small tolerances.

The tapered roof geometry continues beyond primary steel several feet until the upper and lower roof surfaces meet in a "knife edge." For the last 2 ft to 3 ft of the cantilever, there is so little depth that a tapered steel plate with stiffeners is first used, and as the depth decreases only a flat horizontal plate extends about a foot further, until finally the architectural top surface of the roof transitions to a painted steel plate that forms the final foot of the cantilever. The outer edge of this 5⁄16-in. painted plate was sharpened to enhance the crisp appearance of the edge. The high-performance plaster lower surface of the roof extends all the way to the tip of the knife edge. The detailing of a seamless transition from primary steel into an exposed architectural surface that is simultaneously a structural cantilever was one of the project team's greatest challenges.



Designing the structural steel to so closely match the architectural roof profiles required close coordination with the technical architects and full detailing of all connections, primary and secondary miscellaneous steel members alike. The geometry of all steel and connections was fully specified in the structural contract drawings, leaving no interpretation to the fabricator.

The use of structural steel on Skyspace allowed the artist and design team to push the outer limits of cantilever span and slenderness, all the while concealing the structure, to give the impression of a roof almost magically floating in the air. The slenderness of the columns—combined with the huge cantilevers and sight lines, which hide the structural depth—creates an impression so dramatic that visitors are often puzzled by how the roof stands up.

Owner/Developer
Rice University, Houston

Architect
Thomas Phifer and Partners, New York

Artist
James Turrell

Structural Engineer
Skidmore, Owings & Merrill LLP, Chicago

General Contractor
Linbeck Construction Group, LLC, Houston

Photographs
Skidmore, Owings & Merrill LLP and Thomas Phifer and Partners

Chelsea Piers Connecticut accommodates pretty much all sporting tastes. The 400,000-sq.-ft facility in Stamford, Conn., opened to the public in the summer of 2012 and features two NHL regulation ice rinks, enormous turf fields (for soccer, lacrosse, football, field hockey, softball and baseball), a 20,000-sq.-ft gymnastics center, an aquatics center with an Olympic-sized pool, seven tennis courts, twelve squash courts, a trampoline center, a baseball/softball training area, childcare/preschool, food service, pro shop, catering and party/special event spaces.

The building housing this state-of-the-art sports facility is a 45-year-old manufacturing plant previously used by Clairol as the facility for manufacturing Herbal Essence shampoo. The adaptive reuse saved the old building from being demolished and ending up in a landfill; Clairol maintained the building well, keeping it in excellent condition.

Although the building square footage met the project's requirements, the lack of large column-free spaces created a potential roadblock. Professional quality sports facilities such as swimming pools, hockey rinks and tennis courts require large column-free areas in excess of a 100 ft wide. This criterion required the removal of 23 columns from the building in order to achieve the column-free zones. Determining an economical method for removing the existing columns while leaving the entire roof structure in place was the principal challenge. The solutions selected by WSP Cantor Seinuk were extremely creative, economical and highly sustainable, resulting in reuse of the existing roof structure, limited demolition and minimization of new materials.

The proposed structural system was based upon the use of king post trusses constructed out of the in-place existing roof structure. Leaving the existing beams, which formed the top compression chords of the truss, in place and using a portion of the existing columns as the king posts, only a relatively small amount of steel had to be added to form the tension cords of the truss. Upgrading of the in-place top chord members was accomplished via composite action with the new concrete slab poured on the existing in-place metal roof deck. Steel angle members were used for the tension chords of the trusses. Although the simple and basic "off the shelf" structural members remain exposed, their aesthetically pleasing form is apparent. The positive effect of the forms on the facility's

Presidential Award of Excellence in Engineering
CHELSEA PIERS CONNECTICUT, STAMFORD, CONN.

"Great innovation and an **adaptive reuse** of an abandoned space. An idea that can be replicated."
—Mark Simonides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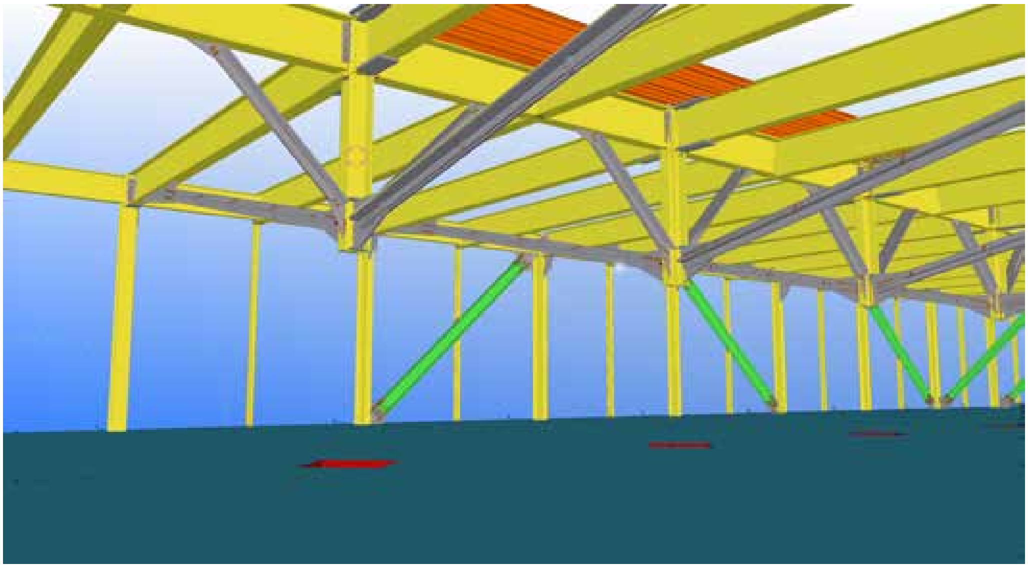
STOP



architecture is further testament to the economic and sustainable accomplishments achievable via innovative engineering. It is an excellent example of form following function.

The design met all the criteria—with the exception of being able to achieve a flat floor after the concrete was poured. Since the existing roof, which was supported upon the new king post trusses, was slated to become additional space for the new sport facilities, there was a requirement for a very flat floor structure. The proposed eloquent solution, calling for the cambering of the trusses prior to pouring the concrete slab, was accomplished via jacking of the existing roof structure prior to the installation of the new truss members. After the installation of the truss steel, the existing columns were cut out and removed. Upon pouring the new roof concrete the trusses deflected precisely as designed, leaving a flat surface for the tennis courts and soccer area to be located above.

Chelsea Piers Connecticut embodies innovative, sustainable engineering for building reuse and development. A forward-thinking design team coupled with a supportive and motivated owner allowed this project to reach its full potential. The result is a state-of-the-art facility serving the athletic needs of the community while forming a viable anchor business in a once abandoned industrial facility. **MSC**

Owner
Chelsea Piers, New York

Architect
James G. Rogers Architects, South Norwalk, Conn.

Structural Engineer
WSP Cantor Seinuk, New York

General Contractor
AP Construction, Stamford, Conn.

Steel Detailer
WSP Mountain Enterprises, Inc., Sharpsburg, Md. (AISC Member)

Photographs
Chelsea Piers
WSP Mountain Enterprises, Inc.