Excellence in Structural Engineering

NCSEA Eighth Annual Awards Program

Jury of Awards

Dr. David Byers
Genesis Structures

Rick Meloy
Structural Engineering Associates

Tom Bergquist
Prestressed Concrete, Inc.

Andy Carter
Needham & Associates Consulting Engineers

Kansas City, Missouri provided the backdrop for the announcement of NCSEA's prestigious 2005 Excellence in Structural Engineering Award Winners. At the closing banquet for their 13th Annual Conference, NCSEA honored some of the most innovative projects in the world!

The 2005 Awards Committee was chaired by **Carrie Johnson** (Wallace Engineering, Tulsa, OK). In her second term, Ms. Johnson continues to be impressed with the caliber of all of the entries. "*There were a wide variety of projects submitted including a renovation of the Hollywood Bowl, an addition to Soldier Field, the longest cable stayed bridge in North America, and an innovative seismic retrofit design. The project locations also varied widely, with projects from throughout the continental United States, Alaska, Hawaii, Mexico City, and one in Taiwan. It is always amazing to see the creative solutions that structural engineers can use to solve unique problems, meet challenging schedules, and save the client money.*"

Jeanne Vogelzang, NCSEA Executive Director, was impressed with the quality and number of this year's program entries. "*The caliber of the projects, as well as the commitment and enthusiasm of the structural engineers submitting them, continues to rise with the number of projects entered.*"

Outstanding Project Awards were presented in all five categories. Please join STRUCTURE magazine and NCSEA in congratulating all of the winners. More in-depth articles on several of the 2005 winners will appear in the magazine over the course of 2006.▪

Outstanding Project Award Winner New Buildings Under $10 Million

Lansing Community College Health and Human Services Career Building

Lansing, MI
Ruby & Associates

Partnering with Douglas Steel to deliver the steel structure of the building, Ruby & Associates, P.C. applied value engineering principals and completely re-designed the structural steel component of the building. The Community College desired additional educational space within a reasonable budget. The redesign saved enough money to meet anticipated future needs by building an additional floor and still bring the project in several hundred thousand dollars under budget.

The original structural design involved a light weight floor, with floor beams placed three-foot-on-center. By moving to a heavier weight floor system, 700 members were eliminated, reducing the sheer studs in the system. The design also moved from a field weld system to a field bolted system, reducing costs further.

Ruby and Douglas Steel adopted electronic document sharing to seamlessly join the steel design, shop detailing preparation and fabrication elements of the project. Ruby sent a CIS/2 (CIMSteel) compliant model from RAMSteel to Douglas Steel electronically, which was downloaded into SDS/2, their detailing program directly. Douglas Steel then generated erection and shop drawings for Ruby to review on-line, and make appropriate revisions. This paperless approach reduced the approval process from weeks to hours by facilitating "real time" collaboration.

Outstanding Project Award Winner New Buildings $10 Million to $30 Million

St. Martin's Episcopal Church

Houston, TX

Matrix Structural Engineers

The Episcopal Church has a history of landmark buildings; St. Martin's, now the largest Episcopal congregation in the United States, wanted to build in this tradition.

Traditional Gothic churches were built by stacking massive blocks of stone, prohibitive in terms of time and money in today's construction environment. The final solution was a creative hybrid system that was sketched by Moyeen Haque, Ph.D., P.E. in the first design team meeting: a series of steel frames, spaced at 16 feet on center to match the architectural module, forming the nave, and two X-braced steel tubes forming the tower.

Innovative features include; the use of gabled moment frames; main columns that bend in an "S" shape under wind loads; designing the peak of the ceiling to be above the eave, saving considerable amounts of brick; special bracing and steel framing around tall stained glass windows; a series of girts, sloping beams, and diagonal braces concealed in the tower buttresses to overcome a lack of east-west x-braces in the towers; shelf angles for brick support in the towers; and more…

St. Martin's does not look modern. But under the skin is a structural engineering achievement. For the Matrix team, there were no go-by projects, no obvious precedents, and no easy answers.

Outstanding Project Award Winner New Buildings Over $30 Million

Taipei 101

Taipei, Taiwan

Thornton-Tomasetti Group, Inc.

Taipei 101 recently became the World's Tallest Building, with an impressive height of 508 m (1666 feet). Even more impressive are the demands placed on this tower: frequent, severe typhoon winds and strong earthquakes. The building shape was a further challenge, evoking segmented bamboo stalks and traditional pagodas by including eight, eight-story flared modules atop a truncated pyramid. The geology of the site, consisting of soft bedrock about 40 to 60 meters below clay and stiff colluvial soil layers, presented a challenge to support the loads of such a massive structure. The resulting foundation consists of five major components: slurry walls, podium piers, a podium pressure slab, tower piers and a tower mat.

Engineers designed the structure of the tower as a "megaframe" with a central braced core connected to several perimeter "supercolumns" on each building face via one-, two- and three-story tall outrigger trusses. To best address the drift resulting from such a tall, narrow building, the engineers decided to use hollow columns filled with high-strength, high-stiffness concrete. For earthquake resistance engineers devised a dual system of steel moment frames along each sloping face of the building working in parallel with the braced core and outriggers.

Inherent structural damping in Taipei 101 is supplemented by a tuned-mass damper (TMD) that uses building motion to push and pull dashpots, or giant shock absorbers, that convert motion to heat by forcing fluid through small internal openings.

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Outstanding Project Award Winner
Bridges & Transportation Structures

Cooper River Bridge

Charleston, SC

Parsons, Brinkerhoff, Quade & Douglas

The dramatic Cooper River Bridge was designed to replace two existing outdated truss bridges and to meet extreme wind, ship collision and earthquake conditions. The bridge, formally known as the Arthur Ravenel Jr. Bridge, is one of the first major design-build bridge projects in the United States.

The Cooper River Bridge provides eight travel lanes and a sidewalk/bikeway. It features a main span of 1,546 feet, a total cable-supported length of 2,846 feet and two diamond-shaped concrete towers, 572.5 feet high from the water line to the top. The main span is the longest cable-stayed bridge in North America.

The South Carolina Department of Transportation (SCDOT) awarded the design-build contract to a joint venture of Tidewater Skanska and Flatiron Constructors, known as Palmetto Bridge Constructors (PBC). Parsons Brinckerhoff served as the lead designer.

The project included many innovative structural engineering solutions including: offset stay cable anchors to reduce main span tower moments; very long continuous approach spans, a 4,351-foot-long west approach and a 2,090-foot-long east approach, that minimized the number of bearings and joints; and elimination of almost all footing by using large diameter drilled shafts that framed directly into the pier columns.

Outstanding Project Award Winner
Other Structures

Adaptive Reuse of Soldier Field

Chicago, IL

Thornton-Tomasetti Group Inc.

The adaptive reuse of Chicago's historic Soldier Field tackled complex geometry and steel construction innovations in the NFL's fastest stadium construction yet. The project required fitting a full-size, modern stadium into a 600- foot-wide space on a 20-month schedule. The architectural solution was an asymmetrical design with general admission seats on one side of the stadium and stacked luxury suites atop two cantilevered club decks on the other. That configuration saved enough space to fit a 61,500-seat stadium inside the colonnades.

Many of the project's breakthroughs were made possible by the stadium's 13,000 ton structural steel frame, which provided great design flexibility. To provide needed vibration control, engineers incorporated 21 tuned mass dampers (TMDs), located at the tips of the cantilever of the grandstand. The TMDs, about 20 tons each, comprise a concrete mass supported on air springs, tunable steel springs and a tunable viscous damper connected to the structural frame.

To accelerate the steel fabrication and erection process, Thornton-Tomasetti, in joint decisions with the project team members, adopted Xsteel 3D modeling software by Finland's Tekla Corp. Widely used in Europe, Xsteel produces a full-size, annotated computerized model. Once the model was in place, piece drawings for fabrication and general arrangement drawings were produced automatically.

Merit Award Winner
New Buildings $10 Million to $30 Million

Merit Award Winner
New Buildings under $10 Million

University of Oklahoma, Everest Training Facility

Norman, OK
Wallace Engineering

The University of Oklahoma wanted to renovate their existing indoor track facility and add a new indoor training facility for football. The twist… construction could not start until late April, and the team had to be able to practice in the facility by the first of November. This meant that the building had to be erected, enclosed and finished in five months.

The structural framing system relied on simplicity more than innovation, selected and designed to allow fast erection and maximum flexibility in use. The roof framing was designed to allow quick erection and to minimize temporary bracing. Erection of the modular framing system moved rapidly. The north end wall was erected first and continued in 30 foot modules to the south. Decking operations immediately followed the erection of a bay.

The facility was turned over to the university in mid-October — two weeks ahead of schedule — and it remains one of the premier university practice facilities in the nation.

Grand River Center

Dubuque, IA
KJWW Engineering Consultants

Located along the banks of the Mississippi River, this 118,500 square-foot, state-of-the-art conference and events center is part of America's River, a $188 million redevelopment of the riverfront in downtown Dubuque. The site presented many challenges, including thick seams of poor materials and fills, including dredge material from the construction of a floodwall, and a 14-foot seam of sawdust from when the site was used as a stockyard for lumber that was floated down the river.

KJWW Engineering designed the facility with long span trusses, a curved flowing roofline, and exposed structural steel. The spine acts as the entrance and primary circulation area, and culminates in the River Room. The east elevation of the Grand River Center is a glass wall facing the Mississippi River. The River Room, enclosed in glass, cantilevers 30 feet beyond the last column, with an 8-foot wide cantilevered walkway wrapped around it.

The primary framing challenges included an exposed aesthetically appealing framing system, the cantilevered River Room, and an aggressive budget and schedule requirement.

Merit Award Winner
New Buildings Over $30 Million

Nimitz-MacArthur Pacific Command Center

Camp H.M. Smith, HI
Baldridge & Associates

In 1999, the Department of the Navy issued a solicitation for a modified Design/Build contract which called for the design and construction of a new military regional headquarters building. The Contractor was required to verify the adequacy of the RFP documents. Based on conceptual exterior drawings prepared by another architect, this project also required an evaluation of alternative structural systems that could provide better performance for less cost. Baldridge & Associates Structural Engineering, Inc. (BASE) worked under the direction of the Benham Companies to assist in evaluating an alternate structural steel system and the blast resistant façade.

Using structural steel framing with poured in place suspended slabs and precast cladding, the final design provided a tremendous savings. Coupled with the state-of-the-art SidePlate ™ steel frame connection technology, the structural steel frame system efficiently addresses the force protection standard to mitigate progressive collapse should it lose the use of a beam or column by force.

Merit Award Winner
New Buildings $10 Million to $30 million

FY04 Squad Operations/Aircraft Maintenance Unit Hanger

Indian Springs Air Force Auxiliary Field, NV
Merrick & Company

The design of the Squad Ops/AMU/Hangar project was a collaborative effort between Merrick & Company and the U.S. Army Corp of Engineers, Albuquerque District. Merrick & Company performed the structural, architectural, electrical and civil engineering design, while the geotechnical, mechanical, and fire protection was completed by the Albuquerque District.

While the Squad Ops and AMU components of the structure were concrete masonry bearing wall systems with interior steel framing, the 40,000 SF hangar steel structure posed more difficult structural challenges. Due to specialized requirements for Unmanned Aerial Vehicles (UAV's), a roll-through design with hangar doors on opposite sides was required. The facility also had to accommodate twelve aircraft. This required clear spans inside the hangar of approximately 142 feet by 250 feet by 27 feet high. For thermal movement and seismic considerations, the hangar structure was separated from the rest of the building with a building expansion joint, creating two separate structures.

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Merit Award Winner
Bridges & Transportation Structures

Rhythm City Skybridge

Davenport, IA
Holabird & Root

The Skybridge, a part of Davenport's "River Renaissance" redevelopment project, is a distinctive cable-stayed style bridge with splayed 99-foot high columns. Holabird & Root's design maximizes the bridge's glass enclosure for unequaled views.

The structural team designed the roof framing as the main supporting element. The roof structure utilized the wide flange longitudinal and transverse beams with steel angle bracing members to act as a horizontal truss that spans between cantilevered columns to resist lateral forces. Eighty-foot long sections were shop fabricated and shipped to the site as a unit for reception.

The bridge floor is a reinforced concrete slab with transverse openings covered with glass insets, allowing light to pass through the floor. The floor deck is a precast concrete element composite with the longitudinal steel beams. The concrete floor structure is reinforced as a slab for vertical loads and as a horizontal frame spanning between columns to resist lateral forces.

Torre Mayor

Mexico City, Mexico
WSP Cantor Seinuk and
Enrique Martinez Romero

Merit Award Winner
New Buildings Over $30 Million

The Torre Mayor Office building is currently the tallest building in Latin America. The tower superstructure utilizes the composite construction of steel columns encased in reinforced concrete up to the 30th floor. Above the 30th floor, steel was the primary material for the structural framing.

The team of WSP Cantor Seinuk and Enrique Martinez Romero Structural Engineers utilized "Performance Based Design," which provides an additional level of reliability and criteria for how the building should and would perform during significant seismic events. As part of the criteria, it was established that the building can be operational immediately, even after a large scale seismic event.

A series of structural analyses were performed to establish the influence of various supplemental damping devices in the performance of the tower. A parallel research study was also conducted by WSP Cantor Seinuk to investigate the optimal utilization of dampers. These investigations allowed for the formulation of a unique application of viscous damping elements into the structure.

Merit Award Winner
Bridges & Transportation Structures

I-74 Arched Pier Bridges

Peoria, IL
Alfred Benesch & Company

A unique, concrete tied-arch pier supports both the University Street and Broadway Avenue bridges over Interstate 74. Alfred Benesch & Company designed the bridges as part of the massive I-74 reconstruction project in Peoria and East Peoria, Illinois.

The new bridges have several innovative features. The proposed roadway was positioned immediately adjacent to the existing flume due to right-of-way restrictions. The adoption of the tied-arch pier facilitated the incorporation of a support for the bridges in the center of the facility while simultaneously spanning the flume. The foundation for the pier consists of steel piles driven on either side of the flume. The concrete pile caps serve as the support for the tension tie member that spans the flume. The tie member not only serves to tie the arch but it also supports it and transfers the vertical loads to the pile bents. The result is a support that does not encumber the roadway or create an obstacle in the flume.

Merit Award Winner
Bridges & Transportation Structures

Talega Bridges

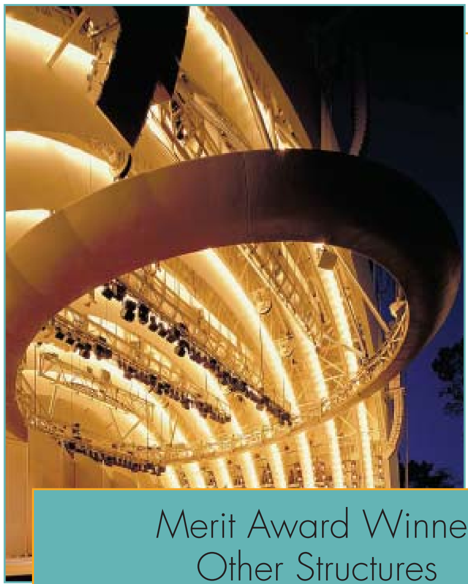
San Clemente, CA
RDF Consulting

RBF Consulting provided bridge design services for three bridges over the Segunda Deschecha Canada wetlands as part of the Talega Master Planned Community.

The Avenida Vista Hermosa Bridge is a three-span, cast-in-place post-tensioned concrete box girder. Its long main-span length of 250 feet was required to avoid a meandering environmentally sensitive area. To support the enormous loads imposed by each of the bridge's six (6) 84-inch diameter columns, large-diameter (120-inch) pile shafts were drilled as deep as 130-feet into the underlying bedrock and filled with reinforced concrete using a polymer slurry to control groundwater and caving.

To satisfy Caltrans Seismic Design Criteria for lateral stiffness compatibility between adjacent supports, some of the columns had to be artificially lengthened by deepening the pile cut-off elevation and isolating the column from the confining effects of the soil by using steel casings around the bottom of the "shorter" columns.

Unique architectural elements integrated into the bridge design included integrally-pigmented pre-cast concrete beams, manufactured stone veneer, and pre-cast concrete paving stones.



Merit Award Winner
Other Structures

Hollywood Bowl

Hollywood, CA
Miyamoto International

As the focal point of the Hollywood Bowl, the new Streamline Modern Shell is intended to solve a number of shortcomings associated with the old one. In designing a replacement, Miyamoto International had to create a larger, state-of-the-art entertainment venue while still holding to the traditional look of the previous structure.

The new shell is much larger, allowing the entire LA Philharmonic Orchestra to sit within it. The shell also is designed to carry a sophisticated "halo", or ring truss, which carries lighting and audio equipment, and can be partially removed for alternate staging schemes. The shell structure consists of a series of ten concentric semicircular steel trusses, varying in diameter from 84 to 144 feet. New columns and foundations were added to support the shell and several existing columns were removed and replaced to preserve usable space.

Miyamoto's engineers guided the fabricator through the complexities of the framing system to account for the myriad pieces of equipment that were to be supported by the structure.

King County Courthouse Seismic Stabilization

Seattle, WA
Coughlin Porter Lundeen

The King County Courthouse is Seattle's oldest major public building. Originally built in 1914 at six stories high, a six-story addition in 1929 brought the building to its current height of 215 feet. The building's primary construction consists of concrete beams and columns.

During the Nisqually Earthquake of 2001, slabs of plaster fell from the walls and ceiling, indicating the structure was in desperate need of improvement. Coughlin Porter Lundeen designed a seismic upgrade which included many elements used for the first time in the Pacific Northwest; buckling-restrained-brace frames and fluid viscous dampers.

To provide significant strength and stiffness in the east-west direction, six bays on each floor received diagonal buckling-restrained-braced-frames. Retrofits in the north-south direction were designed to work in conjunction with the existing frames. To reduce building displacements without significantly stiffening the building, viscous dampers were added at six bay per floor. In addition, several bays on each floor were retrofitted using hybrid steel-fiber-reinforced-concrete beam frames.

Merit Award Winner
Other Structures