

# Excellence in Structural Engineering

## NCSEA 11<sup>th</sup> Annual Awards Program

At their annual meeting in Cleveland, Ohio in October, NCSEA announced the winners of the 2008 Excellence in Structural Engineering Awards. This awards program annually highlights some of the best examples of structural ingenuity throughout the world. Awards are divided into five categories: three building categories which are separated based on construction cost, a bridge or transportation structure category, and an "other" category which encompasses renovations, rehabilitation, upgrades or non-building structures. All structures must have been completed, or substantially completed, within the past three calendar years.

The 2008 Awards Committee was chaired by Carrie Johnson (Wallace Engineering, Tulsa OK). In her fifth term as Chair of the Committee, Ms. Johnson continues to be impressed with the caliber of all of the entries. "The judges had an incredible task this year. We had a diverse group of building projects, ranging from a large hospital with high seismic and snow loads, to a building supported on an existing New York city subway structure. In the bridge category, the judges had to compare bridges ranging from a single span pedestrian bridge to a 7,400 foot, 16 span bridge. And, in the 'other' structures category, the projects ranged even more widely, from a seismic upgrade of the Mormon Tabernacle Choir to the design of a complex 'Dragonfly' sculpture. Seeing the creative ways structural engineers resolve these problems is impressive. The outcome was very close in all of the categories, which attests to the high quality of the entries."

Outstanding Project Awards were presented in five categories. Please join STRUCTURE® magazine and NCSEA in congratulating all of the winners. More in-depth articles on several of the 2008 winners will appear in the Spotlight Department of the magazine over the course of the 2009 editorial year.

### 2008 Panel of Judges

R. JOHN ANIOL, P.E., S.E.  
*Walter P Moore*

ANDREW J. ZEKANY, P.E., SECB  
*HKS, Inc.*

STEPHEN J. CAMPBELL, P.E., SECB  
*Campbell & Associates Consulting Engineers, Inc.*

STAN R. CALDWELL, P.E., SECB  
*Half Associates, Inc.*

MICHAEL G. POWELL, P.E., SECB  
*Raymond L. Goodson Jr., Inc.*

MICHAEL W. LEE, P.E., SECB  
*Wiss, Janney, Elstner Associates, Inc.*

**Special Section**

# Outstanding Project Award Winners

## New Buildings Under \$30M

### Toledo Museum of Art Glass Pavilion Toledo, Ohio Guy Nordenson & Associates

The Glass Pavilion is a freestanding addition to the Toledo Museum of Art in Ohio. The design called for a building with a single level above ground gallery, with independent rounded rectangles enclosed by full height glass walls and an inaccessible 30-inch wide cavity between each room's perimeter partitions. The girders and joists of the steel roof framing are all continuous, which allows for the distribution of the total moment to both positive and negative bending throughout, with reduction in the critical design moments for both girders and joists. Special column construction adds to the architecture. Limiting the number of columns, combined with the use of plate construction, integrates the role of the structural engineer with that of the architect. While the structural systems are unorthodox, they aid in attainment of a building that is both highly efficient and affordable.



## New Buildings \$30M - \$100M

### State Renaissance Court Brooklyn, NY Wexler & Associated Structural Engineers

The State Renaissance Court building is the first building supported directly on top of an existing New York City Subway tunnel. Because the tunnel was built with no seismic considerations, State Renaissance had to be seismically separated from its tunnel supports, using advanced isolators and separators. In addition, noise and ground vibrations were also isolated. The structural design, which used advanced model analysis, was reviewed and approved by NYC Transit agencies and its outside consultants.



## New Buildings Over \$100M

### Intermountain Healthcare Medical Center Murray, Utah Reavely Engineers + Associates



The Intermountain Healthcare Medical Center was designed to serve a community of over two million people after an earthquake, while also limiting any earthquake damage to the building. Buckling-restrained braced frames were chosen as the lateral force resisting system for four of the tallest buildings in the complex. The 648 BRBFs used for the IHMC make this project the largest of its kind in the U.S. A new buckling-restrained braced frame connection was developed and tested to meet strict project-specific criteria. Use of this connection resulted in a \$500,000 savings and a shortened work schedule. Owner's representative, Stephen Dibble, recognized the contribution of the structural engineer to the project's success, citing "the responsiveness of the structural engineers and their ability to provide drawings on a very tight schedule and with unprecedented attention to detail."

*Photo below - courtesy of Dana Sohm*



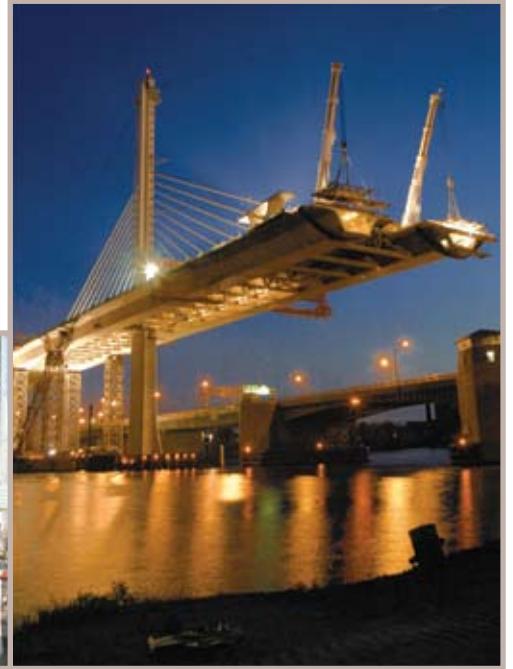
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# Outstanding Project Award Winners

## Bridges & Transportation Structures

### I-280 Veterans' Glass City Skyway Toledo, Ohio Figg Bridge Engineering, Inc.

The I-280 Veteran's Glass City Skyway is a \$237 million, 1525-foot long, precast concrete, segmental cable-stayed main span that features a single 440-foot tall pylon and more than 2.5 miles of ramps, roadway and approaches. It is the first bridge in the world with an internally lit glass-faced pylon and the first in the U.S. to utilize stainless steel sheathing on the cable stay, as well as the first design and installation of a new cable-stay bridge cradle system that provides numerous construction and long term benefits. The pylons are founded on 17 eight-foot diameter drilled shafts, arrayed in a circular pattern connected by a 16-foot thick, 104-foot diameter footing, setting ten feet below the mud line. The new bridge features three lanes of traffic in each direction, with an average daily traffic count of nearly 69,000 vehicles, a number that is sure to increase in the planned 100-year life of the bridge.



## Other Structures

### The Church of Jesus Christ of Latter-Day Saints Tabernacle on Temple Square Seismic Upgrade & Renovation Salt Lake City, Utah Reaveley Engineers + Associates

Originally built in 1967, the Salt Lake Tabernacle was an engineering marvel for its day, with 60-foot tall timber arched trusses that clear span 130 feet and provide a capacity to seat 4000 people. The primary challenge was to retrofit the structure, while preserving the historical architecture. Complex engineering solutions included anchorage of stone columns to strengthen foundations, installing an oval-shaped belt truss that ties the existing timber trusses together, supplementing the existing wooden king-trusses with new steel trusses, and anchoring the famous pipe organ to prevent tipping during an earthquake. All of the above had to be performed under strict constraints placed on the project by the owner, which can be paraphrased as follows: Don't change it, don't ruin it, just fix it; and do it the right way.



*Courtesy of the Church of Jesus Christ of Latter-Day Saints.*

# Award Finalists

## New Buildings Under \$30M

### School of Art and Art History at the University of Iowa Iowa City, Iowa Guy Nordenson & Associates

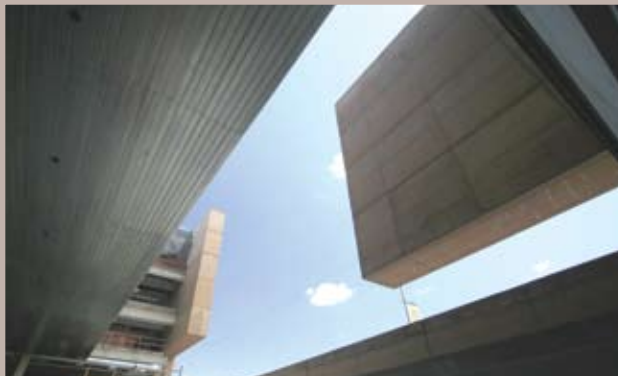
The School of Art and Art History is described as a hybrid instrument of open edges and open center. The building is a formless instrument. The project, based on Picasso's Guitar sculpture, is centered on a full height atrium with a sculptural stairway. Exposed structure plays a major role in the aesthetics. Use of exposed wide-flange steel framing with hollow-core precast concrete floor planks, combined with an expressed pin-connected tension truss spanning an adjacent pond, help define the architecture. While the structural elements are exposed and highly integrated to the design, they play an important role in the character of the interiors. Great care was taken to maintain the structural character (and corresponding lower cost) of these systems.



### School of Architecture and Planning, University of New Mexico Albuquerque, New Mexico Chaves-Grievens Consulting Engineers, Inc.



The School of Architecture and Planning is a 108,000 square foot facility which includes a basement and multi-level roofs. Four wide flange steel trusses provide a column-free 96-foot breezeway at the ground level. The transfer girder trusses support a fourth floor library at the top chord, and the third floor is supported at the bottom chord. The first and second floors are suspended from these massive trusses. Self-consolidating concrete allowed for continuous concrete floors for the shear walls, which were reinforced with wide-flange steel shapes in lieu of traditional bar reinforcing. Cantilevered construction was used both vertically and horizontally, contributing significantly to the building's overall aesthetic. The project stands as a testimonial to the potential for structure to compliment architecture, and will surely foster creativity in architects for decades to come.



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# Award Finalists

## New Buildings \$30M - \$100M

### Tempe Center for the Arts Tempe, Arizona Arup

The Tempe Center for the Arts clusters spaces as building blocks around a dramatic lobby plaza. The clustered design of the “boxes within a box” resulted in three separate buildings assembled under one large roof. Individual buildings include two theatres and an art gallery, as well as meeting facilities. The main roof structure, utilizing long-span steel trusses with a metal deck supporting a concrete slab, encloses a combined structural system of steel framing and concrete for the individual buildings. This enveloping high roof mitigates the airborne noise and vibration caused by the airport traffic, while also shielding the complex from the harsh desert climate.

*Courtesy of John Linden.*



*Courtesy of ARUP.*



*Courtesy of Michael Masengarb.*

### Akron Art Museum Akron, Ohio DeSimone Consulting Engineers

The Akron Art Museum is designed as three distinct experiences: the Crystal, the Gallery-Box, and the Roof Cloud. Structural steel was used extensively, allowing the structural elements to be exposed. Over 200 tons of A36 material is utilized to fabricate the tapered plate girders that provide the design's primary supports. Documentation of feature elements required using a combination of 2D drawings and 3D computer models. 3D data was provided with the software package Rhinoceros. All member lengths and basic connection geometries were defined in 3D; and, 3D “shop models” from the fabricators were reviewed prior to the creation of the shop drawings, reducing total review time drastically.



## New Buildings Over \$100M

### DFW International Airport Terminal D and Sky Bridges Dallas / Ft. Worth, Texas L.A. Fuess & Partners, Inc.

International Terminal D is the 5<sup>th</sup> terminal to be constructed at DFW International Airport. The project was built using nearly 12,500 tons of steel. Significant structural elements include a 45-foot cantilevered canopy, an 800-foot-long, six-span sky bridge, nearly four hundred feet of pedestrian bridges, a 3.1 million square foot post-tensioned parking structure, and an elevated, inter-terminal people mover. Notice to proceed on the project was granted June 2000, and a drilled pier package was issued that November, a full 18 months before architectural drawings were to be completed. To complicate the project, terrorism prevention measures were incorporated in the days after 9/11.



Features such as blast walls, steel jacketed columns, upsizing of framing for blast pressure resistance, and the addition of bottom flange beam bracing to improve ductility, were all added. Terminal D sets itself apart by changing from the traditional DFW horseshoe shape to one stretched outward, further distinguishing this terminal from the other four.



*Courtesy of L.A. Fuess Partners, Inc.*

Terminal D sets itself apart by changing from the traditional DFW horseshoe shape to one stretched outward, further distinguishing this terminal from the other four.

*Courtesy of Craig D. Blackmon, FAIA.*



### IAC / Interactive Corporate Headquarters New York, New York DeSimone Consulting Engineers



This 190,000 square foot, ten-story office building is a sculpted, reinforced concrete structure, clad with an all-glass curtain wall system. Concrete construction, while seismically-disadvantaged due to the site's poor soil conditions, proved economical, as it eliminated the costly moment connections that would be required with steel construction. To facilitate the design of the complex geometric structure, the base geometry was defined with Digital Project. The resulting three-dimensional model was made available to the entire construction team. Two-dimensional drawings were furnished, in which the plan drawing annotated coordinates to more accurately define the true conditions. Despite all of the concrete/geometry challenges, the subcontractor for the superstructure was still able to construct two floors per week, finishing the project much sooner than expected.

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# Award Finalists

## Bridges & Transportation Structures

### New Benicia-Martinez Bridge Benicia, California T.Y. Lin International

The New Benicia-Martinez Bridge is a concrete segmental structure, the largest of its type in California. The bridge is 83 feet wide and 7400 feet long, with 16 spans, 12 of which are over water. For a bridge of this size to be able to endure a seismic event, the design used concrete that was 20% lighter than normal weight concrete, but with a design strength of 6,500 psi and a stringent modulus of elasticity requirement to limit deflections. An innovative, internal cooling coil system was designed to reduce internal concrete temperatures to within acceptable levels. Using high-performance lightweight concrete, to lower mass and reduce seismic demand, satisfied the lifeline structure requirement placed on the project by the owner, meaning the bridge will remain open to emergency traffic immediately after a major earthquake.

*Courtesy of Streato/Havens.*



### SR55 (US-19) over Coachman Road & Sunset Point Road Clearwater, Florida T.Y. Lin International

The design of the US-19 corridor single point interchange, while satisfying traffic needs by improving the overall traffic flow, significantly reduced the width of project construction and provided a simple and compact solution for a complex transportation issue. An innovative solution was achieved by designing the steel box girder with an integral pier cap strap with tension plate, to be sequentially “dropped” into place. A creative structural solution was attained with pile supported slab overhanging the Mechanical Stabilized Earth (MSE) wall, to allow traffic to be queued under the overhang slab and “tucked” under the bridge. Along with the Integral steel bent caps system, the shallow 1-foot 6-inch structure depth, for the pile-supported slab, shortened the bridge length and lowered the profile roadway, thus enabling the roadway to be lowered by approximately seven feet. The structure is

aesthetically pleasing, with V-shaped pier, and congruent with the over-all layout of the corridor. Its creativity and ingenuity have resulted in cost savings by avoiding right-of-way acquisition and providing an easily-constructed structural configuration.

*Courtesy of Streato/Havens.*



## Other Structures

### The Addition at 185 Berry Street San Francisco, California Simpson Gumpertz & Heger, Inc.



The 185 Berry Street owners' desire, to add two additional stories to a three-story structure, created the stage for SGH to make history with the first use of seismic isolation as a means of mass damping a building. The addition is a continuous 800-foot structure, constructed on seismic isolation bearings over the existing roof. Not only did the SGH design satisfy the rigorous requirements of a peer-reviewed performance-based analysis, the design actually reduced the seismic forces in the existing structure, without modification to the building,

by using the new addition as a tuned mass damper. Base isolators 45 inches in diameter allow the relatively light upper structure to move laterally 45 inches. The project employs 87 seismic isolation bearings set within a steel grillage on the roof of the existing building. There is an interlocking shear transfer system, consisting of concrete pads connected to the roof and steel shear lugs connected to the lower steel grid. This ingenious design allowed the owners to achieve their scheduling and cost objectives on a highly-constrained project.



*Courtesy of Simpson Gumpertz & Heger, Inc.*

### Metro 417 Los Angeles, California Nabih Youssef & Associates

The Subway Terminal Building is a 13-story historic tower, constructed in 1925 by the Pacific Electric Railroad. The structural engineers were charged with retrofitting the structure for use as new boutique residences, requiring a new seismic force-resisting system, while maintaining the historic fabric of the steel and brick building.

After in-situ testing and finite element analysis, NYA utilized the existing unreinforced masonry in the overall seismic resisting force system, saving hundreds of thousands of dollars. Additionally, the designers incorporated a shotcrete-punched, shear wall scheme at the interior face of the building's wings,

which helped reduce the building's inelastic drift, to better preserve the integrity of the exterior façade and historic interior corridors. Due to the knowledge collected and techniques employed in the Subway Terminal Building, the project is a case study of adaptive reuse of historic buildings and serves as a guide for other projects facing similar challenges. ■

