Thornton Tomasetti

Building Solutions

Annual Report 2007

Thornton Tomasetti provides building engineering services to clients worldwide on projects of all sizes and complexity — from the tallest buildings and the longest spans, to structures requiring innovative engineering design and materials. Our clients include architects, owners, developers, and others who serve the construction industry.

We provide two complementary services: structural design, and building technology services, which includes investigations, cladding design, and repair and renovations. Engineering of a diverse range of buildings allows us to understand failures from the inside out as well as the constructability of repairs. Insights gained from our investigations continually enhance the quality of our structural designs.

Our 650 engineers, architects, and support professionals are committed to creating the best solutions through technical ingenuity, pursuit of excellence, and anticipating client needs.

Services

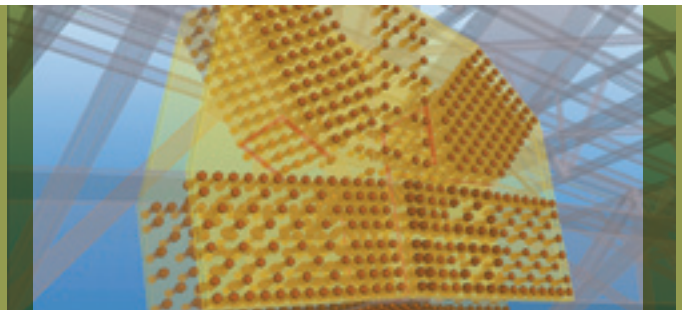
Structural Engineering
Integrated Modeling
Multidisciplinary Consulting and Design
Forensic Investigation and Analytics
Exterior Wall Consulting
Historic Preservation
Building Evaluation and Rehabilitation

Offices

Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Fort Lauderdale, Florida
Hong Kong
Irvine, California
Kansas City, Missouri
London
Los Angeles, California
Moscow
New Haven, Connecticut
Newark, New Jersey
New York, New York
Philadelphia, Pennsylvania
Shanghai
Washington, D.C.

Cover: *The Thornton Tomasetti team responsible for structural engineering of the Johns Hopkins Hospital New Clinical Building, which, at 1.6 million square feet (149,000 square meters), is the country's largest single-facility health care construction project. From right, Zach Kates, Lisa Chong, Wayne Stocks, Michael Cropper (back row), Aine Brazil, Chris Crilly and Matt Horne.* *See story page 10.*

Back Cover: *In 2007 Thornton Tomasetti received the Autodesk Revit BIM Experience Aware for Collaborative Use of Building Information Modeling, illustrated here by this building information model of a stadium now under development. Building information modeling helps to significantly compress project schedules and minimize late-stage changes.*



Front row from left, Dan Cuoco, president and chief executive officer; Richard Tomasetti, founding principal; Tom Scarangello, chairman; and Bob DeScenza, chief operating officer; back row from left are managing principals Joel Weinstein, Dennis Poon, Manny Velivasakis, Joe Burns, Daniel Marquardt, Aine Brazil, and Steve Dennis.

Chairman's Message

Thomas Z. Scarangello, P.E.

I am honored to have been chosen by the Thornton Tomasetti board of directors as our new chairman. Over the last half century, our chairmen — Lev Zetlin, Charlie Thornton and Richard Tomasetti — set ambitious goals for growth, grounded in the framework of the culture they had established. That culture, a meritocracy that cultivates technical excellence, innovation and collaboration in an entrepreneurial environment, continues to thrive today. It is this forward-looking approach that this generation of Thornton Tomasetti leaders is charged with carrying on.

Whether expanding into developing markets around the world, adding services in anticipation of our client's needs or innovating by providing tomorrow's project delivery systems today — we rely on the lessons of our past to guide us into new and exciting areas. As we do so, we extend the legacy of our former leaders while preparing the leaders of tomorrow.

Our history and the promise of continuous renewal of our firm are what inspire me and the other leaders of Thornton Tomasetti. Whether you're a client, colleague or a young professional we invite you to join us as we build the future.

President & Chief Executive Officer's Message

Daniel A. Cuoco, P.E.

Strong demand for our design and investigation expertise drove a steady but disciplined expansion of our services and geographic reach in 2007. We saw the most rapid growth in Europe, Asia and the Middle East, where our proficiency in high-rise and mixed-use complexes is helping our clients meet demand for bold and innovative structures. Our London office, overseeing projects in the U.K., the Middle East, and Eastern Europe, provided an important conduit to assist clients in these growing markets.

In 2007, we made significant investments in the firm to better serve our clients. Our Connecticut office moved to downtown New Haven to improve service to clients across southern New England. Our London office, which opened in December 2006, now has 19 staff supporting sophisticated architectural designs. And our office in Newark, New Jersey celebrated its tenth anniversary, which was made especially sweet with the opening in October of the Newark-engineered Prudential Center, the home of the New Jersey Devils hockey team and the first major stadium in the New York City area in 25 years.

Our investigation, forensic and rehabilitation business was expanded in the property loss consulting arena, and in the area of façade consulting, which overlaps both our investigation/forensic practices and our design services (see projects on pages 17–26).

Always innovating, we have pushed hard on development of tools and techniques for building information modeling, which has proved to significantly compress project schedules and minimize late-stage changes. For our pioneering work, we are proud to have received from Autodesk the Revit BIM Experience Award for Collaborative Use of Building Information Modeling.

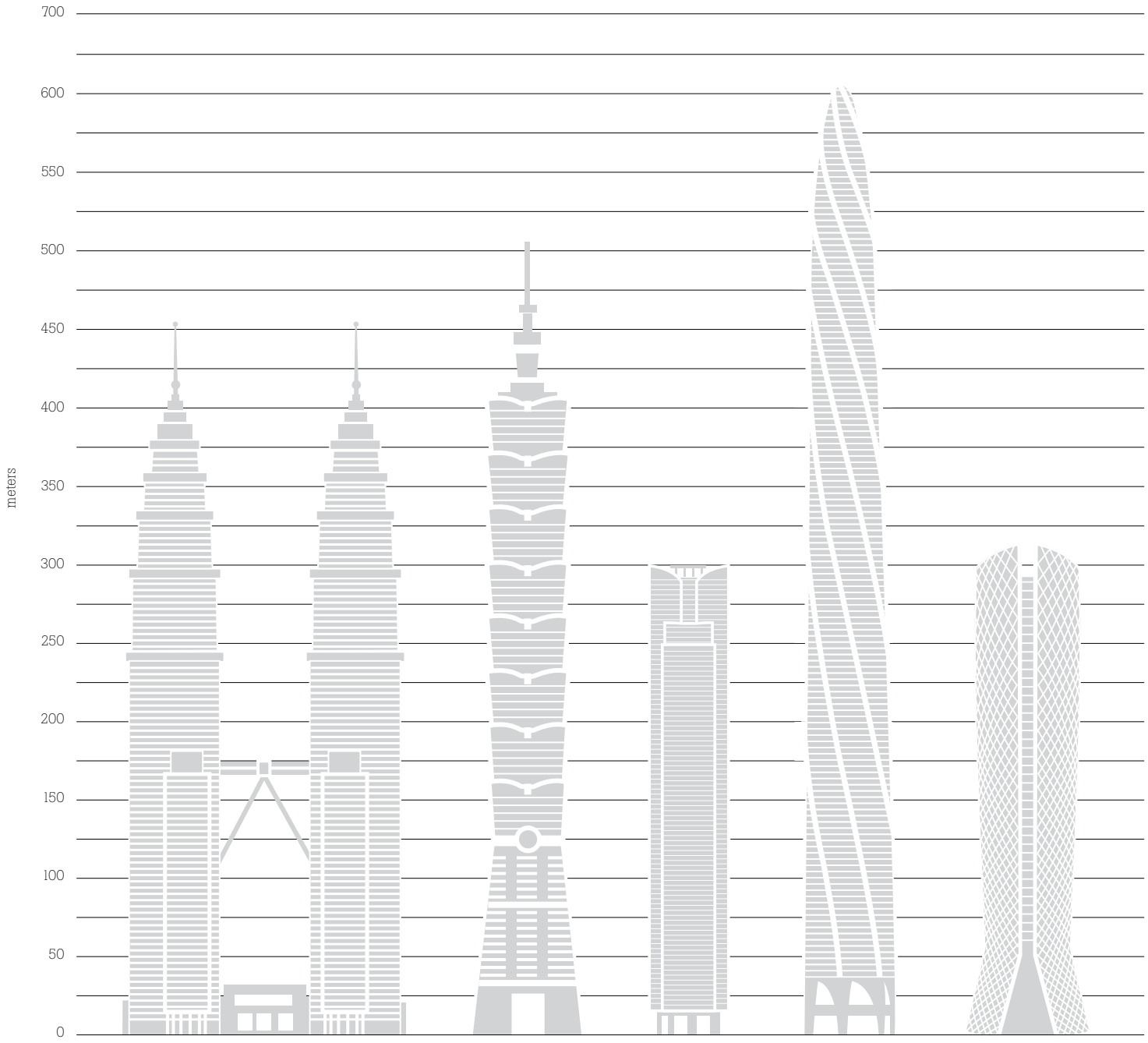
I'm also proud that our 650 people, as hard as they have worked this year, also found time to give back to their communities. Many of our offices are deeply committed to the ACE Mentor Program, supporting high school students considering careers in architecture, construction and engineering fields. We also began a firm-wide initiative this year to become a leader in the area of sustainability and environmental consciousness. This effort, which is being led by our Green Building Strategy Team established in 2007, is related not only to green design practices, but also to the internal operations in all of our offices. We will begin to see the fruits of this effort in 2008.

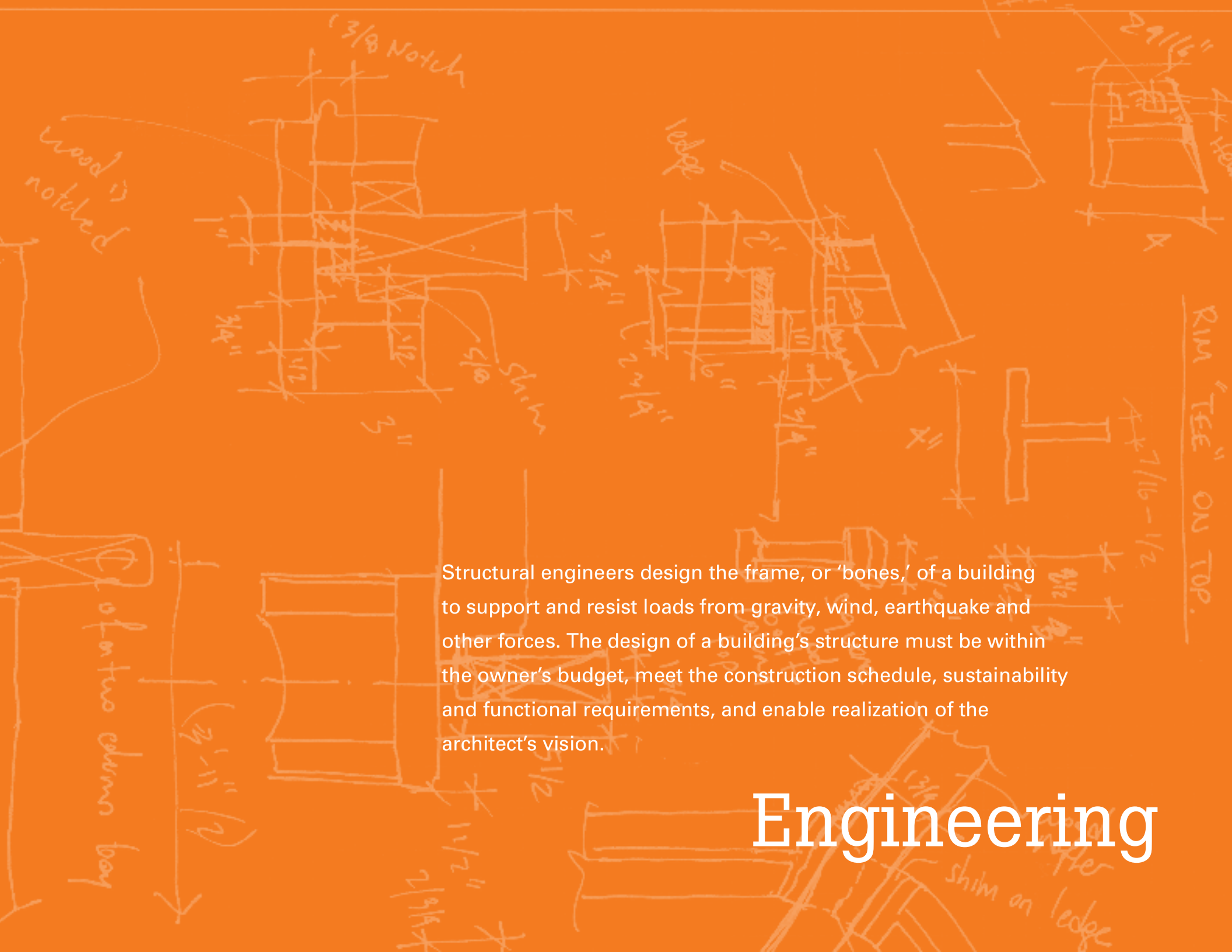
Early signs indicate that 2008 ushers in a different kind of business climate. We are all aware of the global economic uncertainty, particularly in the U.S. where consumer confidence has dropped and there is talk of a recession. Fortunately, our growing diversity of services puts us in a strong position to offer our clients the highest value of professional services, for both new construction and for maintaining and rehabilitating existing structures.

High Rises, Present & Future

Engineered by Thornton Tomasetti

Buildings engineered by Thornton Tomasetti include the current three tallest in the world: the two Petronas Towers and Taipei 101. Projects underway and featured in this report include We've the Zenith in South Korea, the Chicago Spire, which will be the tallest in North America, and Tameer Tower in Abu Dhabi.





Structural engineers design the frame, or 'bones,' of a building to support and resist loads from gravity, wind, earthquake and other forces. The design of a building's structure must be within the owner's budget, meet the construction schedule, sustainability and functional requirements, and enable realization of the architect's vision.

Engineering

The Chicago Spire

Chicago, Illinois

In Chicago, a city of celebrated architecture, construction began in 2007 on a signature building designed by Santiago Calatrava that is both an architectural and engineering phenomenon.

The Chicago Spire boasts numerous superlatives: At 2,000 feet (609 meters), it will be the world tallest all-residential building and the tallest structure in North America; it will have the world's longest elevator run (1,864 feet; 568 meters), and a lake-front vista reaching four states (Illinois, Indiana, Michigan and Wisconsin). With an aspect ratio of 1:10, it will be one of the world's most slender supertall buildings.

"The constraints of the site dictate the small footprint," said Joe Burns, who is leading the structural engineer of record effort for Thornton Tomasetti in collaboration with Calatrava. "Some pretty sophisticated wind tunnel testing ensured the viability of our design." The spiraling, curved design helps disrupt wind vortices, reducing sway and vibration from wind.

A concrete core and perimeter straight steel columns support the spiraling 150 floors. Innovative, circular outrigger truss rings at four levels connect the core to the perimeter columns without penetrating the core. "This design is a truly efficient integration of architecture and engineering," said Founding Principal Richard Tomasetti.

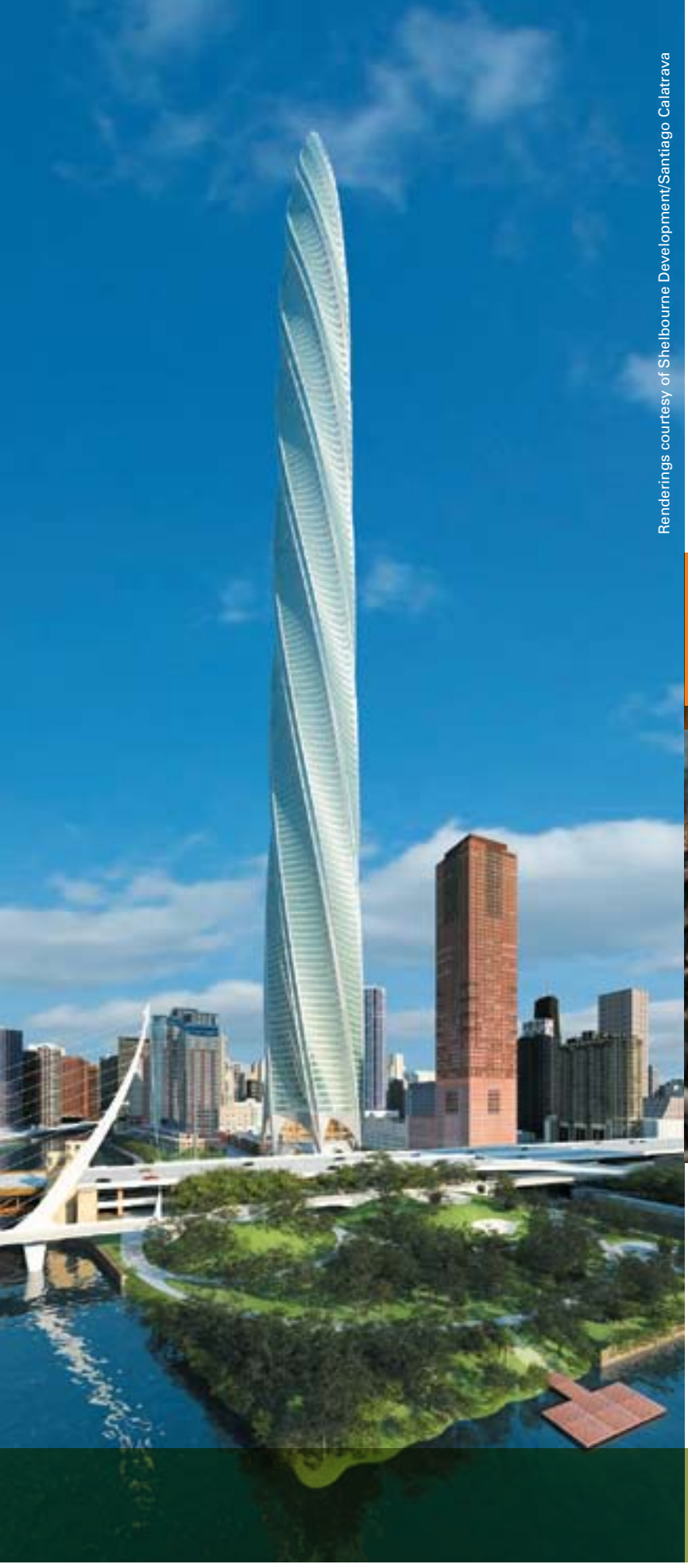
As impressive as the tower is, equally impressive is the part you can't see — the part below ground. To leave room for public open space, parking for the building occupies seven below-grade levels, reaching a depth of 70 feet (21 meters). The building rests on 34 caissons, each ten feet (three meters) in diameter and reaching 110 feet (34 meters) down, and an additional nine feet (three meters) into the underlying limestone.

The Chicago Spire will incorporate world-class sustainable engineering practices to meet Gold Certification for Leadership in Energy and Environmental Design. Sustainable features include recycled rainwater, river water used for cooling, ornithologically-sensitive glass to protect migratory birds, intelligent building and management systems, and waste storage and recycling management.

"Not only in how it looks but in how it works, the Chicago Spire will add to Chicago's reputation for daring, modern buildings," Burns said. "It will become an icon of Chicago."

Developer: Shelbourne Development Group
Architect and Engineer: Santiago Calatrava
Architect of Record: Perkins+Will
Project Height: 2,000 feet (610 meters)
Total Area: 3 million SF (280,000 square meters)
Completion: 2011

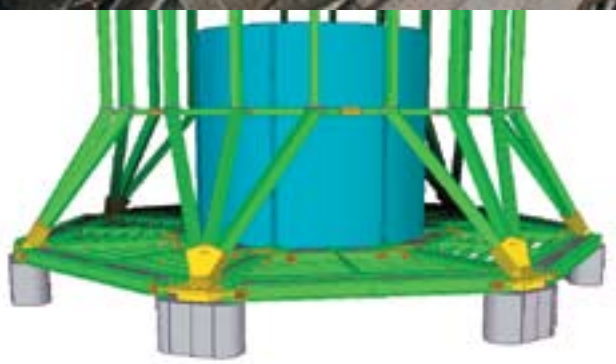
◀ The Chicago spire, the tallest building in North America, will redefine the Chicago skyline. ▶



Renderings courtesy of Shelbourne Development/Santiago Calatrava

▲ *The Chicago Spire echoes many forms found in the natural world and its spiral, fluted shape minimizes dynamic wind effects.*

▼ *Suzanne Provanzana, senior project engineer, observes caisson construction at the site of the Chicago Spire. The caissons go down 110 feet (34 meters) from the surface.*



▲ *This Thornton Tomasetti building information model shows how the 21 columns supporting the150 floors of the Chicago Spire splay outward and come together at seven support points, enabling Calatrava's dramatic lobby architecture.*

Tameer Towers

Abu Dhabi

This five building, 9.5-million square foot (883,000 square meters) complex will be the focal point for the Shams Abu Dhabi master plan and a new icon for the Middle East. Developed by Tameer Holdings Investments, the centerpiece of the complex will be a dramatic 76-story commercial tower with one of the world's largest atriums.

The 1,030-foot (314-meter) tower uses post-tensioned beams to create 1.7 million square feet (158,000 square meters) of floor space without using any internal columns. The tower splits into two legs below level 20, straddling a canal and pedestrian area. A cable-net supported glass wall will enclose the space between the legs to create a spacious and light-filled 175-foot (53-meter) high prismatic atrium.

The external shell of the tower will be constructed with a concrete diagonal grid, which reduces the amount of material compared to a conventional concrete frame. "The biggest engineering challenge is working with the diagrid," said Ben John, the Thornton Tomasetti engineer developing the initial structural design. The diagrid carries both gravity and lateral loads through a multitude of possible load paths. Three-dimensional stiffness models were used to analyze the structure and consider all possible loading arrangements.

"This project has great significance for us," said Les Postawa, director of the London office. "As a showpiece for innovative design, it establishes the new London office on the world stage."

Owner: Tameer Holdings Investments
Architect: Gensler
Total Area: 9.5 million SF (883,000 square meters); commercial tower is 1.7 million SF (158,000 square meters)
Completion: January 2011

Courtesy of Gensler

▲ *The Tameer Tower will rise 1,030 feet (314 meters) and form the centerpiece of a major complex in Abu Dhabi.*

◀ *In the London office, Ben John, engineer, left, discusses the tower's initial structural design with Helen Collie, engineer.*

Prudential Center

Newark, New Jersey

When the Prudential Center, home of the New Jersey Devils hockey team, opened in October 2007, it became the first new sports facility to open in the New York metropolitan area in more than a quarter century, and it is hoped it will be the anchor for redevelopment of downtown Newark. The 18,000-seat arena is also the home of Seton Hall's basketball team, and will host indoor soccer and concerts — like the opening night act by New Jersey's own Jon Bon Jovi.

The project, which started in 2004, involved several engineering challenges. The arena site was sitting on loose fill, so the soil had to be dynamically compacted to acceptable bearing values for a shallow foundation system that was more economical than a pile system. The 420-foot (128-meter) long-span roof was designed efficiently with respect to steel tonnage, as well as functionality keeping sight lines and hung catwalks and a press box free of obstructions. Two prominent glass and steel cylinders, 110 feet (34 meters) tall and 70 feet (21 meters) in diameter, featured on the area's main entry elevation had to be designed without any bracing. They rely on a series of ring frames for stiffness and strength.

"The arena is only two blocks from our office," said Bahadir Ekinci, senior engineer on the project. "From our windows we could easily see it rising, so we became emotionally attached to this project. It is gratifying to be part of a project that will help in the revival of this city."

Owner: New Jersey Devils
Architect: HOK Sport, Morris Adjmi (exterior façade architect)
General Contractor: Gilbane
Total Area: 850,000 SF (79,000 square meters)
Seating Capacity: 18,000

▼ *Prudential Center is the first new arena in the area completed in the last 25 years. Of the five new homes completed, in design or under construction for sports teams in the New York area, Thornton Tomasetti is involved in four.*

Bahadir Ekinci, senior engineer, left, and Armindo Monteiro, senior associate, contributed to the structural design of the Prudential Center. ▲

The Johns Hopkins Hospital

Baltimore, Maryland

Construction is advancing on the Johns Hopkins Hospital's 1.6-million SF (149,000-square meter) New Clinical Building, the country's largest single-facility health care construction project. The $700-million complex includes two towers: one for cardiovascular critical care and another for the Johns Hopkins Children's Center. A shared eight-level base will house adult and pediatric emergency rooms, operating suites, and support facilities.

Medical facilities carry unique engineering challenges. Loads from large medical equipment, the need to control vibrations, and intricate mechanical, electrical and plumbing systems require detailed coordination efforts. "The structure had to adapt to the programmatic needs of the user groups," said Wayne Stocks, principal in charge. "That means there is no such thing as a typical floor; it creates a lot of complexity."

"This is really a story about 'building solutions'," said Zach Kates, manager of the project's design and construction. "We help expedite the whole construction process, not just design the frame." His team takes on a wide range of roles to ensure success of the project. This includes talking with the owner daily, visiting the site once a week, and resolving construction-related design issues. Kates' on-call, rapid field-fix approach helps keep the project on track.

For Kates, the main lesson has been the importance of communication. "You cannot just be the structural consultant," he said. "You need to take an active part and get your hands dirty with the architect, owner and contractor. Engineering is challenging but the real work is making sure information is fully and openly shared throughout the project team."

Client: The Johns Hopkins Hospital
Architect: Perkins+Will
Construction manager: Clark/Banks joint venture
Total Area: 1.6 million SF (149,000 square meters)
Completion: 2011

Jim Kent

◀ *Zach Kates (yellow vest) reviews job progress with, from left, Wayne Stocks, Tim Riesett, superintendant for the Clark/Banks joint venture, and Michael Cropper.*

Courtesy of Perkins+Will

▼ *A Web cam view of the construction site in late December, 2007 and a rendering of the completed structure.* ▲

Block 21:
A New Home for Texas Music — And More

Austin, Texas

Walk along Sixth Street in Austin, Texas and you are almost never out of earshot of a band kicking up Texas sounds made famous by Willie Nelson and Stevie Ray Vaughn. Now, an ancestral home of Texas music, Austin City Limits, is about to get new digs just around the corner from Sixth Street.

The Block 21 development will create a new urban center for the city. This 1-million SF (93,000-square meter) project includes a W Hotel, 200 condominiums, a retail level, and the Austin City Limits venue — seating 2,600 (up from 500 in the present venue).

Channeling all that musical talent is one of the tasks Thornton Tomasetti addressed in its structural design — namely, keeping the music in the theatre and out of the adjoining condos and hotel. Working with an acoustician and theatre consultant, Jeff Elliott, the lead Thornton Tomasetti engineer, helped develop a design for the theatre's roof and floor that includes fiberglass isolators between two concrete slabs. "The air gap created by the fiberglass is what kills the sound and keeps it from leaking into the rest of the structure," he said. An 8,500-SF (790-square meter) grid iron supports 70,000 pounds (32 metric tons) of permanent lights and sound equipment, and allows for a one-ton chain hoist every five feet (1.5 meters) to accommodate traveling acts.

In support of certification for Leadership in Energy and Environmental Design, all structural and reinforcing steel contribute to the recycled content, and fly-ash is used in the concrete. Steel suppliers and fabricators were sourced within 500 miles (805 kilometers) of Austin, and the design includes sufficient support for trees and grass on the plaza and photovoltaic cells on the roof.

Owner: Stratus Block 21 Investments, LP
Architect of Record: BOKA Powell
Design Architect: Andersson·Wise Architects
General Contractor: Austin Commercial, LP
Total Area: 1 million SF (93,000 square meters)
Completion: 2011

▼ *Outrigger walls help stiffen the 465-foot (142-meter) tower at transition floors, where function shifts from office to hotel to condominium.*

Courtesy of Andersson·Wise

▲ *Jeff Elliott, senior project engineer, left, confers with Michael Hackney, engineer. Jeff is the lead engineer on the Block 21 structure, which includes the new home for Austin City Limits.*

Baha Mar Resorts

Bahamas

The Baha Mar Resort is a major world-class development on 600 acres (243 hectares) of beach-front property at Cable Beach, New Providence Island, Bahamas. The resort is grand in scale, and includes four associated but separately branded hotels, a casino, spa, restaurants, retail/entertainment village, timeshare apartments, a convention center, and ballroom. The single largest hospitality investment in the region, the project covers more than three million square feet and includes 2,300 new guest rooms.

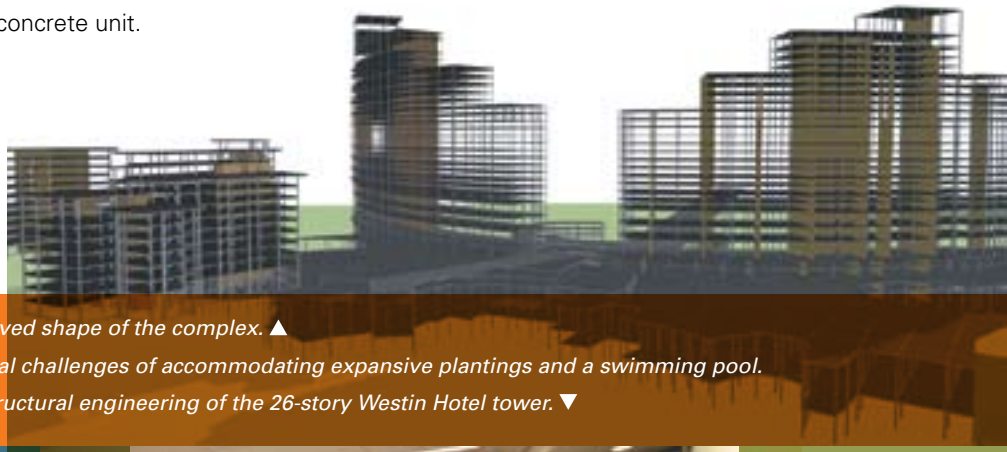
Structural engineering is being handled by a Thornton Tomasetti team of 20, divided between the Newark and New York offices. The design presented several structural challenges. The 1,200-foot (366-meter) podium, for example, calls for extensive landscaping, with trees and a swimming pool. "We designed the podium roof to carry four times the normal load to support three feet of soil, and green roof features," said Ling-en Hsiao, a leader of the New York Team.

Appointments in the four and five-star hotels are first class. The 3,000 bathrooms, for example, will be built and assembled in Germany, each its own concrete unit. "These are very solidly built modular bathrooms," Hsiao said. "Our structural design had to accommodate six times the normal weight of a bathroom."

The convention center features three ballrooms and exhibit halls with varying long spans and is connected to a seven-story, tiered time-share complex. Its design was made complex by the central mechanical plant serving the hotels being attached to the convention center. "An underground utility tunnel running almost 1,200 feet (366 meters), carrying all essential services, had to run under the convention center and time shares, creating challenges with the foundations," said Chris Christoforou, leader of the Newark team.

Ground is scheduled to be broken in April 2008.

Owner: Baha Mar Resorts, Ltd.
Executive Architect: RMJM Hillier and
Design Architect: Michael Hong Architects
Total Area: 3.3 million SF (307,000 square meters)
Completion: 2011

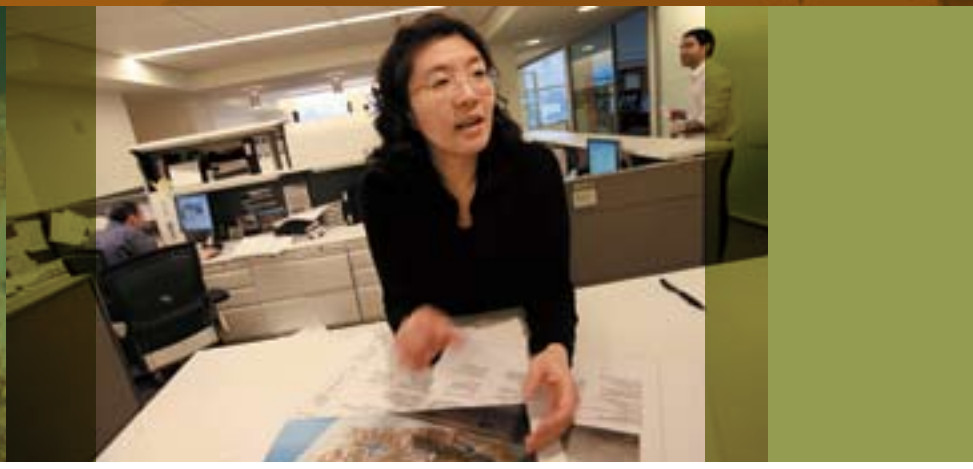


The Revit software rendering reveals the curved shape of the complex. ▲

▼ The multi-tiered podium involved structural challenges of accommodating expansive plantings and a swimming pool.

Joo-Eun Lee, project engineer, worked on structural engineering of the 26-story Westin Hotel tower. ▼

Courtesy of Michael Hong Architects



We've the Zenith

Busan, South Korea

The tallest residential tower in Asia broke ground in December 2007 and is rising on the waterfront in South Korea's second largest city, Busan. At 80 stories, and 984 feet (300 meters), the tallest of three towers in We've the Zenith forms the centerpiece of a 4.1-million SF (378,500-square meter) mixed-use development.

"The biggest engineering challenge is exposure to typhoons," said Sunho Shim, the structural engineer on the project. "Busan has almost the same storm risk as Miami." The team needed to design the structure to withstand sustained winds of 90 mph (40 meters per second) and gusts to 105 mph (47 m/s). The towers present a smooth, rounded face to the wind, which makes them more aerodynamic, and reduces wind forces. Also helping improve stability and comfort for occupants is the very wide stance, with an aspect ratio of nearly 1:7. The efficient design of the core wall, which is butterfly-shaped in cross section, maximizes building stiffness while minimizing the amount of material. Occupancy is scheduled for the end of 2011.

Owner: Doosan Construction & Engineering Co. Ltd.
Architect: DeStefano and Partners, Ltd.
Total Area: 6.2 million SF (572,500 square meters)

Courtesy of DeStefano and Partners

Sunho Shim, senior project engineer, is on the team engineering the tallest residential tower in Asia, on the coast in Busan, South Korea.

Aircraft Maintenance Hangar and Cargo Handling Facility

New Doha International Airport, Qatar

In October 2007, when Airbus delivered its first A380, the world's largest passenger jet, Qatar Airways was well down the runway in its plans to keep the super-jumbos flying. Critical to airline operations are maintenance and cargo handling; that is where Thornton Tomasetti came in, as structural consultant for an aircraft maintenance hangar and a cargo handling facility at the New Doha International Airport.

The cargo handling facility is a state-of-the-art, computer controlled, fully automated warehouse, similar to a jukebox on a massive scale, covering an area equivalent to nearly four football fields. The facility can process 1.4 million tons (1.3 million metric tons) of cargo per year, making it one of the largest cargo facilities in the world. "Designing to accommodate the automated equipment without restricting operations was a major structural challenge," said Cathleen Jacinto, Thornton Tomasetti project engineer. Cargo is stored on a mezzanine level with a load capacity of 750 pounds per square foot (36 kilopascals), supported by steel framing spanning 100 feet (31 meters). Building information modeling was implemented to assist in identifying interferences between various trades.

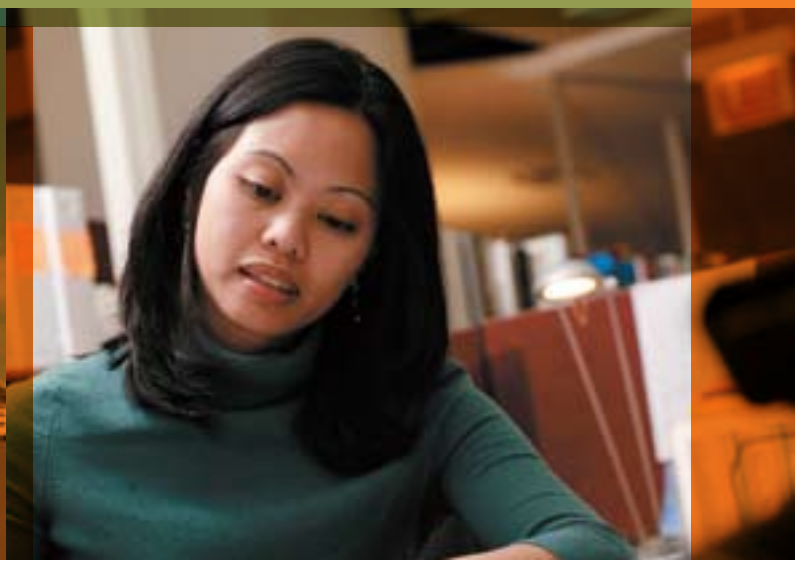
The hangar consists of two bays, workshops and offices totaling 1.7 million SF (158,000 square meters). The two hangar bays, with door spans of 600 feet (183 meters) and 725 feet (221 meters), can accommodate five A380s. "The span is just enormous," said Rob Stadler, associate. A tie-beam is included at the base of the hangar door trusses to create tied-arch action and reduce the thrust forces that would normally be transferred into the foundations. To accelerate construction, the roof structures of the hangar are being assembled on the ground, to be raised with the use of temporary towers. In addition, to cope with the aggressive soils, the foundations of both structures are completely water-proofed and employ the use of anticorrosive concrete.

Architect: GHAFARI Associates, L.L.C., Chicago, Ill.
Contractor: AKTOR, AL DARWISH ENGINEERING, Cybarco, Construzoni Cimolai Armando spa, Joint Venture

▼ *The cargo facility, now under construction, is designed to enable Doha, Qatar to become a major cargo hub. The 850,000-SF (79,000-square meter) facility supports an automated warehouse storage and retrieval system.*

Cathleen Jacinto is project engineer for the cargo facility, helping develop the structural design and coordinating with the architect and other structural consultants in the U.S. and Europe. ▼

Renderings courtesy of GHAFARI Associates



▲ With spans of 600 feet (183 meters) and 725 feet (221 meters), the two maintenance hangars at the New Doha International Airport in Qatar are among the largest in the world, designed to simultaneously accommodate five Airbus A380s, the world's largest passenger aircraft. ▼

855 Avenue of the Americas

New York, New York

As façade consultants for this 35-story high rise, Thornton Tomasetti is helping develop a design and work plan to achieve a Silver rating for Leadership in Energy and Environmental Design (LEED). The mixed-use building utilizes some state-of-the art technologies in pursuit of the rating.

The structural, glazed unitized glass curtain wall is "thermally broken," which minimizes heat loss in winter and heat gain in summer. The proposed panes are argon-filled, improving insulation by about 10 percent. In addition, a three-layer, low-emissivity coating reduces solar heat gain by a factor of almost three over uncoated glass while remaining color neutral and maximizing transmission of visible light. A single-mullion system allows for more cost-effective installation of all curtain wall materials — glass, stone and metal. And a very thin curtain wall design minimizes encroachment on internal space.

A challenge in developing the curtain wall design related to the prosaic but essential job of cleaning the windows. The sloping and projecting surfaces meant that a conventional gondola and davit system could not provide access to all surfaces.

"There was a reluctance to accept the design," said Jeffrey Ng, leader of the Thornton Tomasetti team. "So we brought everyone together and our discussions led to an innovative gondola design." The gondola will open, like scissors, to accommodate the geometry of the building's surface.

The team's work also included a cost-benefit analysis that showed that an initially more expensive façade design would ultimately save money by reducing labor costs for installation, reducing long-term maintenance, and accelerating the capture of heating and cooling costs.

Owner/Client: Thomas Link; Tessler Development LLC
Architect: Costas Kondylis & Partners
Construction manager: Pavarini McGovern
Total Area: 642,000 SF (60,000 square meters)
Completion: 2010

Courtesy of Costas Kondylis & Partners, LLP

▲ 855 Avenue of the Americas in New York is a 642,000-SF (60,000-square meter) mixed-user tower that uses state-of-the-art curtain wall technologies. Ground breaking is scheduled for 2008.

Kai Xiong, senior engineer, evaluated contractor proposals, developed anchorage options, and conducted technical review of curtain wall construction documents for 855 Avenue of the Americas. ▲

Evaluation/renovation includes a wide range of services on existing buildings. It comprises emergency response and forensic investigation and analysis of structural, mechanical, and architectural components with a goal of determining the underlying cause or causes of failure, identification of vulnerability to extreme events, and related risk assessment and mitigation.

Evaluation/Renovation

Post Office Renovation and Cira Centre South

Philadelphia, Pennsylvania

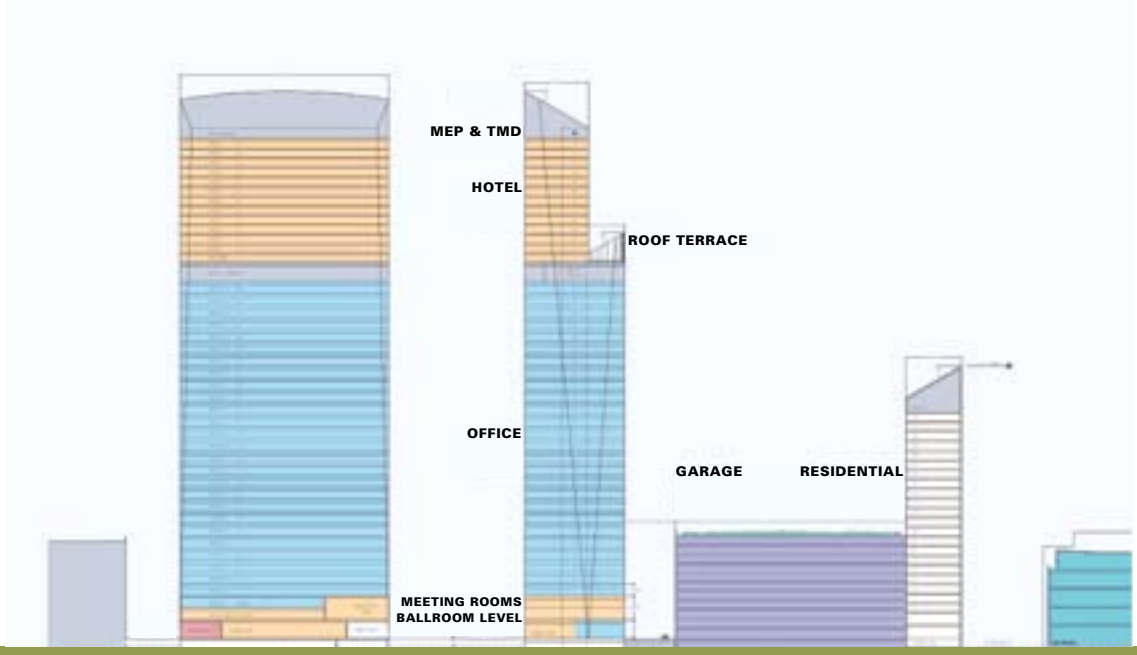
When the Internal Revenue Service looked to consolidate its northeast operations at a single location, it found a new home in a venerable post office along banks of Philadelphia's Schuylkill River. Renovation of the neoclassical post office, and construction of the adjoining Cira Centre South tower, will anchor the riverfront enhancement of the University City section of Philadelphia.

The 900,000-SF (84,000-square meter), five-story post office will house nearly 4,000 IRS workers, and about a third of the footprint of the 40- to 50-story mixed-use tower will be over rail yards. Both projects present unique structural engineering challenges.

The limestone and steel post office, completed in 1935, will be blast hardened and include perimeter protection. Substantial structural reframing will be needed for new elevators, since the pits are suspended above the rail yard. A five-story "light well" will be cut in the ceiling to harness natural light in support of certification for Leadership in Energy and Environmental Design (LEED). In addition, local and recycled materials will be sought, said Sean Levengood, Thornton Tomasetti engineer on the project, including fly ash for the concrete.

The tower also has a substantial footprint over the tracks, with some transfer girders spanning more than 60 feet (18 meters) to eliminate column intrusion into the rail yard. There is the additional challenge of connecting different structural grids in a narrow tower: residential above office above parking. "With residential use at the top," said John Abruzzo, principal in charge of the engineering, "we are also designing for a tuned mass damper to keep accelerations at levels comfortable for occupants."

Owner: Brandywine Realty Trust & Keating Development
Architects: Master planning: Pelli Clarke Pelli Architects
Working drawings & interiors: Cope Linder
Post Office renovation: Bohlin Cywinski Jackson
Total Area: 2.5 million SF (232,000 square meters)
Completion: 2010



Commercial and residential development is part of the renewal of Philadelphia's Schuylkill riverfront. ▲

◀ *Sean Levengood is working on renovation of the 30th Street Post Office into a new regional IRS center for about 4,000 employees.*

The development is just west of Center City near the Schuylkill River and includes plans for a 40- to 50-story office tower and parking garage. ▲▼

Renderings courtesy of Pelli Clarke Pelli

What Caused the I-35W Bridge Collapse?

Minneapolis, Minnesota

Following the tragic August 1 collapse of the I-35 west bridge in Minneapolis, which injured 145 and left 13 dead, Thornton Tomasetti began an investigation into the cause of the collapse. This includes on-site observations, review of more than 50,000 documents, and detailed analysis of the entire bridge.

Our analysis, conducted on behalf of a consortium of 20 Minnesota law firms representing more than 90 victims and their families on a pro bono basis, will be completed by the one-year anniversary of the event, when the National Transportation Safety Board must report its findings.

Studies by the advanced analytics team include assessing the impact of fatigue, temperature and load redistributions on critical bridge members subjected to static and dynamic loads. A key component of the work is construction of a forensic information model, an interactive, computer graphic model of the bridge that enables engineers to catalog and access available information on each bridge component. Simply clicking on a girder or connection brings up all the known information about that member.

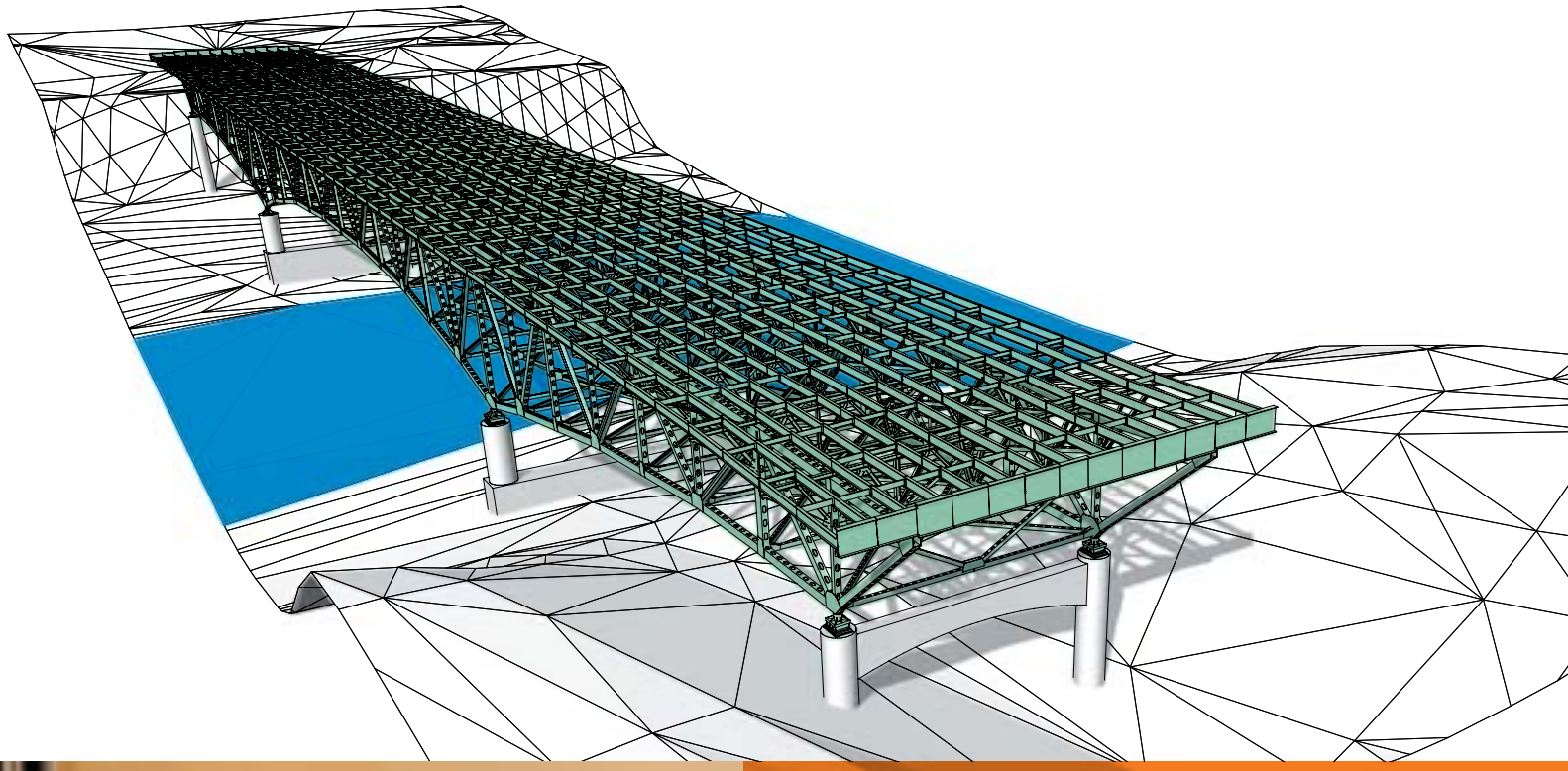
"There is a roomful of data to embed in the model," said Elisabeth Malsch, project director. "We're looking at everything from photographs and video, to design and shop drawings, along with 40 years of maintenance records."

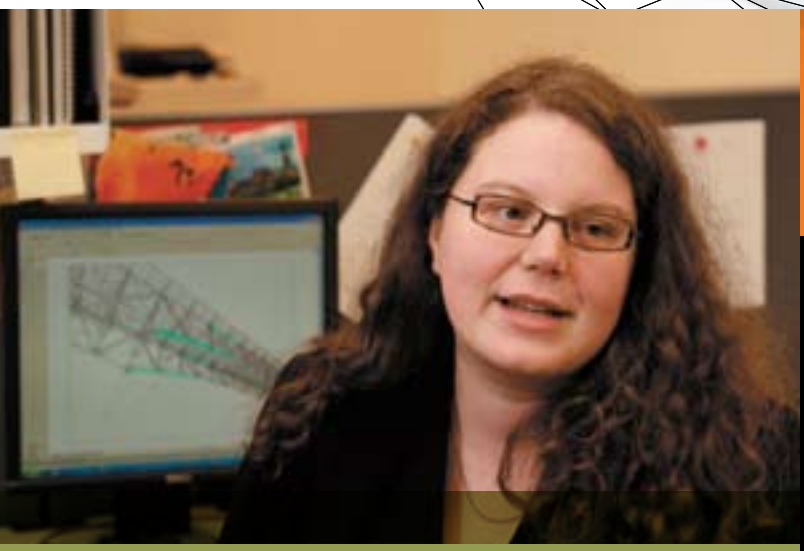
The outcome of the work, said Gary Panariello, principal, "will be a 20- to 30-second computer animation that will sum up what we think triggered the collapse and how the collapsed progressed."

"We feel it will be an important accomplishment to help the innocent people who were affected by this tragedy," said John Abruzzo, principal, "and understanding what happened is a first step in that direction."

Photo montage: *Minneapolis Star Tribune*

▲ *The bridge deck fell more than 60 feet (18 meters) into the Mississippi River. The bridge was opened in 1967.*

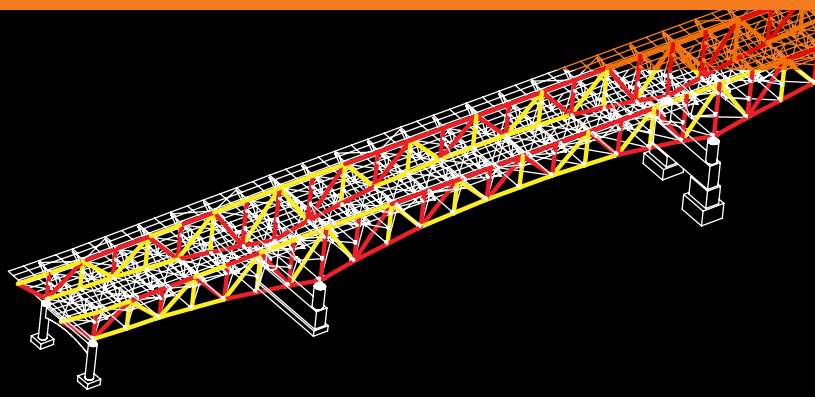




▲ *Elisabeth Malsch, project director, helped collect and analyze data that went into the forensic information model.*

▲ *The Revit rendering of the I-35 bridge is the core of the forensic information model, in which all available information will be embedded.*

▼ *Analysis includes mapping forces at each member. Yellow here denotes members in tension.*



Saving New York's Last Fire Watchtower

New York, New York

To cope with the ever-present threat of fire in the mid-19th century, New York City erected 11 fire watchtowers, using then-revolutionary post-and-lintel cast iron technology. The last remaining tower, completed in 1857 to a modest height of 50 feet (15 meters), was the precursor of the steel cage designs of the 1880s that enabled the evolution of skyscrapers. After years of exposure to the elements and heavy-handed stabilization, Thornton Tomasetti was commissioned to develop a restoration plan to stabilize the tower while maintaining as much of the original material as possible — and make the bell functional.

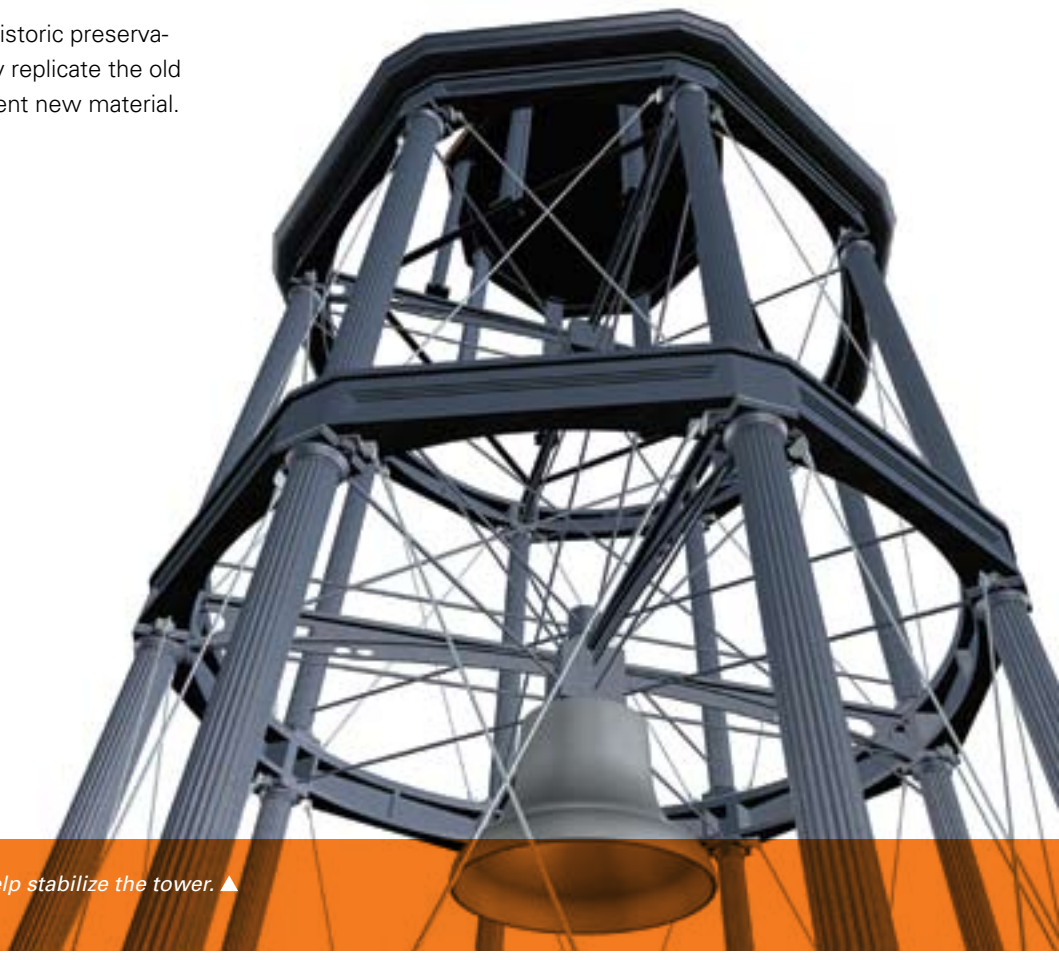
Jessica Foldhazy, a co-op student from Stevens Institute of Technology, helped to fine-tune the design and complete the construction documents. "My job was to help streamline the aesthetics and economy of the design," she said.

There are two schools of thought in historic preservation: to fashion new material to nearly replicate the old and blend in, or to use radically different new material. "We chose the latter path," Foldhazy said. "We think it's truer to the structure — when you look at the tower, it will be clear what is original and what was added for stabilization."

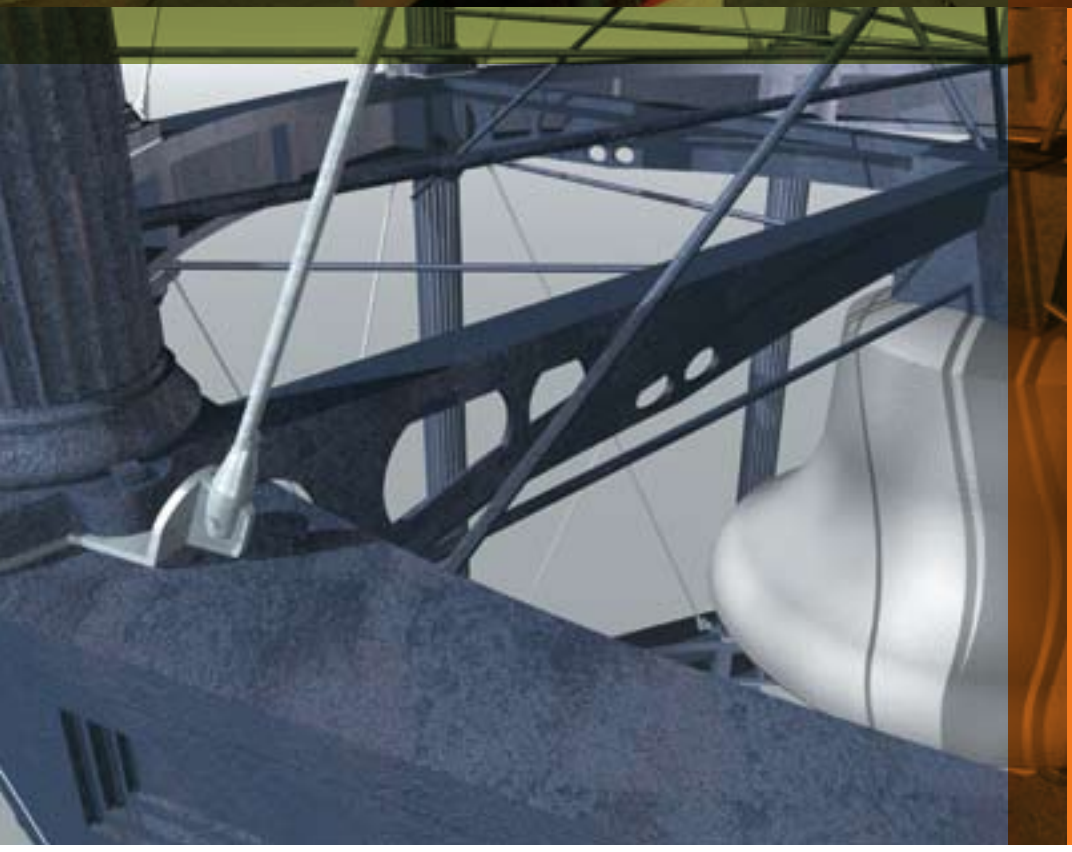
The tower will be deconstructed piece by piece, and original components tested for integrity and replaced in kind or repaired where necessary. It will then be reconstructed with new stainless steel bracing.

"I love this kind of work," Foldhazy said. "To help save a designated landmark is truly exciting."

Client: The Historic House Trust, Inc.
Owner: New York City Department of Parks and Recreation



New stainless steel bracing rods will help stabilize the tower. ▲



▲ *Jessica Foldhazy, an engineering intern and student at Stevens Institute of Technology, helped fine-tune the restoration design and completed the construction documents.*

◀ *Detail of a stainless steel bracing rod, supporting the level that holds the bell.*

Evaluating Hurricane and Earthquake Risk

Caribbean

Hurricanes are so deeply woven into life in the Caribbean, even the word spawned there, coming from the native Taino on Puerto Rico, hurakán, meaning god of the storm. When Marubeni, one of Japan's largest trading conglomerates, purchased a group of electrical generating and distribution facilities in the Caribbean, they therefore asked a key question: Are we adequately insured in the event of a major hurricane or earthquake? The facilities purchased in 2007 are on four islands — Trinidad, Jamaica, Curaçao and Grand Bahama — that are exposed to significant risk of hurricanes, earthquakes, storm surge or all three.

"A pure risk management company often estimates risk with a broad brush," said Sam Cooper, who, with Scott Katzer and Mark Ellis, was on the Thornton Tomasetti team that handled the evaluation. "They use fairly blunt analytical/statistical methods, with little or no engineering input. We inject greater accuracy into the data because we visit facilities and evaluate them in detail from an engineering standpoint. Our own analysis is more like a high-resolution CT scan instead of a chest X-ray."

Over a two-month period, the Thornton Tomasetti team visited 11 power plants, examined part of nearly 12,000 miles (19,000 kilometers) of transmission lines, and assessed substations, hydroelectric facilities, warehouses and offices. They interviewed dozens of employees who knew what past storms had damaged, and what retrofits were installed. For each property, the objective was to determine the degree of risk from earthquakes, hurricane winds and storm surge.

The most challenging part of the work, Cooper said, was fine-tuning the loss modeling software to account for the added data input from the engineering field studies and more accurately account for likely risks.

The result? The probable maximum loss the team computed was found by the client to be within the insured limits for the modeled 250-year and 500-year events (those with, respectively, a 0.4 percent and 0.2 percent chance of happening in any year on average).

"Our satisfaction was in pulling it all together for the client," Cooper said, "and giving peace of mind that they are appropriately covered."

▼ *Sam Cooper was on the team of three Thornton Tomasetti engineers who analyzed hurricane and seismic risk on three Caribbean islands for a utility client assessing its risk exposure.*

Sam Cooper

▲ *Mark Ellis, vice president, left, discusses hurricane hazard mitigation with William Stewart, chief plant engineer for the Hunts Bay, Jamaica power station.*

Thornton Tomasetti

▲ *In 2005 Hurricane Wilma, with peak sustained winds in the Caribbean of more than 175 miles per hour (78 meters per second), was the most intense Atlantic hurricane on record. It caused an estimated $17 billion in damage in the U.S. and close to $300 million in damage in Jamaica and the Bahamas.*

Sam Cooper

▲ *During recent hurricanes, the storm surge at this power station on Grand Bahama Island reached the threshold of the turbines but did not flood them.*

Emergency Response to Curtain Wall Failure

Indianapolis, Indiana

Late in the evening of Sunday, April 2, 2006, a thunderstorm with gusts over 70 miles per hour (31 meters per second) whipped through downtown Indianapolis and ripped approximately 10 percent of the curtain wall off what was once the tallest building in Indiana, the 36-story One Indiana Square. Fortunately, no one was injured by the glass and metal strewn over a three-block area, closing streets and snarling downtown traffic. Thornton Tomasetti engineers, including Scott Nacheman, Bill Bast and Dudley McFarquhar, were on the scene within 72 hours to help stabilize the damage and plan the rehabilitation.

"Windows were blown out, and curtain wall components were sticking out about eight feet (two meters) from the façade," said Bill Bast. "We divided into two teams right away — one to assess the structural condition of the building and the other to assess and stabilize the curtain wall and try to get the streets re-opened. We had to move fast."

For a short-term solution, debris was either removed from the inside or cut loose, and temporary walls were installed. Streets near the building were closed for up to 14 days. For the long-term solution, a fast-track, design/build effort involved 3-D analysis of the building's superstructure and foundations, wind tunnel testing for structural and curtain wall loads, and, in 2007, design and engineering of a new cladding system independent of the old one. In addition, a tuned damper system is currently under evaluation.

Client: One Indiana Square Associates
Architect for Overclad: Gensler
Curtain Wall Consultant: Façade Forensics, Inc.

Scott Nacheman

Michael Boice, senior engineer, helped develop a 3-D analytical model to study the effects of wind on the building's superstructure and foundation. ▲

◀ *Following a severe wind storm, the curtain wall at One Indiana Square underwent a progressive collapse, coming off its attachments like a zipper.*

Starting in spring 2007, new "exoskeleton" structural members and curtain wall, with low-e insulated glass, was installed over the old curtain wall. Plans call for eventually removing the old curtain wall from inside the building. ▶

Abbes Yala

Our 650 people represent a diversity of cultures, backgrounds and skills that enables us to better anticipate client needs, and makes our firm a stimulating and rewarding place to work. We are committed to doing the right thing for our clients, our colleagues and our communities.

People

A Flurry of Publications

No fewer than three peer-reviewed engineering papers were published in 2007 by New York Senior Engineer Ali Ashrafi, who specializes in the dynamic analysis of structures and structural health monitoring. Dynamic in the sense of wind loads and earthquakes, that is.

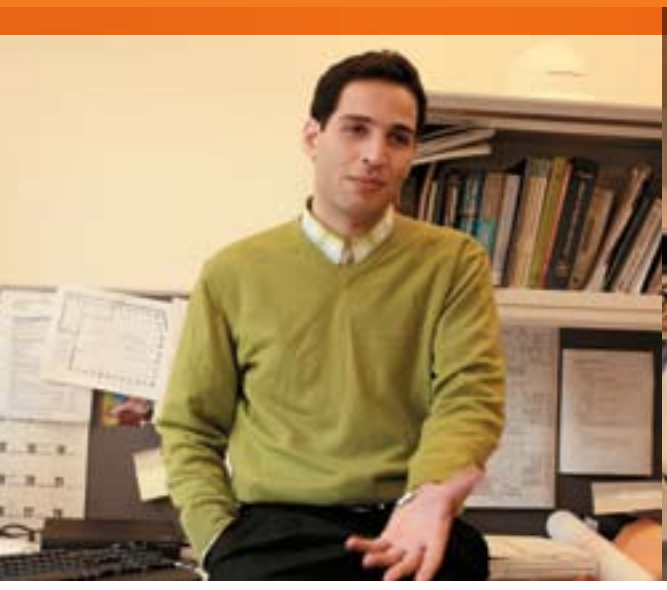
The three papers deal with various aspects of using computer models to represent or identify the behavior of structures under dynamic loads. "Generalized Masing Approach to Modeling Hysteretic Deteriorating Behavior" was published in the *ASCE Journal of Engineering Mechanics*. "The model that I worked on lets you model the damage that you get during an earthquake," Ashrafi said. "You can apply the dynamic loads and see how much of the stiffness and strength of your structure are actually gone. I developed a method of efficiently analyzing this kind of behavior."

Ashrafi's second paper, "A Robust Online Parametric Identification Method for Non-Deteriorating and Deteriorating Distributed Element Models with Viscous Damping," appeared in the *International Journal of Non-Linear Mechanics*. The work concerns existing systems such as structures for which the dynamic characteristics are unknown. "You have something that exists, but you don't know its exact properties," Ashrafi said. "You want to see what model fits that existing structure best."

The third paper, "Online Parametric Identification of the Hysteretic Behavior of the Generalized Masing Model with Viscous Damping," was presented at the 18th ASCE Engineering Mechanics Division Conference in Blacksburg, Va. Similar to the second paper, it deals with real-time analysis to use measurements from sensors to identify structural properties. The ultimate goal is to quickly identify potentially damaged areas after an earthquake or hurricane. The same approach can be used with ambient vibrations caused by sources such as wind or traffic to continuously monitor the health of a structure.

▼ *Ali Ashrafi published three papers this year—in addition to working on more than 10 projects.*

David Kane, left, and Uk Jung are working pro bono with Heidi Segall Levy, AIA, project manager for the Community Design Collaborative, on renovation of a community center in Philadelphia. ▼



Assisting the Community Design Collaborative

Staffers in Philadelphia continue to do pro bono work with the Community Design Collaborative, an offshoot of the local American Institute of Architects chapter that assists nonprofit groups with design services.

A recent project involved Senior Project Engineer David Kane and Architectural Designer Uk Jung, who completed a structural assessment and a preliminary set of architectural drawings for the Liberian Association of Pennsylvania. The LAP purchased a derelict row house from the city and plans to refurbish it for use as a headquarters and community center. The association provides legal and social services to Liberians who have come to the United States as refugees or immigrants.

Kane surveyed the existing house to determine which structural elements are sound and which are unsafe, and developed a report documenting required repairs. This report and the architectural drawings are used to develop a preliminary cost estimate for the building's refurbishment. Jung used building information modeling (BIM) software to create a three-dimensional model of the proposed renovation. The BIM program can be used to print various section and plan diagrams of the project. The drawings and cost estimate are not considered the last word on the building's details, but they give the nonprofit organization a realistic idea of how much money they need to raise and create a clear picture of the project's goals. "We can give them a fundraising target," Kane said. "A lot of organizations use the CDC's report to show what they are working toward and know what they need to get it done."

The Green Engineers

In 2007 Thornton Tomasetti established a Green Building Strategy team to advance a sustainability agenda for the firm's operations and practice areas.

"We are committed to integrating sustainable practices into our engineering and design work, and office operations," said Paulina Calderon, senior project director, who together with Adam Cone, engineer and Wolfgang Werner, associate, are leading the sustainability effort. "When I became LEED accredited in 2004, the sustainable design movement was barely on the radar screen for many design professionals," Calderon said. "It will soon be mandatory to integrate sustainability into all our tasks."

▼ *Co-leaders of the Green Building Strategy Team are developing a firm-wide plan for sustainability practices, in both our work and our operations. From left, Adam Cone, Paulina Calderon and Wolfgang Werner.*

Part of our sustainability work is evaluating mechanical, electrical and plumbing systems. In New York, Margaret Prestwood commissions mechanical systems at Archstone Clinton, two apartment towers seeking LEED certification. ▲

The Green Building team is implementing a plan to that will ultimately integrate environmental considerations into Thornton Tomasetti's design process. To this end, the team is building a network of Thornton Tomasetti technical staff to assess the environmental impacts of engineering and architecture decisions, and develop processes for embedding sustainability options into the firm's designs.

In addition, the group is developing an outreach program to help educate staff and the professional community. For example, Steve Ratchye, associate in the Los Angeles office, and Len Joseph, principal in the Irvine office, will participate in a panel, "Gray Turns Green: Concrete and Sustainability" for the American Concrete Institute. The team is also organizing workshops to increase the number of staff who are Leadership in Energy and Environmental Design (LEED) accredited. By April 2008, the firm had more than 30 LEED-accredited professionals.

"LEED accreditation is a means to an end," said Adam Cone. "The goal is to develop a culture in which environmental concerns are as integral to design as concerns about gravity."

Supporting Breast Cancer Research, Treatment

Under blue October skies 79 Thornton Tomasetti employees, family and friends hit the pavement coast-to-coast, marching in support of breast cancer funding and awareness. The events included the Susan G. Komen Race for the Cure in Dallas and the American Cancer Society's Making Strides Against Breast Cancer walks in Chicago, New York and Washington, D.C.

Controller Debra Miloscia coordinated the events with the four team leaders — Susan Sellers, Stacey Milch, Caridad Gonzalez and Maya Cotton. She also walked with 17 others on a five-mile (eight-kilometer) route through New York's Central Park. "It was a great way to support a worthy cause," Miloscia said.

The four teams raised $29,935 for their respective charities, which represents a 38% increase over the amount raised last year. The total includes a $7,105 company matching contribution.

Hope continues to grow for people whose lives are touched by breast cancer. The latest statistics from the Centers for Disease Control and Prevention show a 2.2 percent decrease in breast cancer deaths per year among women from 1990 to 2004, and the trend is expected to continue.

Events such as these cancer walks are credited with contributing to the decline in deaths through raising awareness and funds for prevention, early detection and treatment of breast cancer.

Shadows Roam Chicago

An informal program has evolved in the Chicago office that gives interested high school students a close-up look at the activities in an engineering company, without consuming everybody's time.

For the past three years Principal Carol Post has been bringing a student or two from Lake Forest High School to work with her on the morning train on a day when other students are taking tests. The idea is to let the students "shadow" professionals to learn something about the world of careers.

"I tell them architects make the building beautiful; we make it stand up," she said. Post explains what she does in her specialty of quality assurance. Then the students shadow for an hour a recently hired employee who's just gotten out of college, so they can see what someone starting out does. Next they move on to spend some time with someone who has five or six years of experience, and finally they shadow a project engineer, so they can see the different phases of a career in structural engineering.

"It makes the time commitment very manageable because all I'm asking is for four people to take an hour out of their day," Post said. She believes Thornton Tomasetti has an amazing message to convey: "We've got people here designing the tallest building in North America. If you want to design exciting projects, this is the place to be."

◀ *Of the four Thornton Tomasetti offices that participated in walks supporting breast cancer research, the Dallas office had the widest age range of participants, from six months to six decades.*

▶ *Carol Post, principal in the Chicago office, with "shadowing" students, Laurel Chavez, left, a senior at Lane Tech High School and Alfredo Gonzalez, a senior at Farragut Career Academy, both in Chicago. Laurel won both a summer internship in the Chicago office and the Eli W. Cohen Scholarship for his participation in the ACE Mentor Program.*

Honor from His Countrymen

New York Principal Narinder Chhabra strode into the Marriot Marquis in Times Square last November to accept an achievement award from the Society of Indo-American Engineers and Architects. "It's an honor for people in the Society who have come to a certain level in their career," Chhabra said. "The Society sees that I became a principal in this top structural engineering firm, and they wanted to recognize it. I am very happy."

The SIAEA was founded by professionals from India who wanted a forum at which to meet. Now the organization has begun to include many American-born engineers and architects as members. "This is a great source of networking," Chhabra said.

He has worked on many important projects including the Bronx Museum of the Arts; Qatar Education City Convention Center; the MIT Lincoln Laboratory expansion in Lincoln, Mass.; the National Flight Academy at the National Museum of Naval Aviation in Pensacola, Fla., and the Computer Associates headquarters in Islandia, New York.

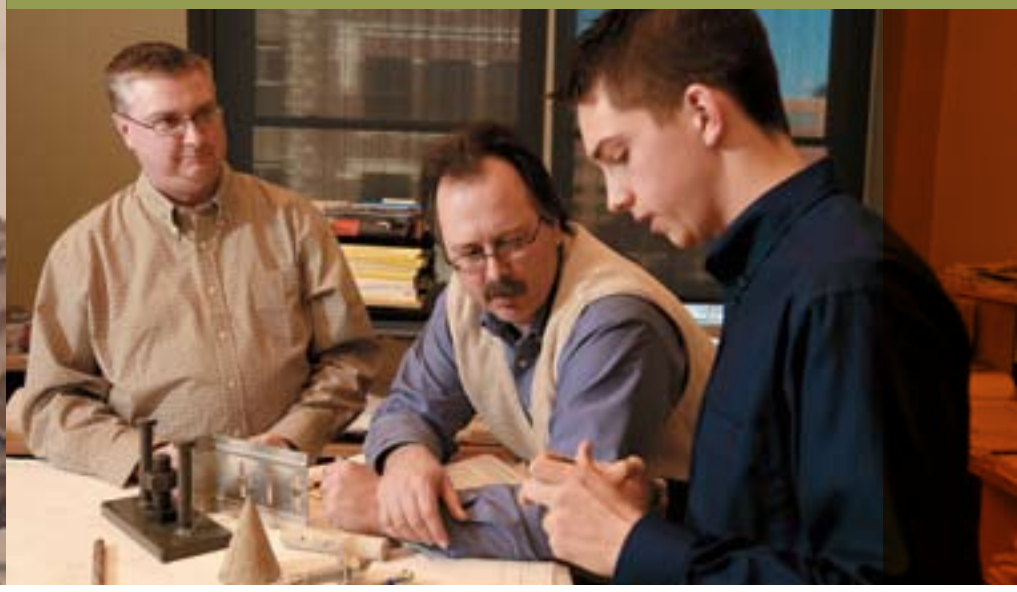
Chhabra is a licensed engineer in New York, New Jersey, Connecticut and Florida. He received a B.S. degree in civil engineering in 1966 from Birla Institute of Technology in Ranchi, India, and an M.S. degree in structural engineering from the Polytechnic Institute of New York in 1974. He offers this advice: "Repeat business is the best marketing."

Former Intern Wins Scholarship

Josh Heath, a freshman attending Kansas State University who interned in the Thornton Tomasetti office, has won financial assistance from the United States Green Building Council (USGBC). Heath is studying architectural engineering, having learned during three summers working in the Kansas City office that it's an interesting job.

Heath was offered his first internship at Thornton Tomasetti when his girlfriend told her neighbor, Steve Hofmeister, who heads the Kansas City office, that her boyfriend wanted to be an architect. And Heath kept coming back, summer after summer. "The projects are really interesting," he said.

◀ *Narinder Chhabra, who became principal in 2006, was honored this year for his contributions to structural engineering.*



The path to the scholarship was through the ACE Mentor Program, which mentors high school students in architecture, construction and engineering, and was started by Thornton Tomasetti co-founder Charles Thornton. Heath joined the ACE Mentor Program during his senior high school year, toured job sites, and learned that USGBC was offering a scholarship. It pays $2,500 over four years toward his tuition costs.

"He's an original thinker who always had something to contribute," said Donna Nalley, office manager in Kansas City. "His maturity is way beyond his years."

Teamwork in Ghana

In the rural community of Obodan, Ghana, Mike Shields led an Engineers Without Borders project to construct a six-stall public latrine. Until that time the 500-resident village — where waterborne illness has been a continuing problem — had no proper sanitation facilities.

A Ph.D. candidate in civil engineering at Columbia University, Shields got interested in Engineers Without Borders and Ghana in 2005, the same year he became an intern in our New York office. Since then, he has made four trips to Ghana and been involved in multiple projects there.

The Engineers Without Borders student chapter at Columbia raised about $20,000 for the latrine project, most of it from private donors including Thornton Tomasetti. Shields went to Ghana a week before the 11 other student members of the team to scout the availability of labor and building materials. It was a lesson in how even the humblest thing, such as well-made concrete blocks, can be hard to find in the developing world. "We went to roadside vendors who had a good reputation locally, but I can tell you they were not high-quality blocks," Shields said. "You rub the blocks, and the sand flakes right off."

Before starting construction the team conducted a rudimentary groundwater flow analysis to make sure that no drinking water wells were in the path of water flow from the latrine. Another necessity was a translator who spoke both Ghana's official language, English, and the region's tribal language Twi (pronounced "tree").

"The biggest piece of the Ghana experience for me has been working with people in such a different culture," Shields said. "It drives home the fact that no matter where you are, you can be very productive if people work together."

◀ *Scholarship award winner Josh Heath, right, with, from left, Mike Valentine and Steve Hofmeister.*

▶ *Columbia University Ph.D. candidate Mike Shields, center, has been interning with the firm since 2005, and made his fourth trip to Ghana in 2007 to help villagers develop basic infrastructure.*

Courtesy of Mike Shields

Student of Disaster

The small town of Greensburg, Kan., was almost entirely gone after one of the most violent tornadoes in history descended upon it during the night last May. "It wasn't a narrow path of damage that's often seen with tornadoes," said Chicago Senior Associate Scott Nacheman. "This thing wiped out a swath about a mile wide."

As one of about two dozen specialty experts on a Federal Emergency Management Agency Urban Search and Rescue incident management team, Nacheman was dispatched to the scene of the disaster along with a group of specially trained firefighters and rescue technicians. Over the next week, he assisted in searching for survivors in dozens of buildings. But job one was checking out the structural integrity of some of the larger, partially surviving buildings, should they be needed as shelters in the event of more destructive weather.

Nacheman was the structures specialist, putting to work his professional knowledge about building shoring and stabilization for damaged structures. "It's triage engineering when you arrive at a disaster site. You're looking at load paths and constructability of shoring options," he said. "What are the immediate risks to the first responders? Where can they gain access to begin the search?"

A firefighter before he studied architectural engineering, Nacheman remains neck deep in the search and rescue community. He is a member of the American Society of Civil Engineers Committee on Critical Infrastructure, where he is developing a national credentialing system for disaster and emergency engineering. And at the University of Illinois, Nacheman continues to teach and develop curriculum for the structural collapse rescue program, one of only two such federally-certified training programs in the country.

Scott Nacheman, left, instructing rescue technicians on the best way to support a fallen concrete structure to safely reach victims, during a training drill at the northeastern Illinois public safety training academy in Glenview, Ill. ▶

Larry Shapiro

Richard Tomasetti, P.E., Hon. AIA

Founding Principal

More than 20 years ago, Charlie Thornton and I wanted our growing firm to avoid a pitfall so common among professional services organizations — the firm *becoming* the founders. To build instead a self-sustaining organization, which persists beyond any individual, we saw that we had to put in place an ownership and management transition plan.

Such planning is easy to talk about and hard to get right. It meant that we had to attract and retain talent, we had to nurture it, and we had to give our best people a chance to show what they could do. Leaders learn to lead by leading. This doesn't happen overnight. It happens over years.

I am proud that the transition of the role of chairman to Tom Scarangello is evidence that our plan is working, and that behind Tom we already have the next generation coming up that we will challenge just as much as we did Tom since he joined in 1979. Our transition plan is no longer just a plan. It's now part of who we are.

I look forward to working with the managing principals and our other excellent design professionals. Together we will continue our success in anticipating the needs of our clients, and staying ahead of convention in our technology and services. In my new role, as the chairman of the Thornton Tomasetti Foundation, I will also have the pleasure of finding new ways for all of us to contribute to the future of architecture, construction and engineering, and the communities we serve. I very much welcome your joining us on this endeavor.

Building the Future of Engineering

The Thornton Tomasetti Foundation

Thornton Tomasetti has established the Thornton Tomasetti Foundation to support the education and community outreach activities of young engineers and architects. Richard Tomasetti, founding principal of Thornton Tomasetti, will serve as chairman.

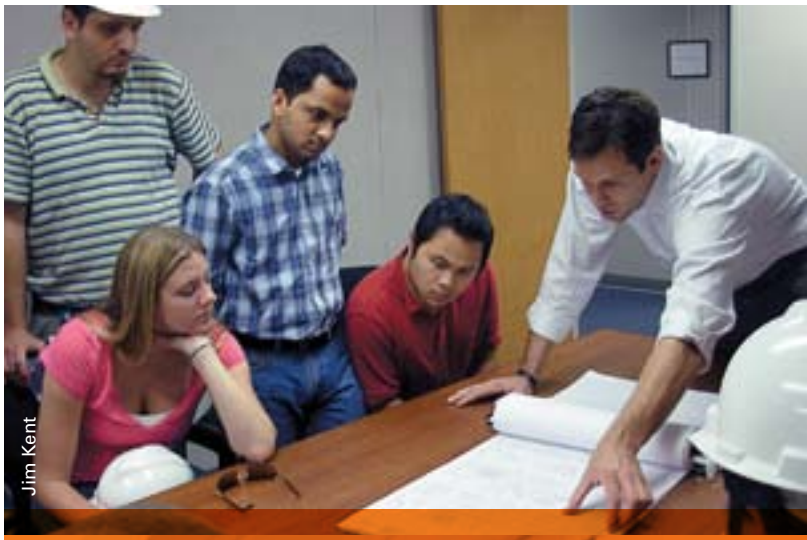
The Foundation, a tax-exempt, non-profit organization, has two primary missions:

- Fund fellowships, scholarships and internships for undergraduate students, and those planning to pursue graduate studies in building engineering, design or technology.
- Provide financial support for individuals and organizations pursuing philanthropic activities related to building engineering, design or technology.

Key elements of the program are college scholarships, traveling internships, and grants to, and partnerships with, nonprofit organizations.

"The Foundation will take our outreach to the next level," said Joel Weinstein, vice chairman of the Foundation. "It will give back not only to the design professional community, but also to the building industry as a whole."

For more information contact:
info@ThorntonTomasettiFoundation.org



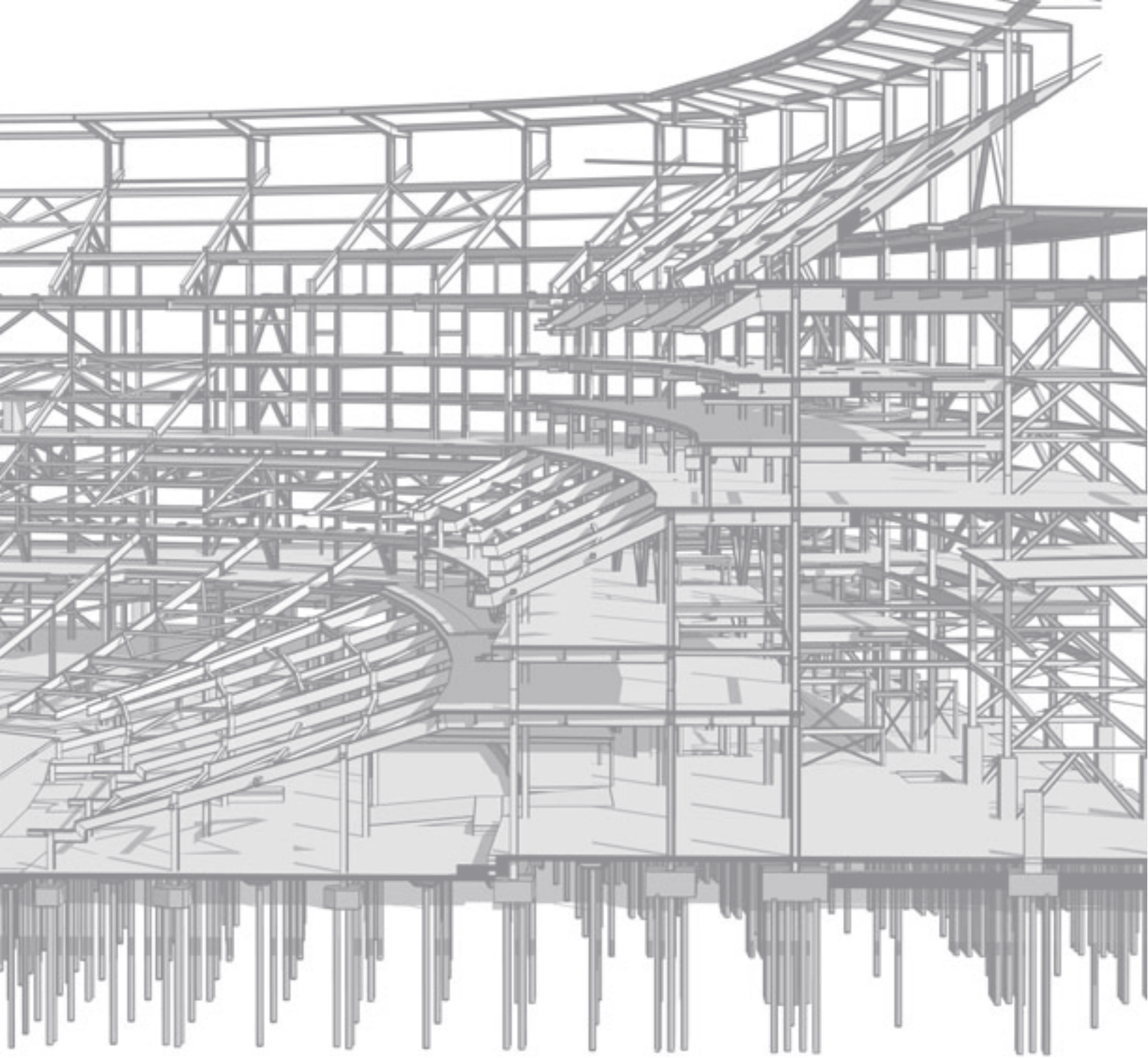
Jim Kent

Courtesy of Mike Shields

The Thornton Tomasetti Foundation aims to support a wide range of scholarship and philanthropic activities related to the built environment.

MOHAWK windpower

Russell Design NYC All photography, unless noted otherwise: Ed Eckstein Writer, People section: Stuart Brown



Thornton Tomasetti

www.ThorntonTomasetti.com