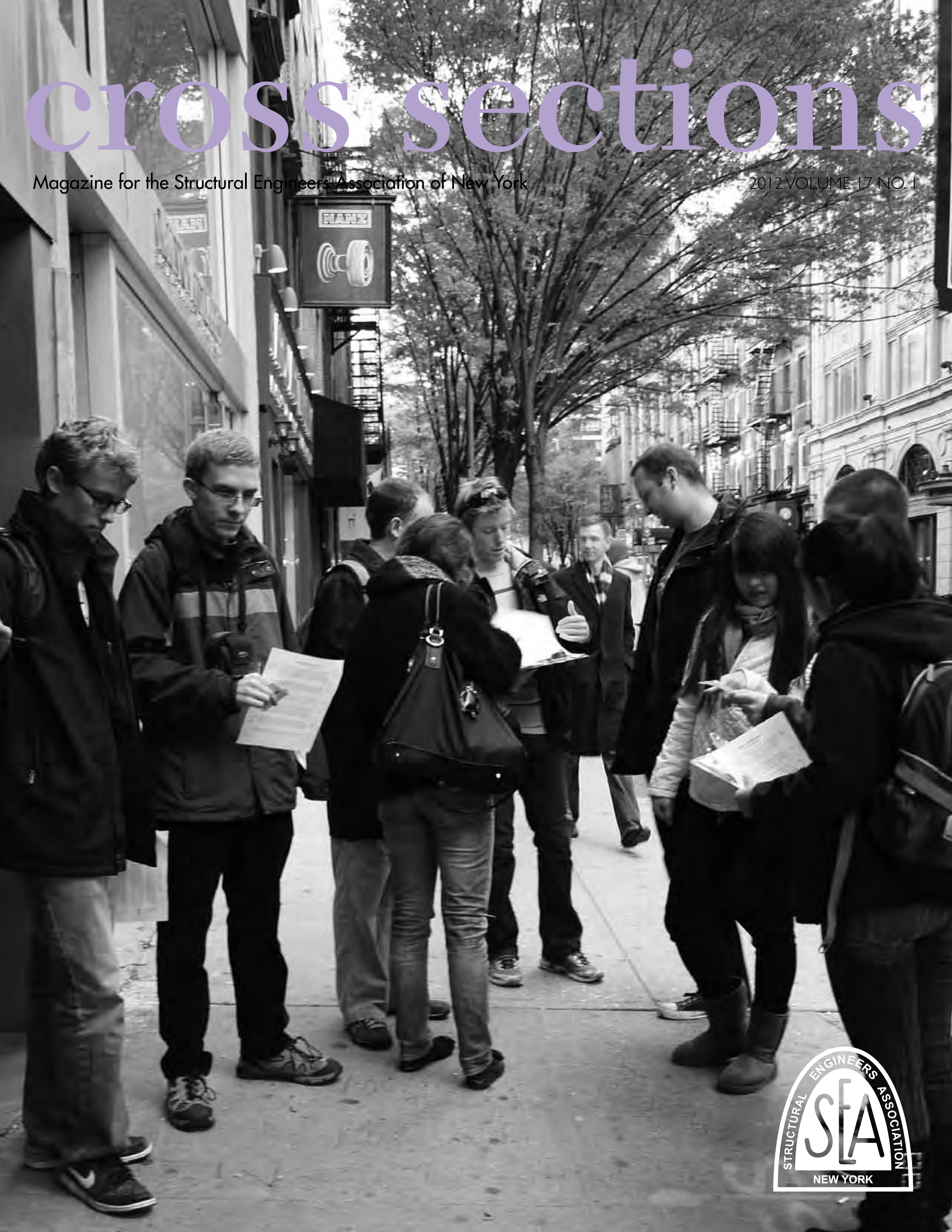
cross sections

Magazine for the Structural Engineers Association of New York

2012 VOLUME 17 NO. 1



STRUCTURAL ENGINEERS ASSOCIATION
SEA
NEW YORK

cross sections

2012 VOLUME 17 NO. 1

SEAoNY
536 LaGuardia Place
New York, NY 10012

www.seaony.org

CONTENTS

ON THE COVER

Team one from SEAoNY's Second Annual Structure Quest plans their next move.

Photo: Victoria Ponce de Leon

President's Message

The purpose of SEAoNY is "to advance the art of structural engineering in New York by improving the flow of ideas and building the community of colleagues". We have been quite successful at this, with a current membership of over 400. A significant goal is to increase the membership, and to this end we must work to promote and make the organization more relevant to prospective members. Relevancy comes with the activities performed and the ability to contribute and make a difference. SEAoNY is a very fortunate organization in the level of energy brought to bear by the members who are active in our committees. I thank all the volunteers who work hard to keep the committees successful.

The education/university outreach committee has been quite active, with a scavenger hunt and a resume workshop. Additionally, they have set up a facebook page, you can find it by searching on "SEAoNY University Outreach".

So far this year, the programs committee has put on a wonderful set of seminars, including an informative full-day seminar on renovation and rehabilitation of existing structures. Soon to come are the Honorary Member lecture by Commissioner Robert LiMandri, and a visit to the Old Croton Aqueduct. Please join us for these and the annual Boat Cruise which will occur in June and include the presentation of SEAoNY Excellence in Structural Engineering Awards. Reserve your table now!

Also in June will be the Annual SEAoNY Golf Outing, run by its own committee, which we all are aware does a tremendous job of raising funds for scholarships. New this year will be beach and boating options for those non-golfers who would like to participate. Please join us for a worthy cause.

The codes and standards committee has been meeting regularly, and has been primarily focused on existing buildings issues. The goal is to collect relevant information and resources, to prepare guidelines, white papers, etc, on relevant existing buildings topics, and ultimately to suggest bulletins and possibly code for existing buildings in NYC. In addition, we are providing assistance with structurally relevant topics to the DOB as requested.

Lastly, the publications committee has been working hard on this newsletter. The general topic, fittingly, is regarding existing buildings, and includes many interesting and well written articles. Enjoy!

On behalf of the board of directors, I thank you for the opportunity to contribute and for allowing us to represent you.

Karl Rubenacker

Editor's Message

Some would say that New York City is the greatest city in the world. Think of almost anything, and chances are you can find it here. Those who disagree should note that now we even have earthquakes! While seismic demands do not typically control the design of new construction here, we are an old city. At the recent Renovation and Rehabilitation Seminar, Tim Lynch of the DOB presented an overview of our building stock. Out of roughly 1 million buildings in the city of New York, only 12,500 rise above 7 stories in height. 600,000 buildings are of unreinforced masonry construction, and 40% of the population are housed within. These are sobering statistics when we consider the recent performance of URM buildings in Haiti, Chile and New Zealand.

In this Issue, we explore the implications of a seismic event in our city. We also recall how our leadership took to the public stage to calm nerves about the earthquake and dispel urban myths about hurricane safety. We report on the Second Annual Structure Quest as well as the Annual Meeting. You will also find insight into the construction methodologies of birds, insight into the construction methodologies of our recent NYC ancestors, and learn about the adaptive reuse of a local landmark.

We hope you enjoy this Issue. If you have any comments or suggestions, or if you would like to write for us, or simply come to one of our monthly meetings, please feel free to contact me at publications@seaony.org.

Allan Olson

call for writers *(and nonwriters!)*

Interested in writing about our profession?
Do you have great ideas, but no time to write?

Contact us at **publications@seaony.org**
Check out previous issues at **seaony.org/publications**

Commissioner LiMandri Honored at Annual Meeting

SEAoNY Leadership Transitions and Scholarship Winners Announced

By Yunlu Shen

ABOVE
SEAoNY members listen intently as Commissioner LiMandri speaks.

FOR THE FIRST TIME SINCE THE ASSOCIATION'S INCEPTION, THE AWARD WAS GIVEN TO SOMEONE WORKING OUTSIDE THE FIELD OF STRUCTURAL ENGINEERING.

On September 20, SEAoNY presented the annual Honorary Member Award to the New York City Department of Buildings Commissioner Robert LiMandri. For the first time since the association's inception, the award was given to someone working outside the field of structural engineering. Although not a practicing engineer himself, Commissioner LiMandri has made a substantial impact on our industry since his appointment in October 2008.

Commissioner LiMandri received his Master's degree in Real Estate from New York University (1998) and his Bachelor of Science degree in Mechanical Engineering from Clarkson University in Potsdam, New York (1987). After joining the Department of Buildings in 2002, he was appointed to First Deputy Commissioner in 2005, and subsequently to Acting Commissioner in April 2008. He has 20 years of experience in the real estate and construction industry, as well as e-procurement, making him well-positioned to lead the department into the new digital age.

With a portfolio of 1 million buildings and over 1200 inspectors, engineers and plan examiners, the DOB oversees all construction, alterations, demolitions and maintenance of buildings. Having taken leadership amidst concerns over the safety and accountability of our city's construction industry, Commissioner LiMandri made these issues his top priority and has taken large strides forward through initiatives such as the High Risk Construction Oversight study in collaboration with other building departments around the world.

At the annual meeting, Commissioner LiMandri addressed our members by thanking SEAONY for all the support we have provided to the city over the years. Along with discussions of various operations of the Department, much emphasis was placed on public safety and the important role structural engineers play in building design and any site supervision they may perform. He also gave a preview of NYC Development Hub, the Department's new operational unit. Architects and engineers can now submit digital construction plans of new buildings and developments to the Department of Buildings at the Hub and resolve any issues with City officials in a virtual environment. This initiative will accelerate the approval process for construction projects throughout the City and is a major step in continuing the Building Department's and Mayor's initiative to modernize the administration.

The commissioner then presented awards to this year's scholarship recipients: Gillian Carzzarella and Ryan Conry from Manhattan College, and Danielle Rubin from Columbia University. An additional scholarship had been presented to Jeffrey Villalon of the Urban Assembly School at the Golf Outing in July and a donation was given to the Urban Assembly School computer lab to buy new equipment.

The transition of SEAoNY leadership also took place at the annual meeting. Kevin Poulin, the out-going president, gave highlights of the past fiscal year, including SEAoNY's growing involvement with other engineering organizations and the media in New York. The new president, Karl Rubenacker, stated goals for the organization for the coming year in his closing remarks. The association will strive to reach out to more structural engineers in the city and state and to bring better and more relevant programs and publications to its members.

Yunlu Shen is a structural engineer at SOM in New York City.

SEAoNY Hosts Second Structure Quest

By Victoria Ponce de Leon

The SEAoNY Education and University Outreach Committee, in conjunction with ASCE Met Section and The Cooper Union for the Advancement of Science and Art, organized and sponsored the second "Structure Quest" event on November 12, 2011.

A combination of students from NYC area universities and engineering professionals comprised the 68 participants who competed in the Structure Quest event. The students hailed from The Cooper Union, Columbia University, Cornell University, Manhattan College, Princeton University and Stevens Institute of Technology. Employees from Leslie E Robertson and Associates (LERA), Buro Happold (BH), Robert Silman Associates (RSA), DeSimone Consulting Engineers(DCE), Murray Engineering and Wiss, Janney, Elstner Associates (WJE) were combined with the students and organized into 8 teams to compete for the title of Structure Quest Champion.

Each team was given a series of clues about structurally and historically significant buildings and bridges in Manhattan. The groups had 4 hours to visit the structures, take required photos, and also find examples of various engineering feats hiding in plain sight such as "plate girders", "steel braced frames" and "laced columns". They were also asked to identify construction equipment and techniques such as "concrete formwork" and "lot line shoring".

When the groups completed their hunt, they gathered back at the Cooper Union's Rose Auditorium, where pizza and refreshments were served. Points were tallied and the top 3 teams were awarded their Structure Quest I-Beam trophies, generously donated by Cives Steel Company.

First Place: Robert Silman Associates, Stevens Institute of Technology, Cornell University

Second Place: Leslie E. Robertson Associates, Columbia University, Stevens Institute of Technology

Third Place: Wiss, Janney, Elstner Associates, Manhattan College

The Committee plans on organizing another Structure Quest in the fall. We are also planning a Resume Workshop as our next event. If you are interested in getting involved in the SEAoNY Education and University Outreach Committee, please email us at seaonyeducation@gmail.com.

Victoria Ponce de Leon is a structural engineer at Robert Silman Associates in New York City

Teams in action around the city.

TOP
Team 7, 1st Place: (from left to right) Connor Souchek (Stevens), Brian Liebeskind (Stevens), Jacky Wang (Cornell), Yuriy Kaunzinger (Stevens), Graham Seward (RSA), Olivia Dunleavy (Stevens), Nick Chack (Cornell), Kyle Twitchell (RSA), Shinjinee Pathak(RSA), Tim Bowden (RSA).

CENTER
Team 9 investigates the construction site below.

BOTTOM
Team 7 gives their best impression of the Guastavino arch.

SEAoNY IN THE news

COMPILED BY EYTAN SOLOMON

In August 2011, as New York and the east coast recovered from a Virginia-centered 5.8 earthquake and prepared for Hurricane Irene within the same week, news stations and newspapers turned to SEAoNY for advice about structural safety and what the public should do. Several SEAoNY directors were consulted on television and in print. Links to video clips can be found at www.seaony.org.

SEAoNY on Anderson Cooper 360

SEAoNY Past President Chris Cerino was interviewed by Anderson Cooper regarding the implications of Hurricane Irene on New York City's buildings.

"With the modern codes, skyscrapers in the city are designed with safety factors that allow them to withstand wind speeds much greater than what we'll see…. Airborn debris is my major concern as a structural engineer: Debris from construction sites, awnings around the city, patio furniture, there's all sorts of things… that can become missiles for windows…. I think everybody needs to help out their neighbors, because basically if you have balcony furniture, anything that you have on a patio, that could become a projectile into your neighbor's building. Everybody needs to help out each other."

SEAoNY on PIXII Morning News

Current SEAoNY President Karl Rubenacker was interviewed on the PIX11 Morning News to discuss the structural integrity of New York City's buildings in the wake of an earthquake that shook the East Coast.

"Newer buildings obviously are [designed for earthquakes], older buildings might suffer some damage depending on the kind of building, how well it's been built, what kind of soil conditions you're on: if you're sitting on soft muddy soil near the river, or if you're sitting on bedrock in the middle of Manhattan."

SEAoNY in the New York Times

SEAoNY President-Elect Scott Hughes had a featured answer on New York Times' City Blog regarding the safety of high rise buildings during Hurricane Irene.

Newer high rise buildings are subject to modern building codes that are more stringent and require windows and glass walls to withstand higher wind speeds, as well as any pressure caused by water build up due to flooding. "A lot of the high rises are less of a risk than people think," said Scott Hughes, an associate at Robert Silman Associates, a New York based structural engineering firm. But the bigger threat, he said, can be so-called wind borne projectiles – items picked up by the wind and flying at high speeds; short of installing hurricane shutters or plywood, not getting hit by these objects is often a matter of luck. Modern high rise buildings are also, after a certain height, required to have back up generators should the electricity fail, to enable elevators to continue operating. Many older buildings, such as prewars, have also installed such generators, Mr. Hughes said, as a selling point for tenants.

earthquakes in new york

Seismic considerations for our local building stock

BY HOOMAN TAVALLALI

RECENT EVENTS DEMONSTRATE THAT A LACK OF PRIOR SEISMIC ACTIVITY DOES NOT GUARANTEE THE CONTINUED ABSENCE OF SEISMIC ACTIVITY.

LAST SUMMER'S EARTHQUAKE IN VIRGINIA, coupled with recent devastating earthquakes in New Zealand, Chile, and Haiti, has elevated the discussion about the possible consequences of an earthquake in New York City. While some owners have been more cognizant of seismic risk on the east coast, others have taken the view that the Virginia earthquake was about as bad as it will get. According to Nat Oppenheimer of Robert Silman Associates (RSA), owners have an overall feeling that New York is not susceptible to seismic events.

Recent events, however, demonstrate that a lack of prior seismic activity does not guarantee the absence of significant earthquakes in future. A good example is the M 6.3 February 22, 2011 Christchurch, New Zealand earthquake, which occurred on an unmapped fault. Prior to September 2010, Christchurch was not considered a high-risk seismic area and had a voluntary retrofit regulation in place for its unreinforced masonry buildings[1] (URM).

Building codes consider the safety of the public in extreme seismic events. Usually seismic design criteria are set to provide a level of "life safety" in moderate to significant earthquakes, where there is limited damage to structural elements, prevention of falling hazards and maintenance of egress for people in the building. Some essential facilities like hospitals and emergency response buildings are designed to be fully operational after an earthquake event. While modern codes provide a margin of safety against collapse for new construction, what should be emphasized more is the assessment of older buildings that were not designed for earthquakes, says Robert Otani, Vice President of Thornton Tomasetti. New York City was one of the first cities in the country to have a building code in the mid 1800's, but the city first adopted seismic provisions in 1995.

Most buildings in New York City completed before the widespread use of steel framing were constructed with load bearing URM walls that supported their own weight as well as portions of the building's floor and roof load. Masonry bearing walls were not engineered but designed empirically based on tables published in local building codes. These codes specified wall thickness as a function of the building height to keep the maximum compressive stress in the masonry below allowable values. Building height was limited by the low tensile capacity of the brick masonry and the impracticality of large wall thicknesses required at the base of the structure. By the early twentieth century, the skeletal-steel frame emerged as the dominant structural form for building construction, replacing previous methods such as bearing wall systems. High rise structures were detailed to have solid masonry exterior walls built integrally within the steel frame, representing a hybrid system that combined characteristics of load bearing masonry and modern curtain walls. The masonry walls, encasing spandrel beams in each floor, were intended to carry no building loads aside from their own self weight and localized wind loading, says Rebecca Buntrock of RSA.

Buntrock, who conducted her masters research on early 20th century masonry high rise structures, explains that numerous researchers have attempted to identify the best way to model these buildings. Different methods for analysis include simple cantilever beam approximation (neglecting the steel), limit state analysis, using an equivalent strut macro model, or the use of finite element modeling. ASCE/SEI-41 *"Seismic Rehabilitation of Existing Buildings (ASCE-41)"* states that masonry infill panels shall be considered primary elements of the structure's lateral force resisting system and as such are integral to the seismic assessment. To calculate in-plane stiffness and strength, the standard recommends creating a nonlinear finite element model of the composite system. However, it does not provide any guidance on how to model the masonry in finite element software, which is a task well known to be extremely complicated and sensitive.

Besides numerical modeling, the performance of structures built with similar technologies in recent devastating earthquakes provides valuable information about the expected seismic performance of similar buildings in NYC. In Haiti, URM was the preferred construction method between the late 19th century and the 1920s. The failures observed in the M7.0 January 12, 2010 earthquake ranged from diagonal cracking in walls to total collapse[2]. In the Christchurch earthquake, hundreds of URM buildings collapsed or were severely damaged. Santiago, Chile also had a large number of URM houses and churches. In these buildings, seismic resistance was usually provided by walls built around the perimeter of the building. In the M8.8 February 27, 2010 earthquake, the lack of reinforcement and weak connections between walls led to wall and roof collapse in many buildings[3].

There are different methods to improve the performance of vulnerable URM buildings. However, the minimum level of retrofit, typically a codified value, can still be insufficient to prevent extensive damage. For example, in New Zealand, local governments had established retrofit policies for vulnerable buildings (including URMs) in seismic zones since 1968. In Christchurch, the majority of the URM retrofits since 1968 were designed for one third of the forces required by code for new construction. Different retrofit techniques were used, including adding concrete and steel moment frames, concrete and reinforced masonry walls and steel braces. In the 2011 earthquake, most retrofit URMs experienced ground motions even higher than maximum considerable earthquake (MCE) motions, and more than 2/3 of the retrofit URM buildings were red-tagged to prevent public entry after the earthquake[1].

Buntrock explains that a full analysis of the existing structure's capacity is necessary in order to prevent "over-intervention." She adds that the New York City Building Code is lenient on seismic requirements for existing buildings when compared to IBC standards. For vertical additions, if the additional base shear or overturning moment is less than 20% of the original, only the addition has to comply with code requirements for new construction. IBC sets this trigger percentage as low as 5%.

RIGHT
The Long Beach earthquake of 1933 spurred significant changes in the construction and detailing of masonry in California. Here, automobiles are partially buried by URM debris.

From a historic preservation perspective, this can be considered advantageous, since retrofits can be intrusive to interior spaces. However, to have only the new part of the structure designed to resist lateral loads per modern codes while neglecting the contribution of the supporting building is a concept subject to engineering judgment. These requirements may also change as the NYC Building Code considers adaptation of the IBC provisions for existing buildings.

Oppenheimer notes that the New York City buildings in most need of seismic retrofitting (namely URM townhouses) are the ones least likely to be retrofit, because of the economics of the work and the fact that retrofitting an unreinforced masonry building with full-time occupants is an almost impossible task. He adds that aside from retrofitting, simple maintenance can go a long way towards increased safety. There is a natural lifespan for any building in the absence of comprehensive maintenance, and we are rapidly approaching that lifespan for many New York City buildings without recognition by the owners or occupants.

The risk of a major earthquake in New York City might not be very significant, but the potential effects are significant not only to the local community, but also to the nation. As stewards of public safety, structural engineers have a responsibility to design for the worst and hope for the best. The key, as always, lies in the definition of "the worst."

REFERENCES

1. EERI Special Earthquake Report : "Learning From Earthquakes; The M 6.3 Christchurch, New Zealand, Earthquake of February 22, 2011", EERI Newsletter, May 2011 Volume 45, #5
2. EERI Special Earthquake Report : "Learning From Earthquakes; The Mw 7.0 Haiti Earthquake of January 12, 2010: Report #2", EERI Newsletter, May 2010 Volume 44, #5
3. EERI Special Earthquake Report : "Learning From Earthquakes; The Mw 8.8 Chile Earthquake of February 27, 2010", EERI Newsletter, June 2010 Volume 44, #6

Hooman Tavallali is a structural engineer at LERA in New York City.

nest engineers

THE TRUE GREEN BUILDERS

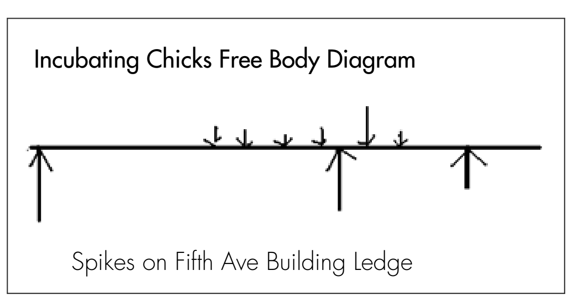
BY ALICE OVIATT-LAWRENCE

LEFT
Pale Male and Lola, photographed in Central Park, Friday June 24, 2011.

Photo: Courtesy of palemale.com

BIRD ENGINEERS, such as local hawks Pale Male & Lola, comprehend that foremost in proficient nest design practice is the acquisition of a stable nest site.

Frequent site visits for the purposes of surveying, testing and evaluating the suitability of the localized environment are obligatory for all avian construction professionals. The findings are assimilated to determine the orientation and placement of the nest structure for weather protection, to plan for ease of ingress and egress appropriate for a four-foot wingspan, to repel predators and to camouflage nest occupants.



Alice Oviatt-Lawrence

Materials and Methods

The Pale Male family, after a Co-op Board snafu which resulted in the removal of its first nest, returns annually to its 12th story Fifth Avenue building ledge, to be seen working with inbuilt tools of talons and beaks to lift sticks into place for an eight foot-wide *platform-beam nest* (the new platform base was designed by local human engineers from Robert Silman Associates). The hawks stack and push multi-branched twigs together to form an interwoven lattice construction. Ends are tucked in. Next, they place smaller twigs in the nest center, then add layers of bark, and finish with soft new green Central Park vegetation for the incubation of the chicks. After hatching, dung droppings, in amounts corresponding to the chicks' growth, dry in place as cement, adding substantially to the initial nest weight and strength.

The structural design sustains the occupants' proposed use via innate avian discernment of the dead and live-load requirements. No matter what the nest design and structural type, knowledge of basic physical forces is a must. If the nest base is disturbed, it must preserve its center of gravity and remain in equilibrium.

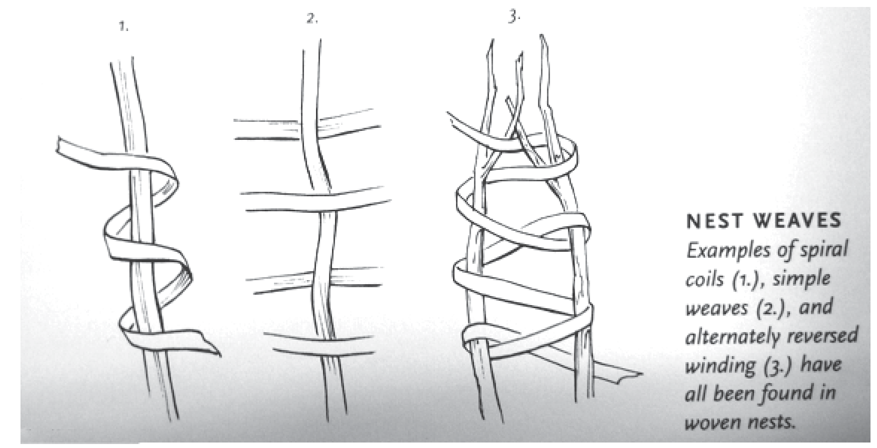
Other Nest Types, Materials & Methods

The golden eagle builds a similar-form, high-platform nest, which is reused and enlarged each year and may become ten feet in diameter. Many nests are lined with wood rush, down, wool, and leaves.

Aquatic nests float and are built up from an anchored raft-foundation that is tied to vegetation under the surface of the water. Floating leaves and other materials such as dead water-plants and grass are piled onto the raft to construct a nest rising to about nine inches above the water level. The mis-named, maligned "bird brain" appreciates Archimedes' principle of buoyancy.

Cup nests are constructed from twigs, leaves, or stems, then cemented by mud, caterpillar cocoon silk, pine resin, or spider silk. Last, the core structure is lined with soft materials. Nests may be assembled in compression, as in nests placed in the "V" of limbs in a shrub or tree, or be suspended. Hummingbirds, weighing one tenth of an ounce, build substantial 2" diameter nests of both types for their pea-sized eggs and chicks.

Proof exists that some birds weave fresh, ductile grass strips via both simple and reverse windings techniques. Folded grass is sometimes skillfully pulled through an existing substrate and tied.



Goodfellow, p. 101

THE STRUCTURAL DESIGN [OF A BIRD NEST] SUSTAINS THE OCCUPANTS' PROPOSED USE VIA INNATE AVIAN DISCERNMENT OF THE DEAD AND LIVE-LOAD REQUIREMENTS.

Spider silk, capable of being stretched to 40% of its original length, is positioned across twigs to form a framework for a nest, while additional silk is wrapped onto the nest's exterior, creating a sticky surface onto which lichen is affixed. The birds intuit Hooke's Law and moduli of elasticity.

The Robin may make 180 trips a day for up to a week to build the nest. Mud is layered onto a rough base of twigs and long dry grasses. Beak and feet 'tools' press materials into a 6" diameter by 3" deep concavity. Mud is installed by beak-loads for a foundation, for walls, for insulation, and for adhesion of materials: Bonding strength is further enhanced by added bird saliva. The bird's head is used as a vibrating machine to compact each mud load so as to avoid air-entrainment and to control moisture content.

Without any building code, the bird knows to build sustainably, defined in ASTM E2114 as: "the maintenance of ecosystem components and functions for future generations."

REFERENCES

1. ASTM E 2114, *Terminology for Sustainability Relative to the Performance of Buildings.* Copyright 2004, ASTM International.
2. Goodfellow, Peter. *Avian Architecture: How Birds Design, Engineer & Build.* Mike Hansell, ed. NJ: Princeton University Press. 2011.

Alice Oviatt-Lawrence is principal of Preservation Enterprises, an architectural-engineering organization specializing in international historic-structures research & analysis.

LONG OCCUPIED BY COMMERCIAL USES, the value of the lot at the corner of Wall and Nassau Streets rose more than tenfold by 1896 when the owners decided to replace a 6-story structure, the Union Building, with a 300-foot tall tower. The slender Gillender Building - then fourth tallest in the city - rose 22 stories on a site of only 26 x 73 feet.

Twelve years later the building and lot were sold to the Manhattan Trust Company for the highest price ever recorded in Manhattan: over $800 a square foot, according to the New York Times. The same year, the Bankers Trust Company, which absorbed the Manhattan Trust, negotiated a lease on the adjoining L-shaped lot, home to the 7-story Stevens Building. The company decided to replace the Gillender - then the tallest building ever razed - and the Stevens with a much larger structure on a combined lot of 93 x 96 feet. At 41-stories, the new building was the tallest banking building in the world when it opened in 1912.

Images are courtesy of Carol Willis and The Skyscraper Museum, and captions are courtesy of Derek Trelstad, a structural engineer at Robert Silman Associates. The full series of over 200 historic photographs and unabridged captions by Mr. Trelstad can be found at www.skyscraper.org.

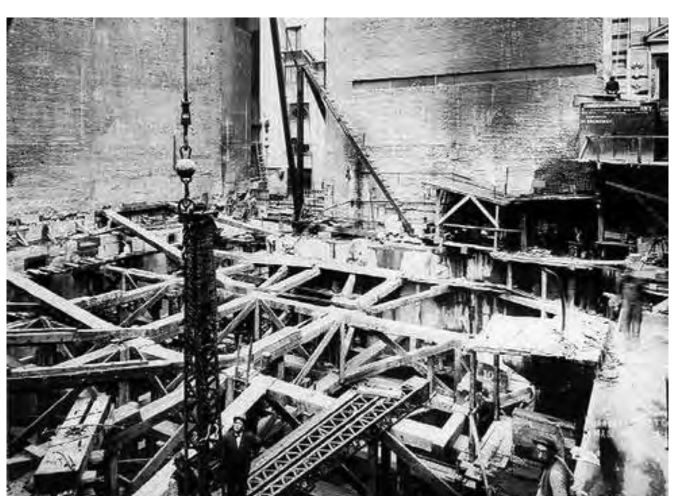
the bankers trust

DEMOLITION AND CONSTRUCTION, A CENTURY AGO

CAPTIONED BY DEREK TRELSTAD
COMPILED BY EYTAN SOLOMON

1910 OCTOBER 31

The gentleman in the jacket and bow tie at the bottom of the photograph, probably a site superintendent for steel erectors Post & McCord, looks on as the mast of a stiff legged derrick is placed.



1910 NOVEMBER 30

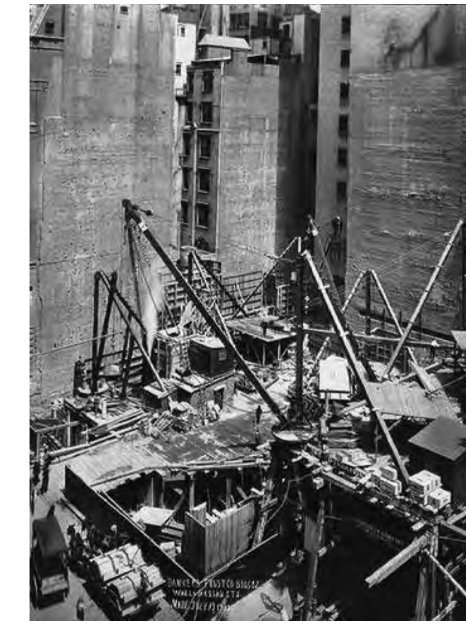
The first tier of steel columns nears completion.

1910 APRIL 28

Demolition staging platforms have been erected on the upper floors of the Gillender Building to permit the demolition contractor's laborers to begin the process of removing the stone cladding and the steel frame. At street level a protective staging fabricated of heavy timber is under construction.

1910 MAY 19

The demolition contractor has focused on removing masonry cladding from the Gillender Building. The stiff legged derrick at the 11th floor within the middle bow window on the Nassau Street elevation of the Gillender Building was installed earlier in the week. There are now several derricks visible on the structure. Masonry debris continues to be removed through the interior chutes, though the longer steel or iron members are more efficiently removed whole by picking them from the frame with the stiff legged derricks.



1910 JULY 19

The Foundation Company - contractors for the foundation of the new Bankers Trust Building - have replaced the protective staging with a more robust structure and many stiff-legged derricks. A two-horse team on Wall Street hauls a load of steel sheet piling, probably destined for the site at the corner of Wall and Nassau Streets.

1911 MARCH 13

The direct comparison of the speed of masonry and steel construction needs also to account for the work underway at the interior of the structure - placement of floor systems, construction of demising partitions and roughing-in plumbing and other utilities. In a masonry bearing wall building, the floors of the upper stories cannot be placed until the masonry reaches the level of the upper stories - and a sufficient time must be provided to allow the mortar in the masonry to set.

1911 JUNE 6

The stepped masonry pyramidal roof is - like the rest of the building - a steel frame clad with stone.

1911 SEPTEMBER 5

The building is near completion.

Derek Trelstad and Eytan Solomon are structural engineers at Robert Silman Associates in New York City.

ADAPTIVE REUSE OF THE domino sugar refinery

A NEW PURPOSE FOR A ONCE-PRODUCTIVE BUILDING

BY REBECCA BUNTROCK

THE NEON DOMINO SUGAR SIGN looks out over the East River as a long-standing symbol of the legacy of industrial production on the Williamsburg waterfront. The iconic sign is the centerpiece of the now derelict Domino Sugar plant (originally the American Sugar Refining Company), which once stood as the largest sugar refinery in the world. Completed in 1882, the vast complex is characterized by masonry warehouses, conveyor chutes, and a distinctive smokestack that rises up from the main refinery building. The plant dominated sugar production worldwide until after World War II, which marked the onset of the decline of the sugar industry. It permanently closed its doors in 2003, citing insufficient demand for cane sugar in the age of high-fructose corn syrup.

The site was purchased by developers shortly after production shut down, and a multi-faceted redevelopment plan was hatched. Designed by Rafael Viñoly Architects and Beyer Blinder & Belle Architects and Planners, the proposed "New Domino" would include high-rise residential towers, a waterfront esplanade, and the renovation of the existing refinery building. Thirty percent of the new residential units would be earmarked for subsidized affordable housing. Local preservationists, fearing the imminent development would destroy the site's architectural significance, appealed to the

ABOVE, RIGHT AND BELOW
Views of the Domino Sugar Refinery.
Photos: Adam Kirk

SURPRISINGLY, ANALYSIS REVEALED THE EXISTING CAST IRON COLUMNS APPEAR TO HAVE BEEN SIGNIFICANTLY UNDER-DESIGNED FOR THE IN-SITU MACHINERY LOADS.

City's Landmarks Preservation Commission for landmark status of the original refinery building, which was granted in 2007. The designation, however, does not extend to the remainder of the buildings on the complex, nor does it protect the signature Domino Sugar sign.

The Refinery Building and plans for its adaptive reuse were discussed during a panel hosted by the Skyscraper Museum in June of 2011. Robert Silman, president of Robert Silman Associates (RSA), chronicled his firm's experience with performing the structural engineering evaluation and assessment of the existing building. The refinery is actually three separate structures with shared brick party walls: the Filter House, the Pan House and the Finishing House. This conglomeration is between ten to twelve stories tall and supported on the perimeter by heavy masonry bearing walls. The interior framing is comprised of brick arch floors, wrought iron filler beams and girders, and cast iron columns.

The first step in RSA's assessment was to obtain any available information on the building construction. Extensive searching through Domino Sugar's storage archive in Yonkers yielded only one piece of useful information, a redrawn column schedule showing typical column sizes. A team of engineers was sent to the site to document the existing framing. While it was still in operation, the refinery was primarily inhabited by machines, so access proved to be a challenge. Sticky piles of charcoal-infused molten sugar cover significant portions of the floor. In many areas, floor systems are discontinuous or non-existent with bare structural frames to support hanging equipment. Some of these machine pieces are so large that they extend through several floors.
When documentation was complete, a structural analysis of the existing framing was performed to evaluate feasibility for the adaptive reuse of the structure to a housing occupancy. Logic would suggest that if the existing structure could support the heavy machinery loads, then it should easily be able to support the significantly lower residential live loads. Surprisingly, the analysis revealed that the existing cast iron columns do not have sufficient capacity to support the proposed residential loading and appear to have been significantly under-designed for the in-situ machinery loads.

The explanation for this phenomenon can be traced back to the history of materials. When the plant was constructed in 1882, there were no uniform standards for cast iron sections. Individual manufacturers each had their own allowable stress formulas. The brittle nature of the material was not fully understood at the time, and it was later determined that these old formulas were actually un-conservative. Today it is universally accepted to use the formula from the New York City Building Code of 1916 for cast iron analysis, which yields values that can be trusted without having to worry about brittle failure. It is clear that less conservative values were used in the design of the Domino Sugar Factory.

Given the overstress of the existing columns, as well as the discontinuous floor layout, the final recommendation was that the existing interior framing be demolished and a new steel structure be erected, maintaining only the original exterior masonry façade. While the existing unbraced walls are temporarily shored, the large pieces of industrial equipment will be craned out of the refinery building. Although some of this historic equipment will be reclaimed by Domino Sugar, the quantity of equipment is so vast that a large amount will likely end up unclaimed or possibly landfilled. One precious item, however, will be spared from the landfill. Despite the fact that it did not receive landmark designation, the iconic Domino Sugar sign was planned to be restored and mounted onto the renovated refinery building.

The future of the Domino Sugar Factory, however, is far from certain. In March of 2012, the developer announced they are exploring the sale of the site, tabling the proposed development and renovation plans.

Rebecca Buntrock is a structural engineer at Robert Silman Associates in New York City.

SEAoNY
536 LaGuardia Place
New York, NY 10012