cross sections

Magazine for the Structural Engineers Association of New York

2014 VOLUME 19 NO. 2

THE 2014 EXCELLENCE IN STRUCTURAL ENGINEERING WINNERS

THE AWARDS ISSUE

STRUCTURAL ENGINEERS ASSOCIATION SEA NEW YORK

cross sections

2014 VOLUME 19 NO. 2

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President's Message

On a recent spring afternoon, I walked through midtown Manhattan enjoying the beautiful weather and admiring all of the impressive buildings that we structural engineers have designed. Reminded of my own start in New York and anticipating this awards issue of Cross Sections, it became an obvious opportunity to share a personal story that gets at the heart of what an organization like SEAoNY is about.

When I first moved to New York in 1990, fresh out of college, I had quite a different perspective than I do today. I was all dreams, desire, and confidence. Maybe I never articulated my ambitions clearly, but truthfully I wanted to literally be everything to the structural engineering profession. My goal was to design every building, draw every detail, obtain every commission, formulate every innovation, and attain every recognition. I wanted to be the favorite engineer of every architect, developer, and institution. In short, I was idealistic and naïve. When confronted with my own inability to realize these impossible dreams, my first emotion was jealousy extended not only to other organizations, but even to my coworkers and superiors.

Then I grew up and realized that there was no way one structural engineer could sate the hunger of our society for the built environment. Many hands are needed to design and oversee the construction of any given project much less an entire city or the world at large. Alas, a league of collaborators would be needed, just to complete the smallest fraction of all the work that needs to be done. There would be many commissions, many experts, and many creators. The solution is to enlist other competent people to advance projects to their full potential.

As you might guess, my realizations did not end there. I was not allowed by the architects and owners to perform great feats of design without regard to their needs and budgets. I require clients that ask great things of me; so I can perform inspiring designs that influence the architectural industry, and inspire the next generation of structural engineers.

Do you wonder why this has anything to do with SEAoNY or the awards issue? It is because we can't do it alone, and SEAoNY exists because we acknowledge that. Yes, we all compete for commissions and recognition, but we all advance as one body on one another's successes as much as, if not more than, we do as individuals, companies, or organizations. SEAoNY recognizes and fosters the rich diversity of talent and dedication that shapes our profession and is in everyone's best interest. In that spirit, I present our awards issue, congratulate the winners, and thank all the participants.

Brian A. Falconer PE, SE

Editor's Message

Dear Readers,

This is our favorite magazine of the year, the awards issue.

For the second straight year, we've included the results of SEAoNY's annual Excellence in Structural Engineering Awards ceremony in our late spring release. It is a pleasure to compile an issue that contains recently completed projects of note by the preeminent design firms in our city. I encourage our readers to go to www.seaony.org and to revisit winners of past competitions to see if you can discover any emerging trends amongst the winners and finalists. Each year it seems to me that the structure becomes a little more evident, that it informs the architecture in slightly more prominent way. This is indicative of the increasingly vital role that we, as engineers, serve in the realm of architecture.

Many thanks to Shinjinee Pathak for all of her efforts throughout the design competition and for compiling all of the awards information for the Publications committee to present in this issue. Also, kudos to Alice Tao for her tremendous efforts to generate another beautiful layout and for always striving to improve the appearance and quality of our magazine.

Accompanying the awards results, we have included two interesting historical pieces, a juxtaposition which speaks eloquently to the enduring aspect of our work as engineers. It is amusing to dwell on the thought that years from now, some of the winners presented in this issue may also be featured in a future issue of Cross Sections as a feature historical piece. In one of these articles, join Eytan Solomon on a tour of the historic, abandoned City Hall Subway Station. The other article also takes us below the street, exploring the city's ancient wooden water distribution system. And so we see that our work above and below the streets, hidden or exposed, new or old can be equally celebrated and admired.

Justin Den Herder, PE

PRACTICALLY ALL NEW YORKERS know the Brooklyn Bridge-City Hall subway station on the 4/5/6 train line. Many have even heard the legends of a "ghost" City Hall station somewhere to the south, where 6 trains make their turnaround loop from downtown to uptown. Few have seen the ghost in person, but real it is: A hidden bastion of dramatic Guastavino tile arches, glass skylights, chandeliers, and intricate masonry.

The old station is in fact 600 feet south of the modern station, with a 400-foot-long platform along the loop curve. The arches of the tunnel at the platform connect via a short stairway to the foyer mezzanine, which in turn connected to the old entry and exit stairs to street level. The mezzanine's tile arch vaults and central oculus skylight hint at an old world cathedral.

The station's opening in 1904 had marked the birth of subways in New York City. It was the southern terminus of the Interborough Rapid Transit (IRT) line, a predecessor to the modern Metropolitan Transit Authority (MTA). The station was created by some of the premier designers of the age, Heins and Lafarge, also architects of the Cathedral of St. John the Divine.

Of course for this publication, credit is also due to its engineer, William Barclay Parsons, founder of Parsons Brinckerhoff. The "jewel in the crown" of the subway system, the station was beloved in its time as part of the City Beautiful architectural movement of the late 19th and early 20th century.

However, the times eventually changed. As the subway system grew, riders tended to prefer the nearby Brooklyn Bridge station which accessed both the express and local lines. When the lines further expanded in the 1940's to use a longer 10-car train standard, the Brooklyn Bridge platform was lengthened to accommodate, but it was impractical to do so for the curved City Hall station. During World War II, the station's skylights were tarred over as a measure to hide the city during possible air raids. Finally, the station was closed on December 31, 1945.

While not used by the general public since then, the old City Hall station is a designated city and national landmark, and the New York Transit Museum holds limited tours, with strict safety precautions, from time to time. Considering nearly 70 years of disuse, the Guastavino, masonry, and metalwork on the whole look to be in remarkably good condition.

While we of course have other pressing needs in our city as well, could we perhaps consider a modest investment to renovate the old station into a small museum accessible to the public?

Visitors would be treated not only to the magnificent architectural and structural features, but also - with safety measures that can surely be designed into the renovation - a glimpse into the hidden workings of the subway as the 6 train glides by on its turn back uptown. Such an exhibit would have everything: Location, history, education, utility, and beauty.

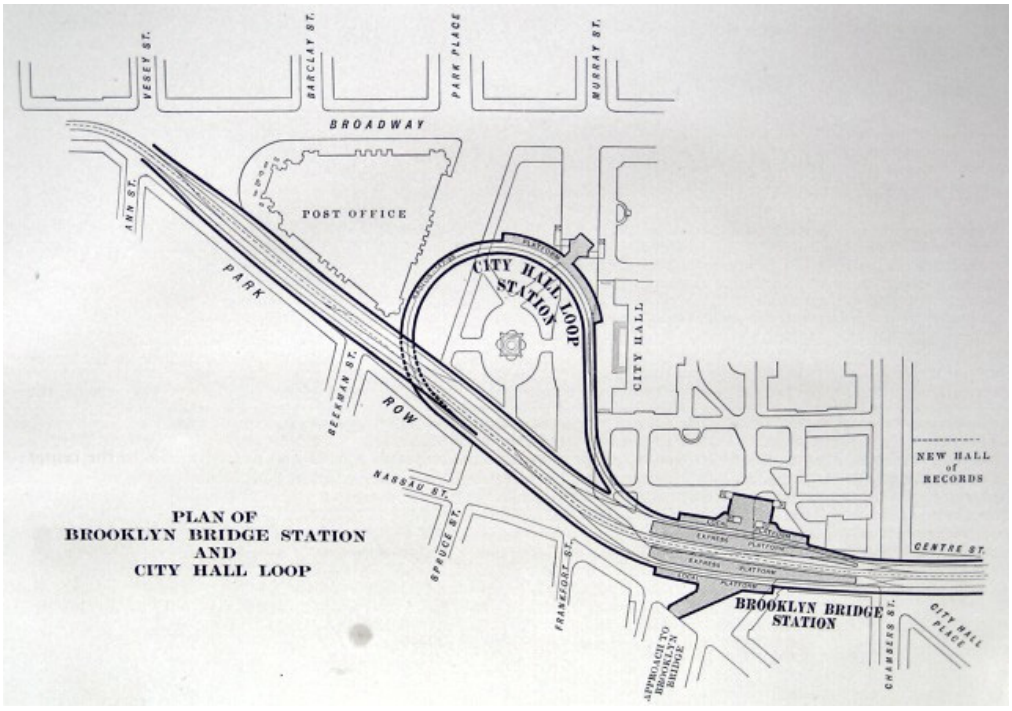


FIGURE 1

FIGURE 2

Workmen boarding up the City Hall station of the East Side IRT
The New York Times

IN WITH THE OLD

BY EYTAN SOLOMON, PE

FIGURE 3

PHOTO CREDIT: EYTAN SOLOMON, PE

FIGURE 2 NEW YORK TIMES ARTICLE ANNOUNCING THE STATION CLOSING.

FIGURE 1 PLAN LAYOUT OF THE ORIGINAL STATION.

FIGURE 3 A PHOTO OF THE OCULUS IN ITS PRESENT DAY CONDITION.

EYTAN SOLOMON, PE
IS A STRUCTURAL ENGINEER AT
ROBERT SILMAN ASSOCIATES

WOOD PIPES

WHAT LIES BENEATH

BY: ALICE OVIATT-LAWRENCE

ARCHAEOLOGIST ON SITE

Joe glided his crawler across the muddy site. Nice day, he thought to himself as he turned down the heat in the cabin. Hey! Got something here! Braking hastily, he signaled the Boss who responded, "OK, it looks old, let me get the Project Archaeologist on the line."

Joe and the Boss schlepped along with the archaeologist. "You've got some 200 year-old wooden pipes under here," they said. Joe and the Boss glanced at each other as the archaeologist continued: "The Romans transported water from aqueducts through 0.5 percent gradient gravity-flow stone open culverts into buried pipes of leather, wood, or lead, to be distributed throughout towns. In Aachen, Germany, wooden pipes with fitted iron collars to align the pipes and to prevent leakage were in place by c.1400 A. D. And London operated a 400 mile buried wooden-pipe water-distribution system in 1613. So New York City thought of it too. Anyway, we'll document this finding right now, and then you guys can get back to work while we write up our report."

FIGURE 1

NEW YORK CITY | WOODEN PIPES REPORT

1774 ~ Coenties Slip & Area Pipe Installations

In pre-revolutionary east-coast cities such as Philadelphia and Boston, gravity-fed piped water supply systems consisted of hollowed-out virgin-stand hemlock or yellow-pine logs. Meanwhile, in 1774 in lower Manhattan, Christopher Colles, (C. E.), decided to construct a 13 mile system of bored yellow pine (670 kg/m3 density) horizontal pipes, similar to the system which he had seen recently while living in Philadelphia.

Isaac Mann & Son, near Albany, manufactured Colles's first order of 60,000 linear feet of yellow pine (longleaf) logs, each 14 to 16 feet long and about ten inches in diameter, the centers of which were augured out three inches in diameter. Original sidewalls were about 3 inches thick. Each log was center-cut heartwood, with the bark retained.

FIGURE 2

FIGURE 1 Aachen, Germany. c.1400 A.D. Wooden Pipes with Lead Collar Connections In-Plane with Core Interior Surface. Some Pipe Exteriors are Square in Section or have Flat Bearing Surfaces, Therefore, Protective Bark Probably Stripped at the Time of Construction.
From: Wikander, p. 63

FIGURE 2 Coenties Slip. Wooden Pipes c. 1774-1825 Discovered During Construction Excavations, early 2000s. Extant Remnants of Corroded Iron Ring (Arrow) due to Alkaline Conditions at Underlying Wet Wood (Cathode), Resulting in Strength Loss to Both Materials. Side Opening for Clean-Out/ Water Tap. Original Bark Remnants on Yellow Pine Exterior Still Intact After Long Service Life. From: Geismar, 2004..

FIGURE 3 Section DWG Softwood Pipe Connection. Wrought Iron Ring(s) Around One or Both Log Ends' Circumference (C) to Resist (A) Bursting when (B) is Driven in. Countersinking the Wrought Iron Rings & Fastener, then Plugging with Wood Would Have Mitigated Iron Corrosion and Wood-Cellulose Degradation. Augured Core One-Third of Overall Diameter. DWG From: Björling, p. 20

FIGURE 4 Coenties Slip. Each Log is 13 feet long. Log in situ, Exactly as seen when Uncovered and Therefore Archaeologically Significant. Pipes Skewed and Separated (Arrow) at Joint After Two Centuries of Displacements & Settlement from Manmade and Geotechnical Forces. Some Fungal and/ or Insect Damage From 100% Direct Sand-Soil Subgrade Contact & Moisture During 230 Years. Resisted Fc –perp from Traffic, due to Ratio of Significant Pipe Wall Thickness to Radius. From: Geismar 2004.

FIGURE 5 Discarded Unused Section of Decayed/Damaged and Off-Center-Drilled Wooden c.1774-1825 Pipe Discovered During Construction Excavation, 1950, Hudson St. New York City. Sapwood & Bark Extant. Heartwood is Naturally Decay-Resistant. Prima Facie Evidence Matching Colles' Specifications for Three-Inch Augured Hole Diameter Here, as Compared with Final Larger Diameter Seen (Fig. 2) After Many Decades of Interior Surface Water-Flow Friction Wear. Archaeologically Significant. Photo: Alice Oviatt-Lawrence 2013

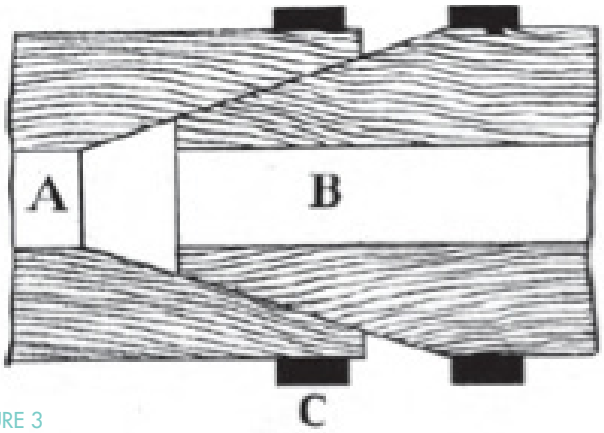


FIGURE 3

The ends of the pipes are tapered male (B) – female (A). The wood pipes were joined and then positioned about one or two feet deep in the main streets and intersections in the tip of Manhattan. Joint ends were crudely made, and jagged 90° clean-outs and/or water taps were cut into some of the log-pipes: The pipes leaked copiously.

Colles assembled and installed a small and inefficient steam engine (the country's second, based on Watt's c.1770 work on a single-acting engine with condenser) to pump water from the festering city water supply at the "Collect", into a public well nearby.

Some Coenties Slip pipes have exterior wrought iron compression rings (Fig. 3., C) at one or both of the joint-ends to resist radial bursting of (A) when (B) was driven in: Fragments of corroded iron can still be seen. Ferric ions in the rings and embedded iron fasteners are active catalysts, which react to form corrosion in the iron (anode)

FIGURE 4

and strength-loss to the wet wood (cathode with pH 4-6), specifically by degradation of the wood cellulose.

1779

Aaron Burr's "Manhattan Company", took over the earlier Colles system in 1779 with rights to seek "financing". Burr set up a financial institution and disregarded the water system. The Company installed only six additional miles of wooden pipes, all south of Chambers St in the developed area of Manhattan. By 1825 a total of only about 25 miles of wood pipes, mostly non-functioning due to the water deficiency and leakage, were in place.

FIGURE 5

DISCOVERY!

Contractors 64 years ago uncovered on Hudson St. an unused c. 1774-1825 pipe section with its original bark, likely dumped as a surplus and defective piece: Burial preserved it entirely. The pipe dimensions closely correlate to Colles's specifications, with its 2.8-inch pipe wall-thickness and an approximately 2.5-inch (but off-center) boring. Because of this prima facie evidence of the pipe's original core size, the extent of the pipe interior's friction-wear can be determined as seen when unearthed in modern times. Remarkably, notwithstanding decades of water-flow parallel to the interior log's wood grain, the sidewalls still retained a close to two inches thickness.

WOOD PROPERTIES OF PIPES

Wood was cheap, readily available, and economical. Water flowing through the pipe limited the pipe's interior decomposition. While early hydraulic studies had started (Pascal, Marriotte (1716), and others), it is probable that the New York craftsmen assumed material characteristics and elementary hydraulics from field experience.

Wood has low thermal conductivity, contraction, and expansion: Parallel to the grain, the co-efficient of expansion is only 1 / 2,000,000th inch per °F. Wood is anisotropic, meaning that its structure and properties vary by orientation. Its tensile and compressive strengths are greatest parallel to the grain. Longitudinal shrinkage is 0.1% to 0.3% for yellow pine. Density and strength of the 18th - early 19th century virgin stand wood are higher than for todays wood.

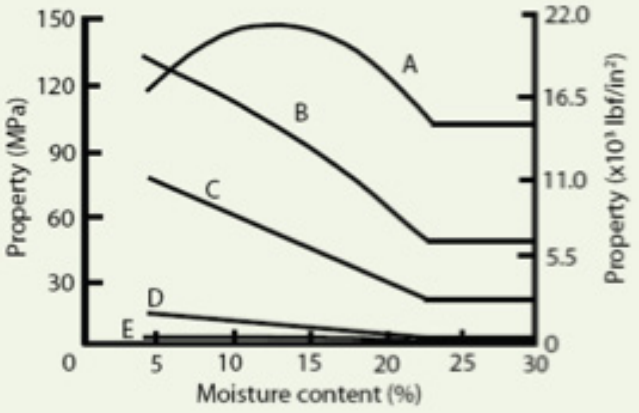
Fc- perp (compression perpendicular to the grain) was sufficient: Buckling from external pressures such as traffic was resisted by the ratio of the significant wall thickness to radius. The elastic limit and ultimate strength of wood are higher under short-time live loading (such as wagon wheels or trucks passing over buried pipes), as compared to long duration stressing.

LATER ERA PIPES

Many American municipal water systems maintained wooden pipes up to 1880, and then overlapped with cast iron pipe usage which emerged and continued after 1825. However, a number of wooden water pipes are today currently in use in a number of water supply systems around the world, including Philadelphia, Boston, Alaska, Washington State (wood plank, barrel stave and wire spiral-wrap construction), and in several European towns. Recovered New York City 1774-1825 pipes can be seen at the New York Historical Society.

ALICE OVIATT-LAWRENCE
is principal of Preservation Enterprises, an architectural-engineering organization specializing in international historic-structures research and analysis.

Effect of Moisture Content on Wood Strength Properties.



A, tension parallel to grain; B, bending; C, compression parallel to grain; D, compression perpendicular to grain; and E, tension perpendicular to grain.

Source: USDA Forest Products Laboratory

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Thornton Tomasetti

2014 SEAoNY EXCELLENCE IN STRUCTURAL ENGINEERING

AWARD WINNERS

The Structural Engineers Association of New York (SEAoNY) Excellence in Structural Engineering Awards serves to recognize creative achievement and innovation in structural engineering. Modeled after the National Council of Structural Engineering Associations (NCSEA) Awards, the program annually highlights some of the best examples of structural engineering ingenuity by firms in New York.

For the 2014 Awards, projects must have been sufficiently completed between January 1, 2011 and December 31, 2013 such that they clearly show the basic design of the structural system. Firms were asked to provide narratives, photos, and plans or sketches to convey the complexities and innovations of their design. Judged by past SEAoNY presidents and honorary members, themselves structural engineers and leaders in the industry, scores were awarded based on: creativity and complexity of design; innovative application of materials or techniques; ingenuity of design for efficient use of labor and materials; sustainability of structure; and exceeding client/owner needs and expectations.

Awards finalists and winners were recognized on the SEAoNY Annual Boat Cruise, with each being represented by a project display board and, of course, their engineers. The SEAoNY Awards provide a great opportunity for engineers to learn more about the work of their peers and to share in their engineering achievements. In past years, several SEAoNY Awards winners have gone on to win NCSEA Awards as well. This year's winners are sure to be no exception.

Judges

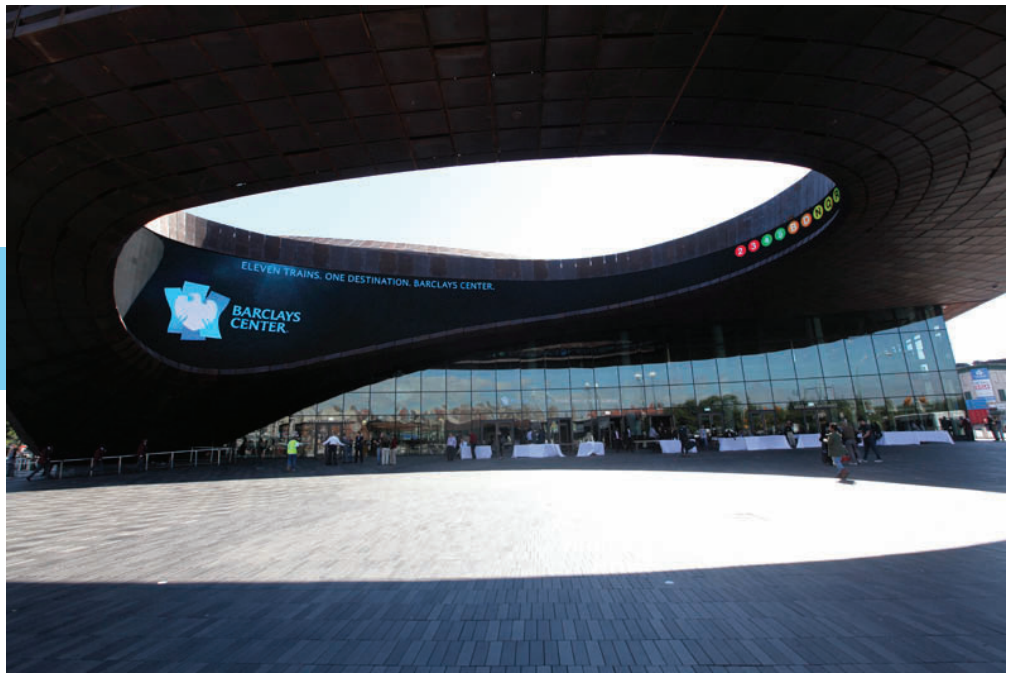
***Thomas A. DiBlasi**, P.E., SECB, is the President of DiBlasi Associates, P.C., Structural Engineers, in Monroe, Connecticut. He is a Past President of the National Council of Structural Engineers Associations (NCSEA), and he currently chairs the Code Advisory Committee of NCSEA.*

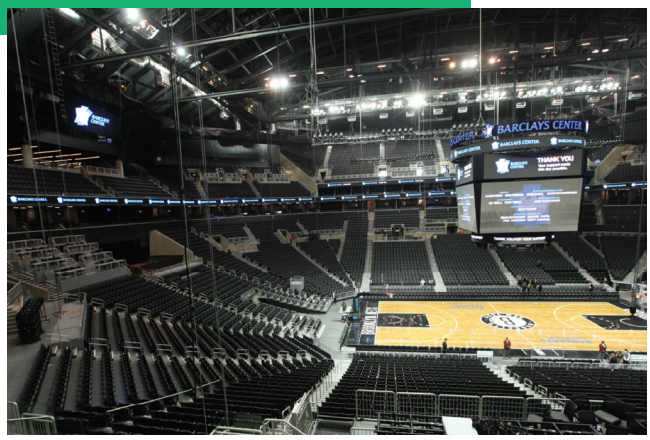
***John Hill** is an architect, author, blogger, and adjunct professor. His time is split between editing the eMagazine for World-Architects.com, blogging at A Daily Dose of Architecture, freelance writing for websites like Houzz, teaching at NYIT, and giving the occasional architectural walking tour. His book, Guide to Contemporary New York City Architecture, was published by W.W. Norton in 2011.*

***Scott Hughes** is a Principal at Robert Silman Associates and is the Past President of SEAoNY. He has served as Secretary, Treasurer and President on the SEAoNY Board of Directors.*

***Francis J. Lombardi** is the former Chief Engineer of The Port Authority of NY & NJ, the position he held from 1995 until he retired in 2010.*

***Timothy D. Lynch** is a NYS Licensed Professional Engineer with over twenty five years of structural engineering experience. In his capacity as Executive Director of the Forensic Engineering Unit of the New York City Department of Buildings, Mr. Lynch oversees a team of specialists who respond to structural collapses, major fires, construction accidents/incidents involving serious injuries and property damage. Mr. Lynch served on the SEAoNY Board of Directors in 2010 and remains involved with the SEAoNY Education and Codes & Standards Committees.*


ELEVEN TRAINS. ONE DESTINATION. BARCLAYS CENTER.
BARCLAYS CENTER

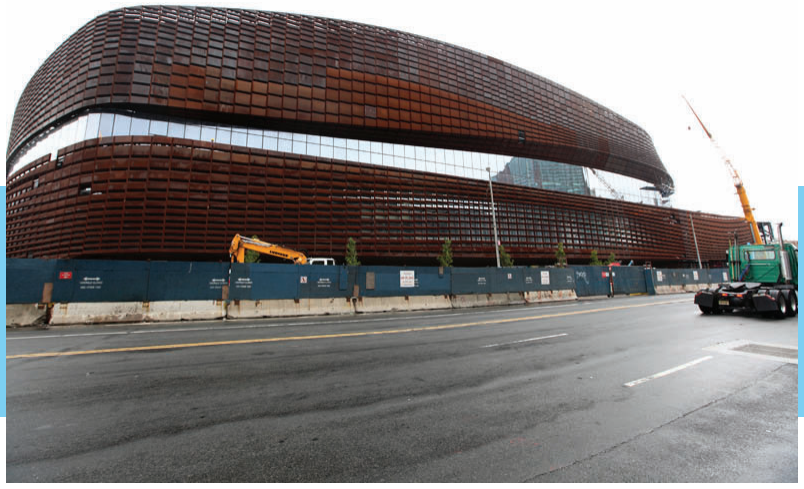

BARCLAYS CENTER

NEW BUILDINGS

BARCLAYS CENTER

Thornton Tomasetti

Location: Brooklyn, NY
Architect: SHoP Architects, AECOM Ellerbe Becket
General Contractor: Hunt-Bovis Joint Venture



Thornton Tomasetti provided structural design and construction support services for the new 675,000-square-foot, 18,103-seat Barclays Center, home of the NBA Brooklyn Nets. The arena features suites, bars / clubs, a restaurant and retail. Project challenges included a tight urban site over a rail yard, complex façade geometry and a truncated schedule. The team coordinated in a 3D environment and provided this information directly to the contractor, emerging as a leader in Building Information Modeling (BIM) and alternate project delivery methods. Daily coordination was the key to the successful delivery of a project of such a large scale and intricate design.

All Images: Courtesy of Thorton Tomasetti

NEW BUILDINGS

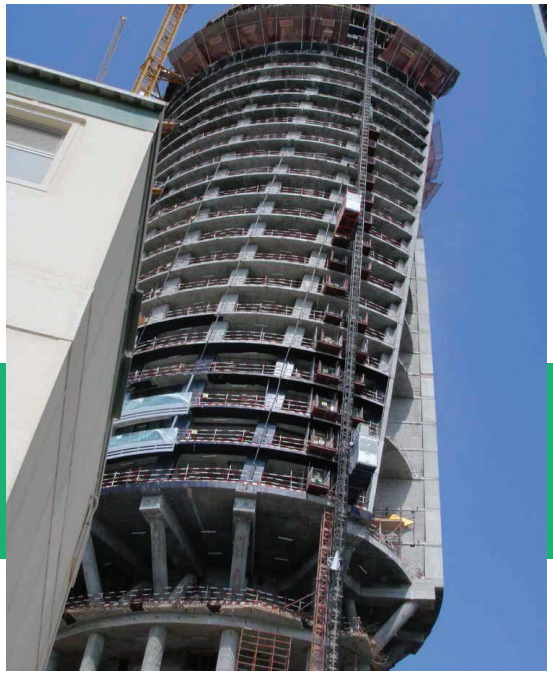
KRISHNA P. SINGH CENTER FOR NANOTECHNOLOGY

Severud Associates Consulting Engineers

Location: University of Pennsylvania, PA
Architect: WEISS/MANFREDI
General Contractor: Gilbane

The intra-disciplinary Singh Center for Nanotechnology ascends as a spiral to The Forum, which is a 68-foot cantilevered room. By design it accommodates collaboration and sensitive nanotechnology research including clean rooms and a transmission electron microscope. The cantilevered Forum is designed to accommodate lectures and social events with vibration considerations such as dancing. The stepping southern façade encloses the sunny Galleria atrium with a curtain wall cut in two directions by a sloping roof. Within the Galleria, a 55-foot long span stair supported by a 20-foot long cantilever floats through the atrium and provides elevated gathering spaces for scientists.

Color Images: © Albert Vecerka/Esto
Black & White Images: © Weiss/Manfredi



Located amongst palaces and high profile skyscrapers on the Cornich Street of Abu Dhabi in the United Arab Emirates, the new 55-story mixed-use $287 million Regent Emirates Pearl development rises and twists 840 ft above ground. The Pearl's signature feature is the 45–story twisting elliptical floor plan and columns which contains 60 luxury apartments on levels 1 thru 10 and a 5-star hotel with 437 keys on level 11 to the roof. The expansive podium area includes five levels of restaurants, retail areas, fitness & spa, swimming pools, and more with another five levels of underground parking. The total project area is 1.4 million sf.

NEW BUILDINGS

REGENT EMIRATES PEARL HOTEL

DeSimone Consulting Engineers

Location: Abu Dhabi, United Arab Emirates
Architect: Dennis Lems Architects Associates
General Contractor: Arabian Construction Company

All Images: Courtesy of DeSimone Consulting Engineers

NEW BUILDINGS, NOTABLE ACHIEVEMENT

WACCABUC HOUSE

Yoshinori Nito Engineering and Design

Location: Westchester, NY
Architect: Chan-li Lin, Rafael Vinoly Architects
General Contractor: Atlantic State Development Corporation

The architect and engineer collaborated extensively to create a cantilevered structure that creates floating spaces, bringing the best of what the site has to offer - views and light. The structure at the 2nd floor contains two floor-height lightweight steel trusses in the longitudinal direction buried inside skinny walls which rest on top of small cantilevered beams in the other direction. The double cantilevered structure is supported by six steel columns and concrete footings pinned to bedrock. The cantilevered ends extend twenty feet beyond the column supports.

All Images: Courtesy of Yoshinori Nito Engineering and Design

OTH
CO
schlai

The Consol Energy Bridge designed for the Boy Scouts of America is a cable supported bridge and is, with a length of 800ft and main span of 575ft, one of the longest pedestrian bridges in North America. The unusual underslung cable configuration was chosen to reduce the height of the towers while maintaining an efficient cable profile. Walkways are provided not only as usual on a main deck but also on secondary walkways located on top of the suspension cables. The latter provide splendid views as users walk just above the tree tops with resting platforms on top of six radially fanned steel masts and at mid span.

ER STRUCTURES

NSOL ENERGY WING TIP BRIDGE

ch bergermann and partner / Hatch Mott MacDonald

Location: Glen Jean, WV
Architect: schlaich bergermann and partner / Hatch Mott MacDonald
General Contractor: Freyssinet

All Images: Courtesy of schlaich bergermann and partner

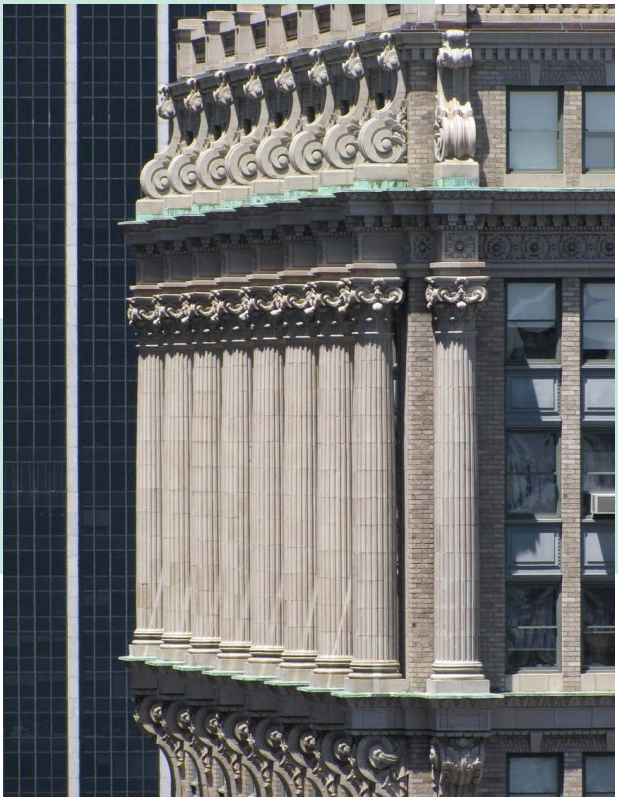
FORENSIC ANALYSIS / RENOVATION / RETROFIT / REHABILITATION OF STRUCTURES

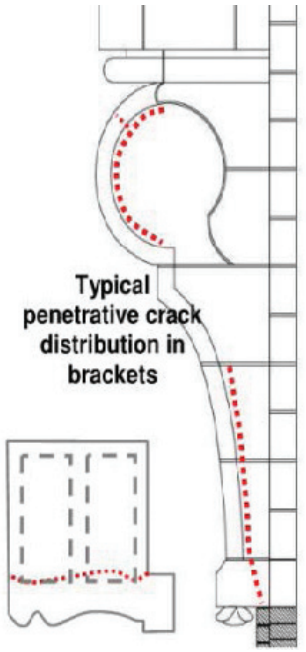
NEW YORK CENTRAL BUILDING, 230 PARK AVENUE

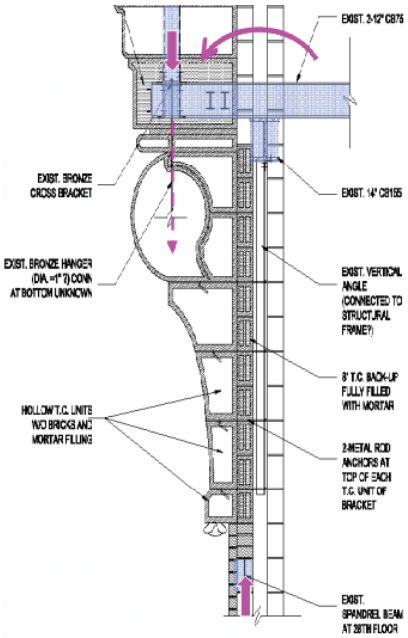
Thornton Tomasetti

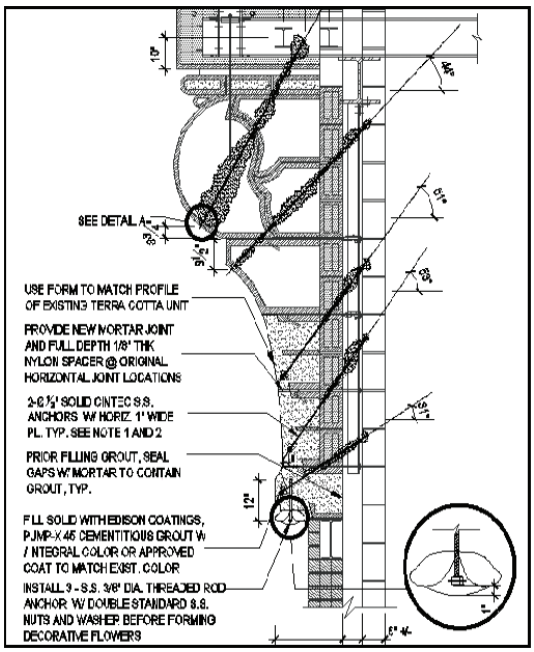
Location: New York, NY
Architect: Warren & Wetmore
General Contractor: United Restoration Services of New York

Thornton Tomasetti provided façade investigation services for this 34-story office building. Impact echo, ultrasonic pulse velocity, infrared scanning, and invasive probing were performed and a finite element model was developed to analyze the behavior of cracks in the building's terracotta brackets. This revealed a high stress concentration that closely matched the observed diagonal cracking. Appropriate and cost effective repair techniques were then implemented, including specially-designed stabilization anchors and an impressed current cathodic protection system. This robust repair program demonstrated the cost-effectiveness of state-of-the-art technology.









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