

cross sections

Magazine for the Structural Engineers Association of New York

2017 VOLUME 22 NO. 3



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The Brooklyn Bridge

Photo by Tushar Nagananda, LERA

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President's Message

Many of you attended the annual meeting recently and heard about all the amazing things that were accomplished last year by SEAoNY committees, both new and well established. This year promises to be great as well, not least because of three new committees, highlighted below:

Young Member Group

For many years SEAoNY has been filled with young members, without an official young member committee. The Programs Committee, Publications Committee and Education Committee have all been chaired by young members for over ten years. I know I personally took a lot of pride in this fact, and have believed that SEAoNY is a dynamic and energetic group that appeals to engineers at every stage of their career. While I still believe this, we must remember that while SEAoNY has about 500 members, there are actually thousands of practicing structural engineers in the New York City area alone!

Thanks to the Younger Member Group's efforts, we have even more young people participating in SEAoNY events, and we still have young people chairing all the committees noted above!

SEAoNY Upstate

SEAoNY has always intended to represent the whole state of New York, not just New York City. However, until this year we had not been very successful at including members from outside the NYC area, due to a lack of connections upstate. Thanks to a little bit of luck and a lot of hard work, we now have a small, but very devoted, group working to offer SEAoNY programming in Syracuse! With a positive response in the Syracuse area, we are strategically planning for this offshoot to become its own chapter, with the long-term goal of starting chapters in other parts of New York state.

Diversity

Many of you may wonder why this group is necessary. Within our offices and within the industry, there is more gender and ethnic diversity than ever. But, as a woman who has been a structural engineer for over fifteen years, I believe that we can do more to recruit and retain women and people of different ethnicities into the field of structural engineering. The Diversity Committee is focused on this. The more diversity we have in our companies, the better we will be at facing future challenges, and communicating with a wide variety of clients and colleagues. We want all of you (not just those of minority groups) to be a part of the conversations about our differences - discussing them and leveraging them. I hope to see a variety of colors, sexes, and faces at every SEAoNY event including the Diversity Committee events.

Sara Steele



Editor's Message

Dear Friends and Readers,

Welcome to another year of SEAoNY Membership! At the Annual Meeting this year, it was a pleasure to listen to the talk by Honorary member Joe Tortorella. Rather than focus on the impressive projects he has no doubt completed in his career, he focused on the importance of mentorship and finding joy in his life's work. It seems that this is something we can all strive to make a focus in our career and dealing with our colleagues.

For the Publications Committee, we would like to let you know about our next themed issue in the works, Wood Construction. If you or your firm are designing and building with wood, let us know! We would love to get your input for this exciting issue, slated for March 2018.

And finally, we look forward to another year of great writing by you, the SEAoNY membership. Enjoy!

Adam J. Kirk, PE

UPCOMING EVENTS

**Oct 30, 2017
6:00 PM**

*Center for Architecture
536 LaGuardia Place*

**SEAoNY Diversity
Committee
Launch Event: Networking
Strategies For The AEC
Industry**

**Nov 4, 2017
10:00 AM**

*Cooper Union
41 Cooper Square
New York, NY*

StructureQuest

**Nov 13, 2017
8:00 AM - 5:00 PM**

*Nicholas J. Pirro
Convention Center
(the Oncenter) in
Downtown Syracuse*

**SEAoNY Upstate –
Syracuse: CNY
Engineering Expo**

**Nov 21, 2017
6:15 PM - 8:00 PM**

*Center for Architecture
536 LaGuardia Place*

**TR Higgins Lecture:
Effective Bracing for
Flexural Members and
Systems in Steel Buildings
and Bridges**

Presenter: Todd Helwig, PhD

Visit www.seaony.org/programs
for additional information on these
and other events!

SEAONY AROUND TOWN

2017-2018 ANNUAL MEETING



Joe Tortorella, PE, President of Silman, was honored as this year's honorary member. He spoke about the joy he has found in this career and the importance of mentorship.

Held at the The General Society of Mechanics and Tradesmen in midtown, the SEAoNY Annual Meeting on Sept 14 kicked off the 2017-2018 Membership year. SEAoNY members welcomed the incoming Board of Directors, honored scholarship winners and also heard a message from 2017 SEAoNY Honorary Member Joe Tortorella.

All (13!) committees gave reports on their progress and activities over the past year and laid out their plans for the upcoming year. There is much to look forward to!



The scholarships were presented to Lucas M. Schmatzer and Colin McGrane, both engineering students at Manhattan College, in the amount of \$5000 each.

STRENGTHENING OUR COMMUNITY AND ADVANCING OUR POSITION IN THE AEC INDUSTRY: THE SEAONY DIVERSITY COMMITTEE AND NCSEA SE3

Jennifer Anna Pazdon, PE,
SEAONY Diversity Committee Chair,
NCSEA SE3 Voting Member

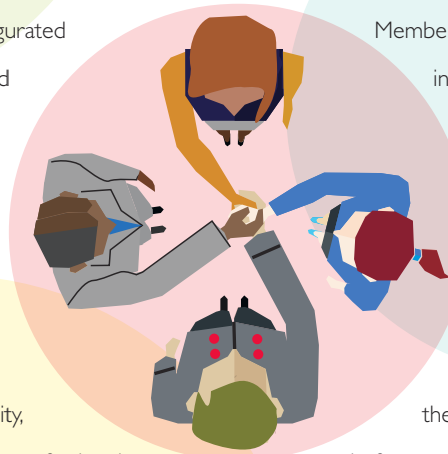
Last year the newest SEAoNY Committee was inaugurated by full Board approval and support from experienced contributing members of the SEAoNY community including Vicki Arbitrio, Aine Brazil, and Erleen Hatfield.

The mission of the Diversity Committee is to advocate for inclusion and advancement of women and minorities in the structural engineering community, raise awareness about the challenges they face in the professional workplace, and propose solutions through worker-friendly, equitable policies.

Our vision is a more diverse and inclusive community with better collaboration in the workplace and longer-term employee retention. These goals are in line with the SEAoNY mission statement "to advance the art of structural engineering in New York by improving the flow of ideas and building the community of colleagues." A community that works together and is inclusive will benefit from the best and brightest engineers when their voices are heard, their contribution is respected, and their potential is valued. A diverse and inclusive structural engineering community will be most effective and productive in the interest of advancing the field.

Our first event was held on June 21st when Rose McClure presented the findings of the SE3 National Survey, followed by a Recap Session with the SEAoNY YMG.

Our next event "SEAoNY Diversity Committee Launch Event: Networking 101" with speaker Judith Nitsch of Nitsch Engineering will be held October 30th at The Black Door. Full event information is available at www.seaony.org.



Members of the SEAoNY Diversity Committee are also inaugural members of the new NCSEA Structural Engineering, Engagement, and Equity (SE3) Committee (<http://www.ncsea.com/committees/se3/>), whose mission is aligned with that of the SEAoNY Diversity Committee. The SE3 Committee was created by SEAONC where an exceptionally committed and active group from the local chapter shepherded this movement locally before catching national attention. SE3 seeks to improve the engagement and retention of structural engineering professionals and promotion of equity within the profession in our advancing industry. SEAONC SE3 administered a survey in early 2016 including questions regarding career advancement, pay and benefits, and work-life balance. A full report of survey results is available here: <http://www.se3project.org>. A follow up survey will be released in 2018 with input from multiple SEA Member Organizations including SEAoNY.

If you are attending the NCSEA Summit, please join us at the NCSEA SE3 Committee meeting on October 11th from 3-5pm. We will have a table on the tradeshow floor to provide resources and further information. The SEAONC SE3 Committee will also be presenting the 2016 survey findings on Friday, October 13th during the Summit.

Both the SEAoNY Diversity Committee and the NCSEA SE3 Committee are welcoming new members and ideas. As a grateful founding partner of NCSEA SE3, I welcome you to participate in one or both of the SEAoNY Diversity Committee and NCSEA SE3 Committee. We look forward to hearing from you. Please contact us with your interest at seaonydiversity@gmail.com

COUNSELOR'S CORNER: STRICT LIABILITY IN CONNECTION WITH ADJOINING PROPERTY LINE CONSTRUCTION

NYCBC

BY
KRITON A. PANTELIDIS,
WELBY, BRADY &
GREENBLATT, LLP.

3309.4.

Most design professionals are intimately familiar with the many onerous dictates of the New York City Building Code (hereinafter the “NYCBC”). However, what they may not be as familiar with are the legal ramifications associated with the violation of certain provisions. This article explores those ramifications in connection with one particular subsection, NYCBC § 3309.4.

In relevant part, this subsection states as follows:

Whenever soil or foundation work occurs, regardless of the depth of such, the person who causes such to be made shall, at all times during the course of such work and at his or her own expense, preserve and protect from damage any adjoining structures, including but not limited to footings and foundations[.] (emphasis added).

Upon first review, this appears to be a relatively straightforward mandate. However, under the surface lurks the potential for a design professional to be held “strictly liable.” With the legalese removed, this means

that the design professional can be legally responsible for damage to the adjoining property without a showing that there was a deviation from the applicable professional standard of care, i.e., liable without a showing of fault on his or her part. Instead, all a plaintiff is required to prove is: 1) soil or foundation work occurred; 2) to some depth ; 3) that the design professional “caused” the work within the meaning of the subsection; and 4) there was resulting damage to the adjoining structure(s) caused by the soil or foundation work.

The first two elements required for strict liability are factually straightforward and are easy to determine. Therefore, not surprisingly, the issue of strict liability will turn on whether the design professional at issue can be said to have “caused” the work. Now, most design professionals would feel comfortable saying that they typically do not “cause” soil or foundation work: e.g., they do not normally make the decision to excavate, direct the contractor in the means and methods, perform any physical work, or retain any persons or entities to do so.

Unfortunately however, recent case law indicates that under certain circumstances design professionals can be considered to have “caused” the work despite these facts.

As such, our focus here is to evaluate what the case law is “telling us” about how courts view an engineer’s role and what types of actions may put strict liability in play. To begin, we need to understand what actions likely do not create an inherent risk of strict liability: For example, it is relatively clear that a design professional who prepares a design that merely calls for excavation and support of excavation (like underpinning) without more will not be held strictly liable, even where that design professional had “discussions” related to the means and methods of the excavation and had “general responsibilities” to visit the site to monitor for compliance with the contract documents. Simply put, typical architectural and engineering “design services” will not likely create strict liability without more direct involvement in the actual soil or foundation work.

However, the greater the extent of the design professional’s involvement with that type of work, the greater the risk of being held strictly liable. For example, a structural engineer that “substantially” contributes to the design and methodology used during the soil or foundation work can potentially be held strictly liable. More specifically, a relatively recent case denied a structural engineer’s motion to dismiss the adjoining property owner’s strict liability claim because the engineer “assumed” responsibilities related to excavation. These “responsibilities,” according to the Court, were, at least partially, evidenced by the facts that the engineer recommended excavation design changes during the work and that those changes were ultimately put into place over the objection of the contractor. While the court in this case did not hold the structural engineer liable as a matter of law, it allowed the claim to go forward, giving the plaintiff an additional advantage in furtherance of settlement or at trial.

In a similar vein, if an engineer has contractual “supervisory” responsibilities related to the methodology employed for the soil and foundation work and assumes a responsibility for such methodology and for the safety precautions during such work, strict liability is possible. For instance, in a recent case, a court held a professional engineering firm performing special inspections for excavation, sheeting, shoring, and bracing strictly liable for adjoining property damage as a matter of law prior to trial. The court relied upon the engineer’s contractual responsibilities and focused heavily on the fact that the engineer revised the shoring technique during excavation specifically to reduce vibrations affecting the adjoining property. The court ruled that such actions evidenced a control over and responsibility for methodology and safety during excavation.

Therefore, given the trend of the case law, design professionals need to be cautious when involving themselves with in-field decisions affecting in-progress soil or foundation work. If the design professional makes a decision to change a technique or method, — especially when it is over the objection of the contractor performing the work — such a decision could be used to show that the design professional had control over and responsibility for the methodology of the work, leading to potential strict liability.

Conclusion

Design professionals — or experienced counsel — need to carefully review all contractual provisions related to the means and methods of the work, safety, supervision, and any other provisions related to soil or foundation work to confirm that the language does not imply a greater responsibility than the design professional intends.

Moreover, design professionals must take care during soil and foundation work to limit their involvement with means and methods and avoid directing or suggesting to contractors how the work should be done as opposed what work is called for by the design.

The 1870s

BROOKLYN BRIDGE

*Cable Wire,
Specifications
and Tests*

BY ALICE OVIATT-LAWRENCE,
PRESERVATION ENTERPRISES



By 1867 John Roebling completed his design for the Brooklyn Bridge, and began borings for this, his last bridge. Scientific and materials information were limited. While Roebling used wrought iron wire from the UK for his 1854 Niagara Bridge and intended it for the Brooklyn Bridge cables, he warily considered, and then rejected, an option for zinc-coated Bessemer steel wire (patented 1850 but unreliable and initially little used), after reading reports of its limitations.

Roebling and Wilhelm Hildenbrand, engineer, tested much available wire: While his own 1850's era wrought iron wire plant near Trenton began to manufacture some early Bessemer steel wire by 1866-7, Roebling did not find in any samples in his own shop -- or from other disparate sources -- with the uniformity of the available wrought iron wire for use in the cable tension members.

From his tests, Hildenbrand established that parallel wires provide 10% greater tensile strength over that of twisted wire. Due to the steel's uncertainty and mixed test-results, more parallel wires were added to the cables, resulting in a final 6308 individual wires comprising each cable of 15¾ inches diameter; as wrapped in galvanized wrought iron wire. Ultimate strength for the cable wire was specified as 160,000 psi, which approximated later tests. (Please see below). The Roeblings used elastic theory, experience, and rigorous testing of materials in their designs.

John Roebling's structural system and Gothic Revival design-scheme of four cables suspended between rusticated granite arched and buttressed towers soaring to the sky, with suspenders and diagonal overfloor wire rope stay cables, were not significantly architecturally altered. Washington Roebling, as engineer-in-charge after 1869, updated various technical construction details; worked on modernizing the caissons construction which he learned from Eads, a trip to Europe, and his own study; decreased John Roebling's excessive loading on the adjustable stays; and stiffened the towers.



Fig. 1. John Roebling 1846-patented invention of the traveling sheave, left, used to traverse the East River span to carry the wires back and forth. Here the Bridge Directors in tails and top hats observe the first passage of the wires to make up the cables. 1876. (Zinc.)

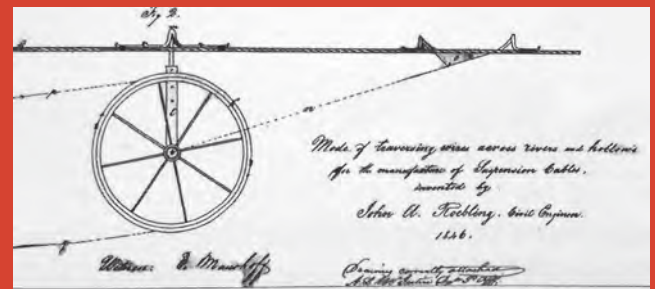


Fig. 2. John Roebling's 1846 Traveling Sheave Patent DWG. The five-foot diameter wood wheel had a V-shaped sheet-iron rim. (Zinc.)

As with the Niagara Bridge, the wire manufacturer for the cables was not the Roebling Wire Plant. A steel manufacturer set up its plant near the bridge site in Brooklyn, where reels of delivered wire were fed onto drums. The Roebling factory did provide Bessemer steel wire and rods for the stay cables and suspenders; all have been replaced over time with steel.



Fig. 3. DWG of Roebling Co. wire splicing invention to connect the cable wire ends. The ends of each wire received either a right or left-hand threading, while each coupling sleeve's interior circumference received counterpart threading. Screwed together and galvanized with molten zinc, the wires cannot unwind. (Green.)

To construct, wires were placed from the drums into the saddle groove of John Roebling's patented traveling sheave to transport each of the approximately 278 to 332 wires comprising each strand back and forth across the span. A Roebling-patented counter-threaded ferrule spliced the wire strand ends. Each of the 19 strands making up a cable weighs 50 tons, resulting in the finished weight of each cable of 900 tons. The four cables comprised about 53% of the total suspended superstructure dead weight, with a total of 14,060 miles of wire, less wrapping. This weight is a factor, along with the stiffening truss that includes an underdeck wire rope network in plane with the truss lower chord, in resisting lateral displacement.



Fig. 4. The nineteen strands of 278 wires each, in hexagon form showing the order in which they were placed on the saddles to form the cables, before compressing and final wrapping. (Green.)

The assembled cables were first hung from cast iron sheaves on the iron saddles on top of each tower, at which time the cables fell into a previously calculated parabolic position. Each cable is cradled (splays out) from base to saddles (in transverse elevation view) between the towers. Cable sag is 128 feet at the center. The original 1870s main cables survive as is, except for new wrapping.

The NYC Public Works Department produced in 1945 an inspection report with recommendations, by *Othmar Ammann* and Holton Robinson. Ammann and Robinson applied a modified elastic theory method to analyze the cables and stays as a statically indeterminate structure, and concluded that the bridge was safe for moderate loading, with trucks barred and with regular maintenance. The nexus of the suspenders and the vertical force components of the diagonal stays tensioned at the deck, distorts the cable parabolic form, except in the bridge center: The cable curve results from its loading.

The report cited a 162,600-psi ultimate tensile strength for the cable wire, as tested in 1943-44 by H. Wessman in the NYU Metallurgy Department labs, which also included detailed chemical analysis and metallographic examinations.

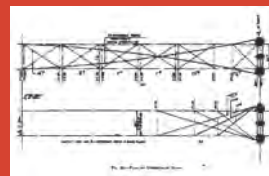


Fig. 5. Wires in plane with the underdeck lateral truss. (a) Two parabolic horizontal diagonal wire ropes are tensioned between towers to enhance the resistance of the truss to lateral forces. (b) Three sets of wire ropes near the center span side of each tower continue via embedded eyebars into and through each tower, to connect to the land spans' lateral systems. (Ammann and Robinson Report)

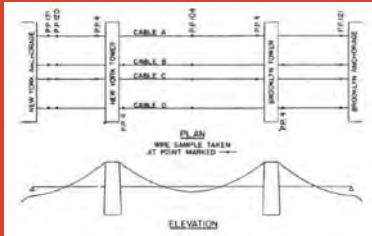
BROOKLYN
BRIDGE*Cable Wire,
Specifications
and Tests*

Fig. 6. Sites where the wire samples were removed for testing. The wire test pieces sprang into reel shape, indicating that the yield point had not been surpassed. Larger-size wires had been added during construction to the cable section bottoms. Oxidation was seen in cable perimeters near anchorages and in the center of the main span in 1945. (Ammann and Robinson Report.)

1878	Fifty-ton strand being let-off the machinery snapped, killing two and injuring three workers.
1898-1944	Heavy elevated trains (44 tons) and trolleys (14 tons) stressed the bridge elements: Structural problems from impact and braking. Original design live loading of 1790 pounds per linear foot approached 3000 pounds per linear foot total loading.
1898	After bumper-to-bumper mass transit & traffic build-up in hot weather, main cables slid off saddles, and lateral bending of several structural grade steel truss chords in bridge main span at attachments to main cable and stays was discovered.
1901	Seven suspender rods in bridge center broke & were replaced with larger size diameter. Cable bands in one cable broke longitudinally, caused by oxidation from non-lubrication.
1903	Leffert Buck poured linseed oil and graphite into the Brooklyn and Williamsburg bridge cables.
1915	Experimental installation at one of the four cable's suspender rod connection to cable bands, at nine panels at bridge center expansion joint, intended to limit angular movement of rods and to minimize wear on the pins. Discontinued.
1922	Trucks banned from bridge.
1944	Trolley service continues on the bridge, heavy elevated rapid transit trains discontinued.
1945	Ammann et al engineering report with recommendations. Both tower tops calculated at only < 5/8-inch out of plumb.
1948	Steinman's contract to create six lanes of traffic and eliminate trolleys.
1970s	Neglect of city infrastructure; Brooklyn, Queensboro and Manhattan Bridges degrade.
1981	Stay cables deteriorate and snap, killing one person and injuring another.
After 1981	All stay cables and suspenders replaced. All main cables rewrapped.
2000s	Annual cleaning and lubrication of the solid rod suspender spherical bearings. Pavement sensors, structural stress-strain sensors, road weather information system and anti-icing system installed.
2015	Existing roadway pavement replaced; rehab of historic arch blocks, railings, and masonry structures. Ongoing...

Sites of wire samples removed for testing, DWG, plan/elev 1943. The wire had inconsistency in the amounts of carbon, phosphorus, manganese, sulfur and slag. The lab found each wire diameter inconsistent, from 0.165 inch to 0.191 inch; approximately No. 8 and No. 7 Birmingham Gauge. While the metallurgic tests of the early steel exhibited the expected disparity in the quality and structural capacity, the lab determined that the wire was generally “acceptable for its era” and in adequate condition for the recommended working stress of 60,000 psi.

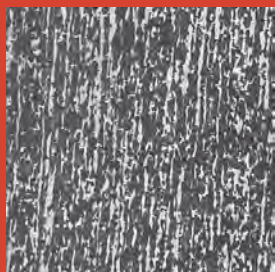


Fig. 7. Slide detail from H. Wessman’s 1945 metallographic tests of the 1877 steel cable wire. Alloy contents are erratic. Widely variable steel was produced in small steel mills in this developing steel-era, and here the wire carbon content ranged from 0.54% to 0.91% and manganese content random from 0.34% to 0.40%. The correlation of certain amounts of alloy content to high strength was not recognized in Roebling’s era, demonstrated by the tested wire’s clear lack of chemical uniformity as built. (Ammann and Robinson report.)

A total of three of the twenty-five samples showed a banded structure similar to that indicated here. This sample showed the structure to a greater degree than the other two. The white streaks are ferrite, practically pure iron, and the dark portion is pearlite, an iron-iron carbide mixture. Phosphorus, silicon and certain other elements sometimes present in steel tend to become segregated. Even after rolling, these elements sometimes remain segregated, being elongated in the direction of hot working. Carbon is less soluble in these areas than in the regions of lower impurity content, giving distinctly banded structures such as is shown here. Banding gives steel directional properties, the impact toughness and ductility being reduced in the transverse direction. The presence of such a banded structure is generally considered as indicative of poor quality.

Fig. 8. Descriptive text to Fig. 7. Wessman determines, based on his metallurgical studies and on wire section-variation, roughness of surface, and very irregular zinc coating, that likely the wire was hot rolled undersized, followed by no or very minimal real wire drawing. Eavg=28,800,000 psi. (Ammann and Robinson report.).

The original specifications stated that the wire ultimate elongation be not less than 2% in fifty feet; the test results were 2.88% (ten inches, 60 tests). The wrought iron eye-bars and anchor chains were still in good condition where they enter the masonry. Today, NYC DOT carries out continued maintenance.

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BY SEAONY PUBLICATIONS COMMITTEE

As structural engineers in New York, we often find ourselves in some tight and/or forgotten spaces. These canvas' sometimes host impressive graffiti works. Please enjoy these images taken by SEAoNY Pubs members on site visits around the city of site visit graffiti that caught our eye. Artists are unknown.



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