cross sections

Magazine for the Structural Engineers Association of New York

2021 VOLUME 26 NO. 1

cross sections

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ON THE COVER
Projecting Blind Header Bricks
by Gary Ogen

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5 STRUCTURAL SOLUTIONS FOR NYC TOWNHOUSE FAÇADES

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PRESIDENT'S MESSAGE

BRADFORD T. KIEFER, PE

WOW! SEAoNY's Program Committee and Jaffe Management pulled it off! Our first fully virtual Annual Meeting was a huge success. The speakers were all extremely knowledgeable and interesting. Our sponsors also prepared presentations that were not your normal advertisements, but useful and enjoyable. If you missed any part of the Annual Meeting, you will soon be able to find videos of the speakers and sponsors on the SEAoNY Website. Due to the success of the Meeting, SEAoNY was able to donate $1,000 to City Harvest and $1,000 to the SEAoNY Education Fund. It is always great when SEAoNY can give back to the community.

During the Annual Conference, SEAoNY Past President Jonathan Hernandez announced that SEAoNY is partnering with the National September 11th Memorial and Museum. Our goal is to raise $250,000 to donate to the museum with the purpose of providing our expert knowledge, collective memory, artifacts, and resources in recognition of this milestone anniversary.

On September 11th and after, structural engineers and other design professionals were called upon to help maintain the safety of structures and piles of debris so that first responders could work towards the recovery of victims. Following this, we continued to provide our services in the cleanup and investigation of the disaster as well as many other affected buildings south of Canal Street.

We believe that our partnership with the National September 11th Memorial and Museum will highlight the efforts of design professionals to aid the first responders, and society in general, after September 11th. We believe showing this effort will underscore our industry's quiet assistance to society that is always necessary, but seldom realized. If you believe, like we do, that our contributions to society are important, please give what you can. To give, please go to the SEAoNY Foundation tab on the SEAoNY Website.

When I look back on 9/11, I remember the period after and thinking that nothing was ever going to be the same, and it wasn't. Now that we have been through a year of the pandemic, I have the same feeling that life as we knew it is not going to return. Hopefully soon we will all feel safe again. When that time comes, don't just go back to business as normal – take time to appreciate what you have: friends, family, and your career.

EDITOR'S MESSAGE

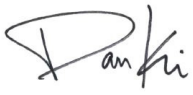
DANIEL KI, PE, SE (NV)

A Brief Summary of Earth:

The year is 2021. A global pandemic starting a year prior has caused most humans to "socially" distance and has effectively put their world on pause. In the span of a year, their scientists were able to formulate an effective vaccine, and with the help of governments and global collaboration, said vaccines are being distributed en masse. This is the largest vaccine campaign in the history of mankind.

As survival instincts kicked in, humans began to gather essentials (Bitcoin, shares of Gamestop, non-fungible tokens) and sharpen their skills (Tiktok dances, Netflix marathons, building alcohol tolerance). Hope and optimism is a source of energy that allows them to see that soon enough, their collective efforts will bring a new and improved "normal". Surely, they will survive, and surely, they will thrive post-pandemic.

-Some intelligent being far, far away



COUNSEL'S CORNER

RISK OF FAST-TRACK FOR DESIGN PROFESSIONALS

KRITON A. PANTELIDIS, JD

CONSTRUCTION/DESIGN INSURANCE & RISK-MANAGEMENT SPECIALIST
VICE PRESIDENT OF PROFESSIONAL SERVICES, **RISK STRATEGIES COMPANY**

Fast-Track construction and other forms of accelerated project delivery (collectively "Fast-Track") are commonplace in today's design and construction industry. Practically every major project has some component of scope being Fast-Tracked. The intent of this article is to present a high-level overview of the accompanying risks structural engineers face, develop issue-spotting skills, and identify basic risk-mitigation techniques.

Like almost all perils on a construction project, evaluation of Fast-Track risk goes hand in hand with an examination of one's project partners, including the owner. At heart, Fast-Track is a bet in which the additional costs incurred by procuring and building a project off of incomplete and uncoordinated design drawings are weighed against the benefits of completing the project in a shorter timeframe: Additional costs normally include redesign fees, late and/or rushed construction/design coordination, material waste/reordering, removal/replacement of work in place, and delays associated with the foregoing; on the other end of the scale, the potential benefits include earlier cash-flows and termination of overhead/carrying costs. Stated plainly, the owner is responsible for this financial analysis and for carrying adequate Fast-Track design and construction contingencies.

A myriad of other obstacles will also need to be overcome during a Fast-Track project's lifecycle: Does the owner understand the need to efficiently make premature design decisions/commitments? Is the owner ready to make necessary program changes? Is there a dedicated ownership team that understands Fast-Track and how to get all interested participants in a room at critical times to have important conversations? Are contractors properly accelerating (among other things) their means/methods, delegated design, procurement, and construction coordination responsibilities alongside the progression of the design? Are the other members of the design team prepared to perform late design coordination and adjust accordingly?

Simply put, Fast-Track projects require an enhanced level of cooperation. Structural engineers, though usually not responsible for such cooperation, may still end up paying the price for an unorganized project that lacks transparency with respect to the above-referenced dangers and obstacles.

As such, the first rule of risk mitigation that structural engineers need to follow is to be transparent about the realities of procurement and construction based on incomplete and uncoordinated plans. This should start with a documented conversation — prior to the start of design — about the need for the owner to conduct a thorough cost/benefit analysis (described above) and to carry the contingencies previously mentioned.

Moreover, in addition to the risks related to the structural design itself still being in development during construction, it is typical for the other design disciplines to work behind the structural design development: They will eventually need to "catch up." Therefore, the structural engineer should advise of this need — in writing — so the owner and/or its representative can adjust (amongst other parameters) any schedules as necessary.

Structural engineers should also implement the following techniques once the project is underway: (a) label all drawings (even those for construction[1]) as "Issued Under Fast-Track"; (b) develop a short form note for the title block and a more robust note for the General Notes Sheet that clearly identify the level of design development, the engineer's understanding of the purpose for the design issuance, and the general risks of Fast-Track; and (c) prepare and include an "open items" letter with all major issuances and/or at critical project milestones that sets forth significant aspects of the design still in progress and any incomplete or outstanding information, decisions, and/or services required of the other project participants to move forward.

The expected project adjustments caused by Fast-Track construction are often bundled into the catch-all phrase of "design changes" at the time change orders are issued. By transparently documenting the Fast-Track design process and the associated risks, structural engineers can prevent the conversation from being framed in such ambiguous terms and protect themselves should a claim of cost overruns/delays ever be made.

[1]Where governmental entities reviewing such plans will not allow any qualification in connection with the language "Issued For Construction," the structural engineer should consider referencing a disclaimer general note via footnote

STRUCTURAL SOLUTIONS FOR NYC TOWNHOUSE FAÇADES

MICHAEL SCHULLER, PE, FTMS, FAPT

PRESIDENT, **ATKINSON-NOLAND & ASSOCIATES**

GARY OGDEN

EI, **ATKINSON-NOLAND & ASSOCIATES**

Townhouses are an iconic part of the New York City streetscape. Many of these structures were originally constructed as single-family homes over 100 years ago, then split into multiple apartments, and are now being transformed back to their original use. Today, a significant portion of the renovations made to these townhouses are wholesale interior renovations, sometimes with multi-story additions, which often expose hidden structural concerns.

The construction type, property constraints, and historic sensitivity of townhouses present several unique challenges requiring creative solutions to address structural issues. The main distinguishing feature of these buildings, the front façade, often requires specific attention to repair and retrofit the distress condition.

Construction Typology

Townhomes are typically long, narrow structures, with floor and roof framing that bears on party walls between units. Party walls are constructed of two or three wythes of brick masonry and are nominally 8- or 12-inches thick. The front façade is often not load-bearing, built using an exterior wythe of stone, or higher quality face brick, over two wythes of common brick backup.

Soft, sand-lime mortar was used with historic construction; harder Portland cement-based mortar became more common in the early 20th century. Construction quality is highly variable throughout the wall assembly and from one building to the next. It is not uncommon to find unfilled mortar joints, voids, and rubble fill at the interior of masonry wall sections (Figure 1).

A common type of distress with townhouses is leaning or bulging of the front and rear walls (Figure 2). This movement often results from poor (or missing) anchorage at floor and roof diaphragms. The entire wall section may deflect outward over time, but more commonly the individual wall layers separate and move independently as connections between wythes fail. For example, metal anchors or cramps, anchoring stone facing to the backing, will corrode over time, causing anchorage fractures and failure.

One problematic characteristic of brick façades was the practice of using concealed brick header courses, also known as diagonal or running bond headers (Figure 3). This coursing pattern became popular in the late 1800s, continuing through the 1920s, and provided a continuous running bond pattern throughout the façade, unbroken by header brick courses. While appealing from a visual standpoint, diagonal headers do not provide the same connection capacity as a full header brick.

With diagonal headers, the face wythe is bonded to the backing through a small triangular section set in mortar. These connections often slip over time, and the facing brick deflects away from the backing (Figure 4). Another issue is that diagonal headers were expensive to install, requiring up to six brick cuts for each header. As such, many townhouse facades were constructed with header courses spaced much wider than the five courses required by Chapter 470 Section 19, in the 1860 Laws of New York. The net effect of this poor connectivity is bulging, leaning, and instability of the face brick.

Diagnostics

While some issues will cause visible cracking or leaning, internal conditions are not visible with the naked eye. This is where nondestructive evaluation (NDE) can provide information without the need for expensive, destructive, and often limited, probe openings. Surface penetrating radar (SPR) is a versatile technique that can identify internal construction including wall thickness, blind headers, voids, and the presence of metals such as anchors or reinforcement

(Figure 5). SPR is beneficial for both determining viability of different solutions, such as grout injection, and providing quality assurance after an intervention. Infrared thermography (IRT) is another tool that can provide a global view of a façade. By measuring surface temperatures, IRT provides information on changes in construction, internal voids, near-surface spalls, and moisture presence.

As with all NDE methods, best practices include confirming results with complementary methods such as a pachometer, which locates conductive metals, or visual observation of internal conditions with a videoscope. Questions regarding the spacing or presence of headers, wythe separation, and extent of distress can be answered using NDE. This will lead to an appropriate and focused solution.

Figure 1: Variable construction between the exterior face brick and two wythe common brick backup.Voids are visible in the backup wythes and behind the face brick. (MASONRY SOLUTIONS INTERNATIONAL, INC.)

SOLUTIONS

As with all engineering design, simple, cost-effective solutions are the objective. Therefore, it is ideal to start with the most basic repairs and work toward the more complex and expensive. With minor material distress, a simple repointing of the brick masonry may be the only necessary intervention. Over time, mortar deteriorates and washes out. Repointing is required as periodic maintenance and should be expected every 50 to 75 years. Deferring maintenance is often the root cause of many building issues and leads to more significant and costly repairs. Repointing mortar joints helps restore water tightness and provide uniform load distribution in wall sections.

Figure 2: Bowing of the historic façade is visible after the adjacent townhouse was rebuilt to be plumb. (GARY OGDEN)

More significant structural distress conditions at townhouse façades include wythes separating within the wall section and excessive wall deflection. When the existing headers are insufficient for providing connection between wythes, remedial pinning with helical ties is an effective solution. Helical ties should be stainless steel and of a sufficiently small diameter to fit within masonry joints.

Small-diameter, helical, solid or threaded stainless-steel rods can also be installed within horizontal bed joints for crack stitching, reinforcement, or to provide connection between intersecting walls. Overall, helical ties are an effective solution to provide supplemental connection to meet prescriptive code requirements and stabilize minor movements.

Displaced brick and stone requires more significant intervention to stabilize walls and restore structural capacity. The retrofit objective is to achieve composite action, where the wythes of the wall act as a single element in resisting loads. In this case, internal voids, cracks, collar joints, and cavities are filled by low-pressure grout injection. Care must be taken when designing and selecting repair materials as the grout must be compatible with historic materials, considering both mechanical properties and response to moisture vapor transmission. Gravity-feed or low-pressure injection is used to minimize outward injection forces that can damage or destabilize the walls.

Supplemental benefits of a solidly injected wall include: the improvement in moisture resistance, slowing the overall deterioration of walls, and increase of supplemental anchorage capacity through additional bonding between retrofit anchors and grout.

If significant out-of-plane movement is occurring, more substantial anchorage is provided through retrofit anchors. Grouted masonry retrofit anchors include stainless steel rods within a fabric sleeve that expands when injected with grout (Figure 6). This allows the anchor to conform to any voids or joints, providing both

Figure 4: Projecting blind header bricks revealed after a partial collapse of the face wythe. Note the complete separation of the wythe and several broken blind headers. (GARY OGDEN)

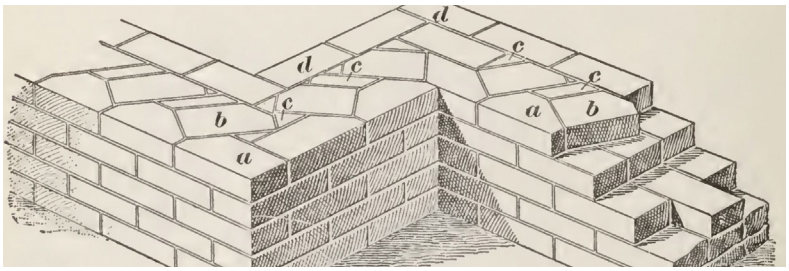


Figure 3: Historical drawing of three-wythe wall construction with blind headers, also known as diagonal or herring-bone bond. (A TEXTBOOK ON ARCHITECTURE AND BUILDING CONSTRUCTION, 1899)

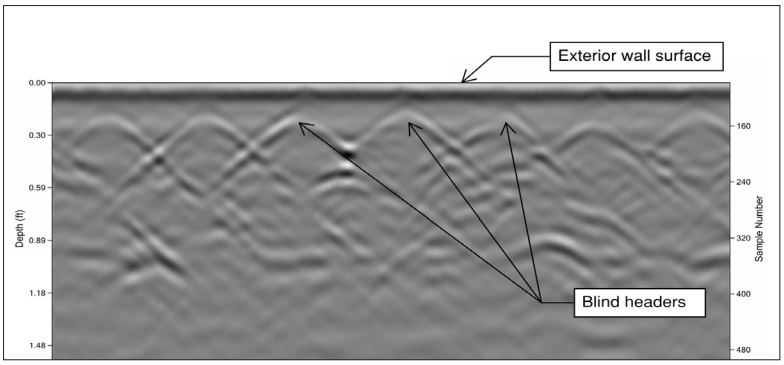


Figure 5: Horizontal SPR scan across a row of blind headers. (GARY OGDEN)

mechanical and chemical bonding, while at the same time confining anchor grout, preventing it from flowing into voids within the wall.

These anchors are used in retrofit cases when new connections to party walls and diaphragms exceed a length of four feet. This length is typically required to fully develop the anchor strength but can vary depending on loading, tributary area, core size, and materials. Exterior bearing plates are sometimes required, depending on the required anchor capacity. Epoxy anchors with screen tubes are another effective solution but their application may be limited by available lengths.

Figure 6: Installation of a grouted sock anchor. This four-foot-long anchor connects the façade to an intersecting party wall. (MASONRY SOLUTIONS INTERNATIONAL, INC.)

ADDITIONAL ISSUES

In addition to façade movement, there are several other common issues pertaining to NYC townhouses. Foundation walls, for example, are commonly constructed with rubble stone and are subject to moisture infiltration. Effectively managing roof and site moisture is essential to prevent long-term material deterioration of historic masonry materials.

Party walls are a particular source of frustration as they often contain fireboxes, flues, pipes, and chases. Legal issues may also arise due to the wall being owned by two parties. While each problem has its unique challenges, the same general approach can be used, regardless of the situation: review knowledge of the construction, conduct adequate investigations, understand the root causes of the issue, and provide a targeted solution.

Townhouses in New York City have a distinct charm, but their construction typology is repeated in many cities across the United States such as: Philadelphia, Boston, and Washington D.C. The methods discussed in this article can generally be applied in these cities as well. Lessons learned from New York City can thus be combined with those learned in other cities, collectively furthering industry knowledge of this common type of building construction.

EVENT RECAPS

SE LICENSURE TOWNHALL Q&A

BY SE LICENSURE COMMITTEE

The SE Licensure Committee hosted an interactive town hall on January 28, 2021 to provide a forum for the SEAoNY membership to ask questions and share their opinions about SE licensure in New York. The event was split into three parts: a brief presentation by the Committee, a moderated Q&A session with all attendees, and a small group segment meant to foster conversation between members of SEAoNY and the SE Licensure Committee.

The Committee began the town hall by re-stating the purpose of an SE partial practice act and by providing an overview of the proposed regulations, including threshold structures and licensing requirements. The Committee also provided a synopsis of the 2020 survey results. In general, the survey indicated that SEAoNY members were uncertain as to the types of projects that would require an SE license under the proposed SE partial practice act - a more detailed presentation of the results can be found in Cross Sections - Volume 25, No. 3 published in December of 2020.

In the next part of the town hall, the Q&A session, attendees submitted their questions to be answered by the Committee. Topics included: the purpose and objective of pursuing SE licensure, which threshold structures should require design by a licensed SE, requirements of individuals to obtain SE licensure under the proposed rules, and the procedural steps for successfully legislating SE licensure. **The following are selected excerpts from the Q&A session:**

Q: Will an SE license be required for the design of miscellaneous assemblies (stairs, guardrails, etc.) on important and complex structures where an SE license is required for designing the main building?
A: No. Delegated design items can be designed by a licensed PE when working on a structure that requires a licensed SE as the Structural Engineer of Record.

Q: For an engineer with a NYS PE license, who is already licensed as an SE in another jurisdiction, how do the proposed regulations apply?
A: A NY licensed professional engineer who can demonstrate appropriate experience will be eligible to receive a NY SE license under the proposed regulations.

Q: Will the SE license be required for bridge engineers? If not, what happens in hybrid situations where bridge structures may pass over or under high-occupancy residential units or other areas with potentially high occupancy (parks, plazas, etc...)?
A: There is a provision for an SE to be required for structures that span more than 150 feet, but additional consideration for bridge structures can be made with additional guidance by bridge engineers. The Committee welcomes participation from practicing bridge engineers to help formulate the requirements.

Q: The pass rate for the 16-hour SE examination is typically below 50%. The pass rate for the bar exam is approximately 75% and the passing rate for medical boards is frequently above 90%. What is the purpose of emphasizing a test where the pass rate is so low compared to other important professions?
A: The SE Licensure Committee is basing their recommendations for NYS on those used by other jurisdictions. Passing the 16-hour examination is part of the basis for SE licensure across all jurisdictions that currently have either a full or partial practice act.

Q: Have the requirements for continuing education as an SE been developed yet?
A: There will be requirements for engineers with an SE license similar to those required of PE-licensed engineers in NYS.

Q: Is "grandfathering" acceptable if part of the basis for SE licensure is passing the 16-hour SE examination, which assesses knowledge of current codesand standards?
A: The Committee believes that "grandfathering" is a fair means of allowing those NY PE-licensed engineers, who have been gaining sufficient experience and successfully practicing the profession of structural engineering on qualifying structures, to continue their current work without requiring them to take and pass the 16-hour examination.

Q: Is the proposed SE practice act applicable for NYC only or for the whole State of New York?
A: The proposed SE practice act would be applicable for the full State of New York, including NYC.

Q: When does the Committee anticipate the SE partial practice act going into effect?
A: This is a legislative decision that must be passed by both houses of the legislature and signed by the governor. The Committee is currently promoting SE licensure to the industry and the general public. The next step will be to produce the text of a bill and start promoting it to state officials and legislators. The Committee cannot predict when any other northeast states may adopt an SE license, but that could be a significant influence for the New York legislature.

Q: Is the Committee advocating for increased compensation with the more advanced skills needed by SE licensees?
A: The Committee's main purpose of proposing the partial practice act is to enhance public safety on important and complex structures. Most structures will not require an SE, and historically, general compensation has not increased in other states because of SE licensure; however, there is no data on the change in compensation for complex structures. Increased compensation may occur if licensed SE's can demonstrate additional value to project owners, but this is not a focus area for the Committee.

Q: Has there been any feedback from the architect/developer/real estate communities regarding their views of SE licensure?
A: The Committee is not aware of any specific feedback from other related professional communities in New York. It is assumed, as SE licensure spreads in the United States, that there will be an increased demand from project owners for licensed SE's on projects across the United States.

In contrast to the Q&A session with the full audience, the breakout segment allowed direct communication between town hall attendees and members of the SE Licensure Committee. Committee members were assigned to each small group to facilitate conversation and take notes. The following provides an overview of the most frequent discussion topics:

- Bridge design thresholds and other types of complex structures should be considered for inclusion in the list of structures requiring design by a licensed SE.
- Consider excluding very small hospitals/healthcare facilities (and similarly small-sized important structures) where requiring an SE license may not represent a significant risk reduction to loss of life.
- Some concerns were expressed that the proposed SE practice act may not meet the goal of raising public safety, particularly if NYS is tasked with determining who is qualified to be licensed as a structural engineer.
- Continuing education requirements for SE should consider a heavier weight towards structural topics compared to existing requirements for PE's in NY.
- Several participants work for firms that encourage pursuing SE licensure. These participants found the experience of preparing for the 16-hour exam valuable, even if they were not successful in their first attempt of passing the exam.

The Committee greatly appreciates those who actively participated in the town hall. These conversations, questions, and even dissenting opinions are all necessary to successfully move forward with SE licensure in New York. While it is important for the Committee to share its work and goals with SEAoNY members, it is equally important for the concerns of the membership to be heard and understood by the Committee. Feedback from the town hall is being considered and will be incorporated in the proposed SE partial practice act as deemed appropriate. The Committee will provide updates on the SE licensure initiative later in 2021.

SE LICENSURE TOWNHALL Q&A — SE LICENSURE COMMITTEE

2020 NCSEA STRUCTURAL ENGINEERING SUMMIT EXPERIENCE

BY WILLIAM CHENG
STRUCTURAL ENGINEER, SEVERUD ASSOCIATES

The 2020 NCSEA Structural Engineering Summit, like most events in 2020, was held virtually. While certainly different from previous years, the summit was no less amazing or unforgettable of an experience. Topics included: mass timber structural developments, performance-based design updates, the latest adoption of tornado wind loads, equality within the structural engineering profession, and strategies for engineering firm growth.

I found myself trying to watch each presentation. Luckily, the presentations were recorded and made available for viewing after conclusion of the event, an advantage of the virtual format. The summit was an invaluable opportunity to learn about the latest developments in our industry and to engage in discussions outside of one's typical practice area. I would like to thank SEAoNY for sponsoring the young-member scholarship that allowed me to attend the 2020 NCSEA Structural Engineering Summit. It was truly a transformative experience.

NCSEA STRUCTURAL ENGINEERING SUMMIT — WILLIAM CHENG

IN MEMORIAM

LESLIE E. ROBERTSON, 1928-2021

PE, CE, SE, DSc, DEng, NAE, Dist. MASCE, AIJ, JSCA, AGIR, Chartered Structural Engineer

The structural engineering community mourns the passing of Leslie E. Robertson on February 11th of 2021. Mr. Robertson practiced engineering for over 60 years and led his firm for over 40 years. During his career he worked on some of the most iconic projects around the world including the World Trade Center (New York, NY); the U.S. Steel Tower (Pittsburgh, PA); the Bank of China Tower (Hong Kong); the Shanghai World Financial Center (Shanghai, China); the Suzhou Museum (Suzhou, China), and countless other notable projects.

Not only did he design iconic buildings, he did so by breaking away from traditional methods and developing new ones such as the prefabricated multiple column and spandrel wall panels used at the World Trade Center, and an outrigger system utilized in the U.S. Steel Tower.

Throughout the years, Mr. Robertson earned numerous awards including the Mayor's Award for Excellence in Science and Technology for his structural design of the World Trade Center after it withstood the 1993 terrorist bombing. He was also awarded the World Trade Center Individual Exceptional Service Medal for his work in the reconstruction of the twin towers.

Additional honors and awards included the IStructE Gold Medal, in recognition of unique and outstanding contributions to the advancement of structural engineering; the Gengo Matsui Prize, in recognition of those advancing the field of structural engineering; the ASCE Outstanding Projects and Leaders (OPAL) Award, honoring the lifetime accomplishments of outstanding civil engineering leaders; the AISC J. Lloyd Kimbrough Award, honoring engineers and architects who are universally recognized as the preeminent steel designers of their era; Engineering News-Record's (ENR) "Man of the Year"; the inaugural Henry C. Turner Prize, recognizing invention, innovative methodology and/or exceptional leadership by an individual or team of individuals in construction technology; and the inaugural Fazlur R. Khan Lifetime Achievement Medal, recognizing excellence in technical design and/or research that has made a significant contribution to the design of tall buildings and the built urban environment. He was SEAoNY's Inaugural Honorary Member in 1999.

Mr. Robertson also gave back to the community, serving as a Member of the National Academy of Engineering, a Distinguished Member of the American Society of Civil Engineers, and Advisory Board Member of the Center of Sustainability, Accountability, and Eco-Affordability for Large Structures. He served on the board of several notable cultural and professional organizations including New York City's Skyscraper Museum, the Architectural League of New York, and the MacDowell Colony. He had a lifelong passion for human rights, supporting many causes. Education and women's right were especially meaningful to him, and he set up a scholarship to support these issues.

People who worked with Mr. Robertson describe him as having a boundless passion for life. He imparted his knowledge to those around him and shared his talent with the architectural and engineering community. For many engineers in the New York City area, Mr. Robertson holds a special place as the engineer of the World Trade Center. At the time, we were proud to have the tallest building in the world designed and constructed in New York City. It was a symbol of what could be achieved, and for this we will always be grateful to Mr. Robertson. With his passing, we have lost an icon in our field.

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This fund is designated to support students with an emphasis on supporting women.
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