cross sections

Magazine for the Structural Engineers Association of New York

2022 VOLUME 27 NO. 1

STRUCTURAL ENGINEERS ASSOCIATION
SEA
NEW YORK

cross sections

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ON THE COVER
Tornado Damage
by John O'Brien, PE, SE

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PRESIDENT'S MESSAGE

EUGENE KIM, P.E.

2022! Can you believe it?! 2022 has been an exciting year so far. In February, New York City hosted the NCSEA Structural Engineering Summit which had both in person and virtual events. It was great to see and interact with fellow engineers from all over the country considering the past couple of years we have had. I recommend attending the Summit if you can. It is a great way to see the wider world of Structural Engineering. Then in March, SEAoNY followed up with our Virtual SEAoNY Annual Conference titled "Design Scenarios for the Changing World." Many thanks to our Programs Committee and Jaffe Management for making that two-day event a huge success. The diverse group of speakers were all very knowledge and presented topics that highlight the increased performance expectations we place on our built environment and unusual design scenarios.

It is hard to believe that it has been more than two years since SEAoNY had our last in person event. Like many of you and your firms, we have all had to adapt and continue to adapt to the latest trends. SEAoNY has tried to our part by continued to offer our usual host of seminars, networking events, etc, all offered virtually. We have been listening to our membership and with the encouraging outlook on the pandemic the last few months, I am happy to report that SEAoNY is starting to plan some in person events. We are currently in the early stages of planning for the Engineering in Structural Excellence Awards Dinner aka the Boat cruise. With some luck and careful planning, we hope to again have this event in person maybe on a boat. We have also heard from our membership that some of you prefer our virtual events, so we plan to continue to offer many events virtually. Our virtual events allow us to reach a larger portion of our membership. We will continue to adapt to any new challenges that await us.

Finally, I will again ask for more members to step up and volunteer some of their time to SEAoNY. Please take a look through our long list of committees (https://www.seaony.org/Committees). All of our committees are always on the lookout for more people to provide their time and input. Any help is appreciated. Structural Engineers at all levels of experience are welcome and encouraged to participate. It is a great way to connect, interact and learn from others in our profession. 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. And one of the best ways to do that is to be a part of one of our committees.

Sincerely,
Eugene Kim, P.E.

P.S. My latest hobby is making granola. Looking to share recipes.

RIYA MANIAR, E.I.T.

EDITOR'S MESSAGE

I am excited and honored to be the editor for Cross Sections this year. Thank you to the publication team, authors, and readers of Cross Sections for your continued efforts into making this publication possible. This issue includes articles on codes and provisions that practicing engineers may not always consider, but if implemented can improve the collaboration of design teams as well as the safety and sustainability of buildings.

As structural engineers, we strive for the betterment of ourselves and the community by applying and sharing knowledge. A principal goal of Cross Sections is to act as an outlet to share the knowledge we gain in our profession with the larger structural engineering community. This goal recognizes that the experience and expertise that practicing engineers have is both valuable and individual. As the topics of this issue shows, your expertise is indispensable, and, by sharing it, you contribute to the knowledge base of the community and the development of well-rounded engineers. So, as you read through this issue, and the following issues of Cross Sections, consider what you might be able to contribute to the conversation with this outlet as we all grow and learn together, and feel free to reach out to seaonypubs@gmail.com for any contributions. We sincerely hope you enjoy the first issue of 2022.

Thank You,
Riya Maniar, E.I.T.

STRUCTURAL ENGINEERS AND THE ENERGY CODE

BY JAMES A. D'ALOISIO, P.E. LEED AP PRESIDENT KLEPPER, HAHN & HYATT

With the increasing complexity of buildings and building codes, structural engineers often feel they have little bandwidth for taking on aspects of the design that are outside of their traditional scope. Taken to the extreme, this has been referred to as "siloing" – where individual professionals on a project each perform their duties independently, with little interoffice collaboration. This can lead to problems -- since a building is more than the sum of its parts. Energy codes continue to become more restrictive, and we've become more aware of an increase in related problems, like condensation or interior temperature variations. The time has come for structural engineers to own up to their role in the performance of a building's thermal envelope and compliance with governing energy codes.

A building's structure and a building's envelope are inexorably intertwined. Every building that has a thermal envelope has structural elements that connect and support its envelope components and cladding back to the primary structure. The thermal properties of these cladding systems can have a large effect on the overall thermal performance of the building. This can impact not only the amount of heating and cooling energy used, but also the indoor thermal comfort, the potential for condensation, and the operational carbon emissions of our buildings. Structural engineers should consider the effect of structural elements on the thermal performance of a building to be a critical serviceability design parameter, similar to deflection, vibration, and material shrinkage.

Traditionally, architects and mechanical engineers have been the team members who bear the primary responsibility for compliance with the energy codes. However, certain requirements fall squarely within the purview of structural engineers, such as point and linear structural thermal bridging, thermal properties of balconies, parapets, and other appurtenances, and foundation and slab edge insulation. Wherever structural elements create a thermal bridge, allowing heat to bypass the thermal resistance of the envelope insulation, the thermal properties of the affected portion of the envelope need to be determined.

Although structural engineers are rarely expected to perform such calculations, it is useful to understand what makes structural details problematic and how to modify them to improve their thermal performance. The overall coordination of the thermal envelope systems occurs as a collaboration by the entire design team. This is the integrative approach to creating high-performing buildings.

First, engineers should be aware of what energy code governs the project. The currently applicable versions of the codes below were all adopted in May 2020:

- The Energy Conservation Construction Code of New York State (ECCCNYS) applies to all buildings in New York outside of New York City, unless a more restrictive local ordinance has been adopted.
- The NYStretch Energy Code is an overlay to the ECCCNYS developed by NYSERDA that is available for municipalities and other code authorities to adopt for their jurisdiction.
- The New York City Energy Conservation Construction Code (NYCECCC) is applicable to buildings in New York City. It is based on the NYStretch Energy Code, with additional requirements.

Next, determine the building type. All three of the above codes have separate requirements for Commercial and Residential projects. Basically, a building serving a residential occupancy that is three stories or fewer must follow the Residential portion of the governing energy code; all other projects must follow the Commercial requirements.

Next, the team must agree on a code compliance path. The specific paths and their requirements vary

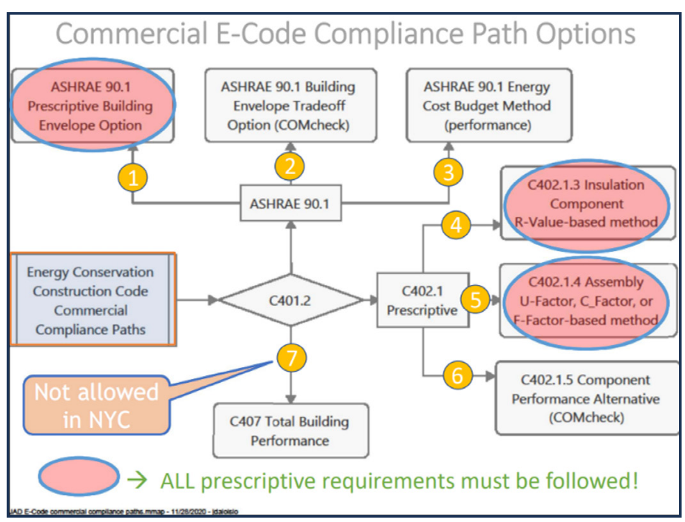

Figure 1: Diagram of the various BCNYS commercial compliance paths.

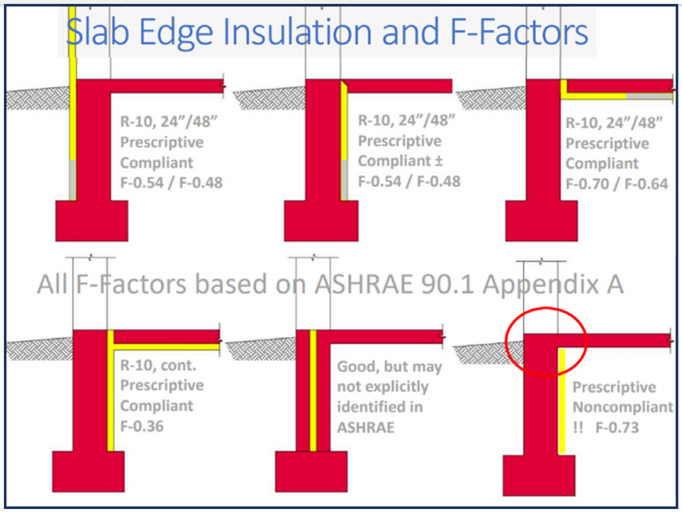

Figure 2: Foundation/Slab edge insulation F-factors

across the different Codes and between Residential and Commercial projects, but for any of the purely prescriptive compliance paths, all prescriptive requirements of the applicable tables must be met (see Figure 1).

This includes insulation at the edges of a slab-on-grade, which reduces the thermal flow across this section of the envelope, known as the F-factor for all but the prescriptive R-value compliance paths (see Figure 2). Note that the insulation must extend to the top of the slab-on-grade or the project will not comply with the prescriptive requirements. This can be relaxed for envelope tradeoff compliance paths (i.e., COMcheck and REScheck), and for all performance-based compliance paths, which use energy modeling, although the resultant increase in thermal losses must be offset somewhere else in the thermal building envelope.

Figure 3: Concrete-to-concrete manufactured structural thermal break assembly at S.U.

Balconies and parapets have been singled out in the NYStretch Code and the 2020 NYCECCC and will require either a thermal break assembly of R-3 minimum or be fully wrapped with minimum R-3 continuous insulation. A structural thermal break assembly is a manufactured, usually design-delegated, component that transfers shear, bending, and axial forces while minimizing thermal transfer (see Figure 3).

They have been used in Europe for over 30 years and can be seen in virtually all European balconies built over the past few decades. Concrete-to-concrete thermal break assemblies utilize small-diameter stainless steel reinforcing bars for tension and shear – stainless steel conducts heat about one-third as well as carbon steel – and discrete, proprietary, low-conductance compression elements. There are at least two manufacturers that have a US presence and can offer competitive pricing. Hundreds of buildings in the Northeast now utilize these assemblies.

Steel shelf angles, considered linear thermal bridges, can create thermal losses as significant as balconies and parapets. Although not specifically identified in NYStretch, NYCECCC 2020 explicitly requires that the thermal conductivity, or U-factor, be calculated for every condition of linear thermal bridging in a building project.

But for all of the above codes, calculating the U-factors of thermally bridged envelope elements is necessary to show compliance with prescriptive U-factor requirements, COMcheck, REScheck, or any type of energy modeling. The energy code requires that these conditions be taken into account regardless of which compliance path is used. The ability to calculate the total U-factor of an envelope assembly is not part of most structural engineers' skill sets, so collaboration with other members of the project team is essential.

One effective mitigation solution to the linear thermal bridging of continuous angles is to introduce discrete bridging elements, such as vertical steel "fin" support plates, spaced along the length, positioning the shelf angle completely on the exterior of the wall insulation. Figure 4 shows comparative images for a standard shelf angle and for an improved version with the fin plates, demonstrating the large difference in thermal performance between the two details.

Another mitigation strategy is the use of fiberglass reinforced plastic "shims." A word of caution – if the detail requires an increase in the cross-sectional area of the steel, such as when end plates are used, the shims must be sufficiently thick - typically at least 1½ inches - or the intervention will not be effective. Depending on the detail, this can actually result in greater heat transfer than if there was no attempt at a thermal break at all!

One strategy that has gained recent popularity is the use of thermally insulative paint applied to steel surfaces. This is appealing because it requires no change to the way the structure is detailed or sized. While thermal paint may help to reduce the potential for localized condensation in some cases, the resultant reduction of energy flow is minimal and will likely contribute very little to energy code compliance.

Figure 4: Large steel-to-steel manufactured structural thermal break assembly

No matter how thermally resistant a material is, a paint-coating thickness of insulation is simply not very effective. For example, if the paint has a conductive thermal resistance of R-4 per inch, a 100-mil coating (which is a very thick coating of paint!) contributes R-0.4 to the reduction of heat flow. This is less than the resistance that can be assumed for an interior air film per ASHRAE 90.1 Appendix A.

Compared to linear thermal bridging, one-dimensional, or "point," thermal bridging conditions, such as a steel beam cantilevering out through a thermal envelope, usually creates much less thermal loss; however, if frequent, they can add up. Thermal bridges can create interior cold spots that are vulnerable to condensation during cold exterior temperatures. One effective mitigation solution is to introduce proprietary steel-to-steel structural thermal break assemblies that utilize low-conductive materials, such as stainless steel (see Figure 5). But the most effective solution is to work with the project architect to modify the detail so that no steel passes through the envelope, truly separating interior and exterior steel.

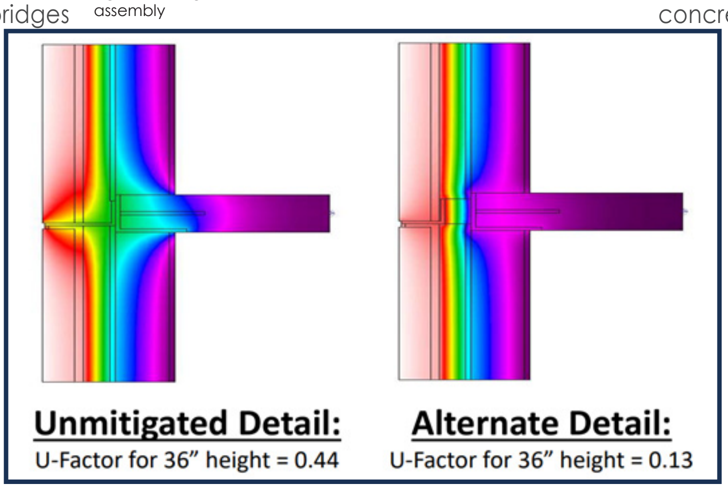

Figure 5: Traditional and improved shelf angle details and corresponding THERM images

Another aspect of building envelopes that relate to structures is foundation and basement wall insulation. Since engineers' drawings usually detail the foundation concrete more extensively and accurately than the architects', it is useful for the structural drawings to include the specifics of the insulation. This is similar to the common practice of engineers' slab-on-grade information showing the vapor barrier under the slab – a building component that has nothing to do with the slab's structural performance. The details, thickness, type, and thermal properties of the foundation and basement wall insulation need to be carefully coordinated with the architect. Like slab edge insulation, insulation may or may not be required in 100 percent of a project's basement walls, depending on the code compliance path and the thermal properties of the rest of the envelope. For all but the prescriptive paths, the walls' C-factors (which is similar to a U-factor except that it excludes the thermal resistance of all elements beyond the surfaces such as air barriers and soils) can be area-weighted averaged to show energy code compliance.

The last thermal envelope component that structural engineers should be aware of is a building's air barrier system. Required in New York State since the year 2000, it must completely envelop the interior conditioned space and be in contact with the conductive thermal insulation. The material is never structural unless it is part of a system with structural properties such as a SIP panel, coated wall sheathing, or an ICF or conventionally formed cast concrete or precast wall.

Structural elements frequently pass through the air barrier planes – including brick ties, canopies, and other protrusions. Having a basic understanding of a project's air barrier system and the related requirements to seal around all penetrations can help avert construction and performance problems.

In summary, structural engineers should understand the basics of thermal envelope performance and the governing energy code for their projects. Identifying and minimizing significant conditions of thermal bridging and air barrier continuity and foundation insulation challenges occurs through collaboration between the architect, the structural engineer, and other members of a project design team. Collaboration can result in better, more thought-out details that are likely to result in successful, trouble-free buildings.

DESIGNING FOR NATURE'S MOST VIOLENT STORMS

ASCE 7-22 TACKLES TORNADO LOADS

BY JOHN O'BRIEN
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Tornado impacts to communities and the built environment are frequently documented in the media. According to the National Institute of Standards and Technology (NIST), tornadoes kill more people each year than hurricanes and earthquakes combined, and the average annual insured losses due to tornadoes are on the same order of magnitude as hurricane losses. However, design for tornadoes has historically been excluded from the model building codes.

While extremely violent EF-3, EF-4, and EF-5 tornadoes are often the most newsworthy storms, statistically they represent only around 5% of all recorded tornadoes. 95% of tornadoes are classified as EF-2 or lower, with estimated 3-second gust wind speeds of 135 mph or less. Tornadoes historically have occurred in all 48 of the contiguous United States, with most tornadoes recorded in the eastern two-thirds of the country, with the highest concentration in the Tornado Alley region of the Midwest.

THE EVOLUTION OF TORNADO DESIGN STANDARDS

Following the devastating Joplin, MS tornado and ensuing tornado outbreak in the Spring of 2011, both FEMA and NIST issued assessment and investigation reports with their findings. Their recommendations included:

- A call for building codes and standards to address risk consistently across environmental hazards;
- Development of tornado hazard maps for use in design;
- Improvement of the performance of critical facilities so that they can remain operational during a tornado and following its impact.

During the ASCE 7-16 code development cycle, the ASCE Wind Load Subcommittee accepted the challenge from FEMA and NIST and developed an extensive 8-page commentary section. Section C26.14 provides extensive guidance for designing and detailing structures to resist tornado loads; however, the nonmandatory nature of commentary made this a purely elective decision for the building owner.

When the ASCE 7 committees started development of ASCE 7-22 in January 2018, they elected to include tornado loads as an environmental design hazard in the body of the standard, upgrading tornado loads to a mandatory design consideration. The development of the new tornado load provisions was led by a tornado task group within the wind loads subcommittee. While tornado loads are in some ways similar in nature to wind loads, the committee decided that tornado loads should remain separate from wind load provisions. And while Chapter 32 is a completely new section devoted to tornado loads, it does reference the traditional wind chapters, invoking the existing wind load provisions when appropriate. Designers will see similar coefficients and factors within Chapter 32, with the subscript -T or -TOR used to differentiate those variables from those used in Chapters 26-31.

The standard development process concluded in the fall of 2021, and ASCE 7-22 is now publicly available. ASCE's intent is for the new tornado load provisions to be adopted by reference into IBC 2024. At the time of this article, the 2024 IBC code development process is underway.

APPLICABILITY OF TORNADO LOAD PROVISIONS

Consideration of tornado loads in ASCE 7-22 is only required for Risk Category III & IV structures, with the intent of improving life safety and the performance of important structures during a design tornado. The new tornado load provisions are not intended to replace or achieve the same level of performance of the storm shelter design provisions contained in ICC 500. Design in accordance with ICC 500 is still required if portions of a building are classified as a designated storm shelter, or for certain Risk Category III & IV structures specified in Chapter 4 of IBC.

For practitioners designing Risk Category III or IV structures in accordance with ASCE 7-22, three checks must be made to determine if the engineer will need to perform any tornado load calculations for the structure.

The following checks are conditions for consideration of tornado loads in design and are contained in Section 32.5.2:

1. Location of project in a tornado prone region shown in ASCE Figure 32.1-1
2. Magnitude of design tornado speed greater than or equal to 60 mph

3. Design tornado speed for the site equal to or exceeding a fraction of the basic wind speed, as a function of the wind exposure category

The process is also summarized in a convenient flowchart, ASCE Figure 32.1-2. ASCE's intent is for the engineer to be able to use these simple steps to quickly assess the tornado risk for the structure. If all the checks are performed and return negative, it is unlikely that tornado loads will control the design. Instead, design wind loads will govern, and the engineer will not need to perform any further calculations to determine tornado loads. However, if all these conditions are true, the engineer must proceed to calculate tornado loads. Note that wind loads must be calculated using Chapters 26-31 even when design for tornado is required, since tornado loads are a separate load case from wind loads.

THE SAME…BUT DIFFERENT: CALCULATION OF TORNADO LOADS

Calculating tornado loads in Chapter 32 is a similar process to determining wind loads. An outline of the process is shown in ASCE Figure 32.1-3. The basic parameters for the site and structure are determined, and the resultant loads on the main wind force resisting system and components and cladding are calculated.

The tornado speed, VT, is determined from the tornado hazard maps in Chapter 32 or by using the free web-based ASCE 7 Hazard Tool (https://asce7hazardtool.online/). A risk-based approach was used to develop the new tornado hazard maps consistent with other hazards included in the ASCE 7 standard. Risk Category III and IV maps are based on 1,700- and 3,000-year mean recurrence intervals, respectively. There are 16 total hazard maps, 8 for each Risk Category, based on the structure's effective plan area, ranging from 1 ft2 to 4,000,000 ft2. The user may either use the map with the next higher effective plan area or interpolate between maps using the logarithm of the effective plan area. An example of the interpolation is provided in Commentary Section C32.5.1.

The reason for ASCE's inclusion of multiple maps is to accommodate a variety of structures and their respective design tornado speeds. For example, a smaller building has a lower probability of being impacted by a tornado than a larger building; therefore, a smaller building has a lower design tornado speed than a larger building. The effective plan area is determined by taking the area of the footprint of the structure.

For non-rectangular buildings, the effective plan area is based on the smallest convex polygon enclosing the plan of the building. For essential facilities, the effective plan area must also enclose any structurally independent, but functionally dependent structures required to maintain the functionality of the essential facility. Pictorial examples for determining the effective plan area are provided in the Chapter 32 commentary.

Tornado speeds vary across the country and range from 50 mph to 124 mph for a large Risk Category III structure, and to a maximum of 138 mph for a large Risk Category IV structure. Note that 135 mph is the estimated low end wind speed for

Figure 1: Tornado Damage from an EF-1 storm near Atlanta, GA

an EF-3 tornado; therefore most building designs considering tornado loads will be designed for the most common EF-2 and lower tornadoes.

The tornado velocity pressure coefficients, KzTor and KhTor, are determined from a table or equations in Chapter 32, similar to coefficients for wind design. However, the concept is quite different from wind loads. Standard atmospheric boundary layer wind speeds are lowest near the ground and increase with height. By contrast, the highest tornado wind speeds occur close to the ground and decrease with height. It is important to note that the tornado velocity pressure coefficient is constant up to 200 feet above ground, and then begins to decrease slightly. Therefore, most engineers designing low- and mid-rise buildings will likely find constant tornado velocity pressure over the height of the structure, with decreases in pressures only occurring in heights over 200 feet.

When determining internal pressures in partially enclosed buildings, the internal pressures are based on the level of the lowest opening in the building that can affect the internal pressure. Some major distinctions of tornado velocity pressure calculations include:

- Topographic effects need not be considered;
- Exposure categories are not used;
- Directionality factor KdT has moved from the velocity pressure equation to the design pressure equation.

Tornado enclosure classification is determined using the Chapter 26 enclosure provisions as modified by Chapter 32. Because wind-borne debris is a significant consideration in tornado events, ASCE 7-22 requires that glazed openings in essential facilities be protected with impact-resistant glazing, or an impact-protective system. For structures without impact-resistant glazing, all glazed openings on a windward wall shall be considered as open when determining the enclosure classification; it is assumed that they will be breached by wind-borne debris, creating a partially enclosed condition.

The positive internal pressure coefficients for sealed, enclosed and partially enclosed structures are higher than those for standard wind loads. The discrepancy is due to the significant atmospheric pressure change that occurs in a tornado event, creating higher positive internal pressures in structures close to the storm. Internal pressure coefficients can be determined from Table 32.13-1.

The tornado pressure coefficient adjustment factor KvT is a new factor unique to tornado loading. Its purpose is to account for the increased pressure on roof elements caused by the strong updrafts that occur in and near a tornado. KvT applies only to roof pressures and varies depending on the roof slope and roof zone being considered.

To calculate design loads for the main wind force resisting system and component and cladding, the user will find modified pressure equations provided in Chapter 32 which incorporate tornado specific design criteria. Note that the pressure equations for enclosed, partially enclosed, and partially open buildings include the tornado directionality factor in the external pressure component of the equation, but the tornado directionality factor is not applied to internal pressures. The appropriate sections and figures in Chapters 27, 29 and 30 are used to select pressure or force coefficients for the structure or component being designed. Wind tunnel testing is also permitted using the Chapter 31 provisions as modified by Chapter 32.

Load combinations in ASCE 7 Chapter 2 have been updated to include a new tornado load, indicated as WT. The load factor on tornado loads is the same as for wind loads, 1.0 for strength design and 0.6 for allowable stress design. However, unlike wind load combinations, snow loads need not be considered concurrently with tornado loads.

COMPARISON OF DESIGN PRESSURES: TORNADO VS WIND

Given the number of factors that must be considered in designing for tornado loads, it is not possible to quantify a constant relationship between tornado and wind pressures. Many factors, including but not limited to site wind speed and exposure, tornado speed, effective plan area, and structure height make a constant correlation unlikely. However, some general observations can be made regarding design for tornadoes versus wind:

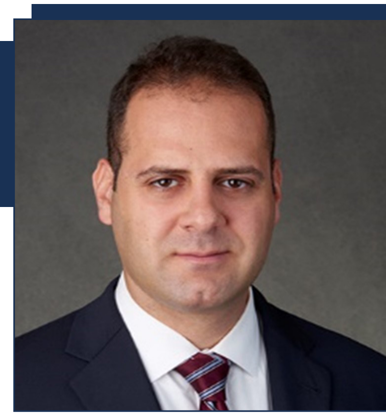
1. Tornado loading will likely increase the design suction pressures on building roofs, particularly at interior roof zones.
2. For walls, it is likely that tornado loads will increase positive wall and interior zone wall suction pressures.
3. Any increases compared to wind are likely to be larger for low-rise buildings than for taller buildings. An example presented at the 2021 NCSEA Structural Engineering Summit considered an average size, single-story Risk Category III structure located in Nashville, TN. For roof component and cladding loads, the example showed negligible increases in Zone 2 & 3 roof design uplifts. However, Zone 1' uplift pressures exhibited tornado design uplift pressures 47% greater than wind, while the tornado pressure at zone 1' was on the same order of magnitude of the zone 1 wind uplift pressure, approximately 25 psf.

The above example illustrates the uniqueness of design considerations for tornadoes, and that they cannot merely be considered a subset or variation on traditional wind pressure calculations. In fact, the new tornado provisions will result in some design and construction changes for many average sized Risk Category III & IV buildings due to the higher design loads on the elements vulnerable to tornado loads. At this time, however, any increase in the overall construction cost is expected to be very small for this needed factor of safety. ASCE's improved tornado provisions answer the call from NIST and FEMA to address the lack of design provisions for tornadoes and acknowledge the need for specific requirements for such potentially lethal events.

NEW PERIODIC INSPECTION REQUIREMENTS FOR NYC

A CLOSER LOOK AT LOCAL LAW 126

BY MUHAMMAD RAHAL, P.E.
SENIOR ASSOCIATE
SEVERUD ASSOCIATES



Beginning January 1, 2022, Local Law 126 of 2021 (Intro No. 2261-A) will require owners of parking structures to hire a NYS licensed and registered professional engineer to inspect the structure at least once every six years and file a report with the Department of Buildings.

The emergence of the automobile in the late 19th century changed the way Americans travel. In 1896 there were 4,649 horse stables in Manhattan alone1. The first parking garages in New York City were often converted from these stables, and the tradition of converting parts of existing buildings to car shelters stands to this day.

Early garage owners typically maintained repair shops and gas stations inside, but when the mass production of cars began in 1913, the structural landscape of the city had to adapt to keep up with the skyrocketing demand for parking spots. The New York City Department of Buildings (DOB) adopted the first code for the parking garages the following year, where it was defined as "a building wherein are kept more than three automobiles or motor cars charged with or containing a volatile inflammable liquid for fuel or power."2 By 1917, the horse drawn carriage house was officially no more.1

The surge in popularity of cars in the 1920's coincided with the greatest decade of construction in New York, and perhaps not purely by coincidence. This decade saw widespread use of the cinder concrete slab, with its low strength and excellent fireproofing characteristics, lovingly referred to by structural engineers as "goulash." Maybe this type of floor is compared to stew for a reason.

There are unique challenges when it comes to maintaining the safety of parking garages. Exposure to water and roadway salts are a particular concern, especially at the level closest to the street, which typically sees the heaviest exposure to corrosive liquids and abrasion from moving vehicles. Floor slabs that are unprotected and exposed to water and chloride ions over a prolonged period of time face severe deterioration due to liquid seeping through the porous hardened cement, eventually making its way to steel reinforcement and/or supporting beams. If the liquid is allowed to stay within concrete elements, the calcium compounds that make up the hardened cementitious portion of the concrete will begin to slowly dissolve, eventually leading to loss of stiffness and hardness. Additionally, steel reinforcement and steel beams will deteriorate if not protected. Corrosion of steel elements in contact with concrete, or other types of masonry floors, may cause safety issues, even if the section loss of a particular beam or piece of reinforcement is not significant. Relatively small amounts of section loss may correspond to significant expansion of the steel, which may cause surrounding concrete or other materials, including delaminated corrosion from the steel itself, to become dislodged and fall down potentially onto patrons below. This is a very common safety issue in parking garages all over the city.

The code requirements for parking garage floor construction and fireproofing first established in 1914 required developers and garage owners to spring into action to adapt to the new regulations. January 1, 2022 could also be considered the beginning of another upheaval of the status quo for garages; this time on the administrative end of things. Effective this year, owners of parking garages must hire a Qualified Parking Structure Inspector (QPSI) to assess the building and file a compliance report with the DOB every 6 years.

The owner of any building or space defined by the Department as a Parking Structure3 needs to show proof that it is safe and that any structural deficiencies or unsafe conditions are being addressed. All the requirements for the cyclical inspection and assessment of these structures, including inspector qualifications and report content, are now contained in the Code.

The new rules outlined in Article 323, Chapter 3 of the New York City Construction Codes (Title 28 of the Administrative Code) were added in November 2021 as "Local Law 126." Additionally, Sections 101-03 and 101-07 were changed and Section 103-13 was added to introduce fees for filing compliance reports and to add language defining parking garage inspections and qualified inspectors. Owners can no longer potentially conceal unsafe conditions; the new law ensures that garage owners are indeed properly maintaining their building, according to a qualified professional.

The new law affects structural engineers as well. Gone are the days when parking garage assessments were largely regulated by that engineer's own experience, discretion, and way of doing things. Minimum requirements outlined in the Code will ensure a city-wide standard level of care for inspecting these structures, to ensure continued safety and integrity. Similar to the requirement for a Qualified Exterior Wall Inspector (QEWI) in NYC's Façade Inspection & Safety Program (FISP), formerly known as Local Law 11, not just any state-licensed Professional Engineer is fit to perform the required assessment and report for parking garages.

A QPSI must be a NYS registered PE with at least 3 years of parking garage experience. Candidates must demonstrate their experience by submitting a resume and attending an interview with the Building Department to gauge the applicant's knowledge of parking garage structures, common ailments, code provisions, basic engineering competency, and knowledge of historic NYC structures. Those interested in applying for QPSI certification can find contact information and helpful resource links to the appropriate code sections on the official NYC website.[4]

It is worth mentioning that although many engineers in New York City are proficient in various types of buildings and deficiencies found within them, many engineers are not as familiar with the provisions of the administrative code, as engineers typically do not have to consult these codes for day-to-day design activities. It turns out that life does not start and stop with Chapter 16 of the Building Code.

All structural engineers in New York City should be familiar with the new article in the administrative code (not just those seeking to become QPSI's) to inform clients and other design professionals of the new requirements.

[1] Jackson, Kenneth T. The Encyclopedia of Manhattan: Second Edition. Yale UP, 2010.
[2] Jakle, John A, and Keith A. Sculle. Lots of Parking: Land Use in a Car Culture. Charlottesville: University of Virginia, 2004.
[3] For more information, refer to: https://www1.nyc.gov/site/buildings/safety/parking-structure.page
[4] https://www1.nyc.gov/site/buildings/safety/qpsi-certification.page

A 1917 Parking Garage on East 64th Street in Manhattan. Photo taken by Muhammad Rahal.


We'd like to express our continued gratitude to the structural engineering community in the SEAONY region for the privilege of working together to solve infrastructure challenges.
We appreciate your trust in our products and engineering support services.
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Structural Engineer: STV
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