LESSONS AND QUESTIONS FROM THE SURFSIDE COLLAPSE: NEEDED CHANGE[1]

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Before sunrise 24 June 2021, the day when the ***Champlain Tower South*** condominium tower partially collapsed in the small coastal southeast Florida community of Surfside killing 98 of its occupants, a date forever etched in the minds of those who survived or witnessed the terrible event, as well as first responders, journalists, officials who came together to manage the initial search-and-rescue and post-disaster recovery effort, and the many others who followed the aftermath of the event through local and national media outlets.

It is still too early to determine the technical causes and contributing factors that resulted in this partial building collapse, but the recent designation of a ***National Construction Safety Team*** (Team) by the ***National Institute of Standards and Technology*** (NIST) to oversee the needed investigation is a good thing. The Team is also charged with recommending appropriate actions to improve the structural safety of buildings like the collapsed one, as well as specific improvements to building standards, codes, and practices. We must wait for this investigation to take its course to learn why this happened, so that we can then implement effective corrective actions to prevent repetition of this tragic and deadly event.

It is however not early enough to recognize that the structural failure we witnessed also ***represents a failure of an entire system*** consisting of all those entities, authorities, processes, and pertinent regulatory environment involved in every aspect of the *life* of a building in Miami-Dade County, from building design and specifications, to project approval, zoning, permitting, construction, testing, project management, code compliance, inspection, project completion and acceptance, certificate of occupancy, real estate practices, condominium association practices, building maintenance, repairs, to building recertification.

It is appropriate for authorities in Miami-Dade County and its municipalities, with support from others with relevant knowledge, expertise, and experience, to conduct a critical review of the various components and processes that constitute such a system.

It is in this context that I offer my comments and preliminary ideas and recommendations regarding areas or processes where improvements and change may be needed, as a contribution to the critically important effort of ensuring all buildings perform effectively under a wide range of anticipated impacts for their entire service lives, protecting life and property and maintaining functionality, and to help prevent similar disasters in the future.

BACKGROUND

The built environment is symbiotically connected with the natural environment and climate. This provides a foundation to understand the site-specific vulnerability of a building, the impacts it will experience during its projected service life as it interacts with known hazards, and determine design criteria and construction methods to ensure continuity of function and effective performance and its capacity to protect life and property?

Understanding this symbiotic connection between buildings and environment allows us to define, qualify, and quantify the ***value at risk***.

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The true value at risk of a building derives from its function as a shelter for ***human activity*** and its capacity to protect life and property and ensure functionality, as much as it does from the costs of design and construction, its market value, and other qualitative factors.

To understand such building/environment interconnection and calculate the value at risk it helps to start by assessing the ***vulnerability*** of the site and community where a building is located.

VUNERABILITY

From the Latin noun ***vulnus*** = wound, the verb ***vulnerare*** = to wound, to be wounded. The roots of the word certainly point toward something painful, something bad, damage, adverse consequences that may happen.

For purposes of this discussion let us define vulnerability as follows:

Vulnerability is the result of the interaction of human activity with hazards. Or, for an even simpler definition: ***vulnerability = exposure to hazards***.

What is the vulnerability of a building in Surfside, or in Miami-Dade County? In relative terms, the vulnerability of a building depends on the characteristics of its site and its immediate surroundings, the hazards that may impact that location, and any natural or artificial features that may act as ***impact modifiers***.

A logical starting point in assessing vulnerability is to determine what ***natural hazards*** affect the coastal region where the building is located.

NATURAL HAZARDS

1) Natural hazards have from time to time caused ***disasters*** resulting in loss of life, vast human suffering, extensive damage to the built environment, infrastructure, and the natural environment, and economic losses to the detriment of development;
2) Beyond documented disasters, natural hazards in this region generate a constant stream of high-frequency low-damaging events whose cumulative impacts over the years slowly and inexorably affect and degrade building envelopes leading to damage, and possible structural damage.

It is important that owners, developers, design professionals, tenants, and authorities understand the combined and cumulative effects of such continuous stream of minor hazard events and eventual disasters, and consider these in their decision-making relative to design-criteria, methods and materials of construction, maintenance and repairs, and the regulatory framework needed to ensure effective performance of buildings and their capability for protecting life and property.

Public Law **P.L. 106-390**, also known as ***Disaster Mitigation Act of 2000 (H.R. 707)***, requires Florida to practice *Mitigation Planning* and adopt a State Hazard Mitigation Plan, as a prerequisite to qualify for certain kinds of federal funding. In compliance with such law Florida has implemented ***The Florida Enhanced State Hazard Mitigation Plan*** (Plan). The current version of the Plan is effective from 24 August 2018 through 24 August 2023 (view the Plan at: *https://www.floridadisaster.org*).

To comply with mandatory Plan updates, every five years the Florida Division of Emergency Management conducts a state-wide ***risk assessment*** identifying hazards that may impact every jurisdiction, indicating the probability of impact and expected magnitude of damage. The report associated with this is an appendix to the Plan itself, and an excellent source of information regarding the vulnerability of any place in Florida.

As a proxy for a site-specific assessment of vulnerability for the Champlain Tower South building, we can identify natural hazards that affect the coastal region of Miami-Dade County along the Atlantic shore of the barrier island and characterize their expected impacts.

For purposes of this discussion let us use the following definition:

Natural hazard = source of potential damage.

Damage includes adverse consequences directly caused by the impact of a hazard on the building, such as structural, architectonic, loss of contents, financial losses, loss of functionality, injury, or loss of life. Also losses caused indirectly by the hazard and long-term adverse consequences from the impact.

All natural hazards involve ***damaging*** components, which are the causes of direct damage. The main natural hazards of concern in this case include the following:

- **Tropical Cyclones**
  Southeast Florida is the most hurricane-vulnerable region in the country having been impacted by several tropical cyclones, including many major hurricanes (category 3 through 5) over the years. The annual Atlantic hurricane season, officially running from 1 June through 30 November, places the entire region at risk.

  Tropical cyclones cause damage by the action of two damaging components: ***wind*** and ***water***, in the form of wind pressure, wind-borne debris, hydrodynamic pressure from storm surge and wave action, floating debris, and a wide range of secondary effects from the actions of both wind and water.

- **Other Wind Storms**
  Although infrequent, ***tornadoes*** and waterspouts are also hazards that may cause significant localized damage to buildings, infrastructure, and the natural environment.

  Twenty tornadoes category EF1 – EF2 have hit South Florida in the last 25 years with winds of 136 kph to 176 kph (85 to 110 mph) causing severe roof and other damage to buildings, powerlines, and exterior infrastructure, and uprooting trees.

  Other wind storms capable of causing damage to buildings placing life and property at risk are microbursts. These are rather common violent radiating wind downdrafts associated with approaching thunderstorms or extreme rain.

- **Flooding**
  Coastal flooding from storm surge and wave runup generated by hurricanes, or King Tides, or inland flooding from extreme rain, are common and increasingly more frequent in this area.

  Water infiltration, hydrostatic and hydrodynamic pressures, floating debris, and soil erosion and scouring, are all potential causes of damage to buildings and infrastructure, related to flooding.

- **Extreme Rain**
  Beyond its capacity for causing flooding, extreme rain itself can cause damage to buildings. Extreme rain may overwhelm the drainage capacity of roofs leading to overloading, water infiltration, and possible structural damage

  The potential for extensive damage to contents and interior systems and finishes, and mold infestation, resulting from water penetrating buildings during extreme rain events, is well documented.

- **Marine Environment**
  The entire coastal region in Miami-Dade County, such as that where the building collapse occurred, is part of a ***marine environment*** where sodium chloride, other electrolytes in the ocean, salt spray in the air, and other contributing factors make it highly corrosive and damaging to buildings.
  Corrosion of steel structural members, of reinforcing steel in concrete, and corrosion of finishes, are well known and a continued cause of damage to buildings in the coastal region. Significant damage occurs unseen below ground as saltwater intrudes into building foundation and below-grade spaces.

- **Geologic Hazards**
  Although there is evidence of land subsidence from a variety of causes as well as sinkholes throughout Florida, the probability of these hazards being a concern in Miami-Dade County, and more specifically the coastal region of interest, is very low based on the historical record. I personally know of no such events in 42 years of being a resident here, except for cases in some manmade islands in Biscayne Bay built with the dredging spoils from the navigation channels in the Port of Miami.

  There are documented cases of land subsidence in the Everglades, and the fact that the urban development that exists is built on land reclaimed from mangroves, wetlands, and the Everglades is concerning. There are natural processes and human activities in progress that may contribute to more active geological hazards in the future.

- **The Exacerbating Factor of Climate Change**
  A contributing factor that makes these hazards increasingly more damaging is ***climate change.***

  Most of these hazards are seasonal, but climate change has been in progress for thousands if not millions of years, with the aggravating factor that human activity is influencing the rate of change leading to more frequent and damaging extreme events.

  Global warming leads to ***sea level rise***, resulting in deeper water near shore, faster flowing and higher storm surge plus higher breaking waves above, and stronger hydrodynamic pressure and impact loads on coastal buildings during hurricanes, and a much higher potential for damage.

  Sea level rise has a horizontal component that in this region is from 150 to 200 times the rise itself. As the sea rises, coastal flooding and storm surge penetration inland will continue to increase placing new buildings at risk and those near the coast at higher risk. This will increase salt water intrusion underground exacerbating the corrosion of foundations and building structures and the potential for damage. Also, the effectiveness of septic-tanks and water management structures will be gradually reduced and may cease to function.

These are but two examples of how climate change is increasing the risk to buildings in this region, by exacerbating the natural hazards to which they are vulnerable.

LESSONS

Knowledge of the vulnerability of a specific building, and how hazards that may cause direct damage, informs how we design and built to ensure effective performance and resilience.

The most important lesson is that damage caused by hazard impacts and disasters is cumulative, and these hazards are being exacerbated by climate change, so their damaging potential will grow incrementally worse in the future. Our building design paradigm must change, from one based on historical data to one focusing on the future and the anticipated hazard impacts during the remaining or projected service life of a building.

QUESTIONS

In the context of exposure to natural hazards and potential damage to our buildings, let us get back to the partial collapse of the Champlain Tower South on 24 June 2021.

Three critically relevant questions arise:

HOW DID IT HAPPEN?

Ongoing work by the NIST National Construction Safety Team will be instrumental in shedding light on the sequence of events, and causality of damage once it is completed.

There is ample evidence of what transpired prior to and during the partial collapse that has been publicly shared. A review of such evidence is helpful in establishing the sequence of events leading-up to the partial collapse of the building.

This is what I believe we know based on publicly shared information:

The disaster event transpired in four sequential but distinct episodes:

1) On Wednesday 23 June 2021 occupants of the building reported feeling some swaying movement and hearing noises emanating from the building itself, which continued into the late-night hours;

2) In the early hours of Thursday 24 June noises increased until there was a sudden loud bang, “like an explosion” in the words of survivors. At that time a portion of the pool deck/underground-garage roof collapsed leaving a large hole;

3) Shortly after, the central portion of the building east of the elevator well and shear wall on the west portion of the building, totally collapsed in the span of about ten seconds. This left standing the western portion of the tower fronting on Collins Avenue, and the northeast corner fronting on the beach and the side street to the north;

4) Some nine second later, the northeast portion of the building slowly started to lean and rotate toward the southwest, in the direction of the initial pool deck collapse, and then suddenly and totally collapsed in about ten seconds. The western portion of the building, including the shear wall and elevator well remained standing.

Except for episode of noises and movement over several hours and the initial collapse of the pool deck, the actual partial collapse of two sections of the building was over in about 30 seconds as shown on available video footage. Also, evident from video footage is that failure appeared to start at the lower region of the tower.

WHY DID IT HAPPEN?

I will defer to the experts of the NIST National Construction Safety Team and wait for their report of findings regarding the technical causes of this partial building collapse.

I would however like to share my opinion regarding ***plausible causes*** of the partial collapse, about which I wrote and posted an article the day after the collapse, because it aligns with this discussion and the questions that follow.

Chloride-induced corrosion and sea-level rise may be plausible causes or, at the very least, a significant contributing factor to technical causes of the collapse.

The Champlain Tower South stood a few feet from the Atlantic Ocean, in a progressively more corrosive marine environment since 1981. During its forty-year service life this building endured the corrosive effects of salt spray in the air, periodic impacts from even more corrosive salt water, and the largely unseen corrosive effect on foundations and below-grade structures due to salt-water intrusion gradually and continuously being pushed further inland and closer to the surface by sea-level rise.

Chloride-induced corrosion attacks reinforcing steel in concrete becoming a slow-acting but incremental process resulting in spreading cracks, and concrete spalling, which may over time degrade the integrity of foundations and other structural members, leading to structural failure. Forty years enduring the effects of corrosion is quite a long time especially if no remedial actions were taken.

A key take-away from this is the realization that a large stock of existing buildings have been facing similar effects in the corrosive marine environment along the coastal regions in Miami-Dade County, and in vulnerable regions elsewhere, making this reality a high-priority concern for local authorities and the public.

WHAT NEEDS TO CHANGE?

There will be many lessons to be learned from this disaster, and many more once the NIST report and recommendations become available, and the findings of a Grand Jury convened by State Attorney Katherine Fernandez-Rundle are made public. Hopefully these lessons will be collectively heeded and lead to decisive and effective actions to prevent repetition of this disastrous event, to reduce risk and potential damage from hazard impacts, enhance the resilience of existing and future buildings affording a higher level of protection to life and property in our vulnerable communities.

I recommend we identify and explore what may need to change, ***not for the sake of change itself but to make our buildings, both existing and future, safer and more resilient***. In Miami-Dade County we have a history of making changes and implementing improvements following transformational events. An example of this is what happened following Hurricane Andrew (1992). Significant changes to the South Florida Building Code considerably strengthened the way houses and buildings are designed and built in Miami-Dade County. This enhanced building code which took effect in 1994 eventually became the especial "***High-Velocity Hurricane Zone***" section of the Florida Building Code effective since 2002. Other provisions implemented in Miami-Dade County in 1994, such as product approval requirements and the testing protocols that support them became models for other counties and states, which now apply these Miami-Dade standards in their own communities. These changes spawned improvements and beneficial changes in other areas such as insurance, risk modeling, mitigation planning, and research, in Miami-Dade County and elsewhere.

Areas where change may be needed and beneficial include the following:

1) **Required Recertification of 40-Year-Old Buildings**

Adopted by Ordinance of Miami-Dade County in 1975 Section 8-11(f) Miami-Dade County Code requires every 40-year-old building to be recertified (***Building Recertification***) by an engineer or architect to ensure the integrity of its structure and electrical system. To support compliance with this requirement the County provides *Recommended Minimum Inspection Procedural Guidelines for Building Recertification***.**

Building Recertification has protected the public well since inception. However, as it tends to happen over time, flaws have developed and become apparent in the program under the glaring spotlight of investigations in the aftermath of the Surfside disaster.

After 45 years, Building Recertification as it exists today has outlived its effectiveness. Knowing what we know today about the vulnerability of this region, the impacts of natural hazards, the exacerbating and increasingly more damaging influence of climate change, and advances in building technology, plus what we are learning from the Surfside collapse, it is clear we need to move on to *Building Recertification v. 2* or even a new comprehensive approach for Building Recertification. Nothing else will suffice toward the objective of protecting life and property by ensuring building performance and resilience.

Developing a *version 2* or a *new approach* for Building Recertification will of course require time, even if an ad-hoc dedicated workgroup were appointed now to start working on this as soon as possible. In view of this, the prudent action is to pursue a two-pronged approach. We must immediately address flaws in the *existing recertification process* by making the necessary changes to enhance and improve its effectiveness as a tool for the protection of life and property. On a second front, as soon as possible, we must undertake a comprehensive assessment of what a *new building recertification process* will need to look like, to incorporate what we now know about expected hazard impacts, the exacerbating effect of climate change, and new methods and materials of building construction, and prevent a repetition of the Surfside collapse.

A critical starting point should be answering the question: ***What is the main purpose of building recertification?*** Is it to certify that the current as-built condition of the building complies with the original code requirements and design criteria, and that it poses no threat to the life and safety of its occupants? Or is it to certify that in its current condition the building will perform effectively under expected impacts from known natural hazards and protect life and property? Or something else?

Those elements of the existing Recertification Process in need of change and improvement are the following:

a) This process requires the professional in charge to be a Florida registered engineer or architect. This is the only requirement stated in the Ordinance. Since the process also involves recertification of the building's electrical systems, it is understood that a Florida licensed electrician or electrical engineer will complete this part of the process under the responsibility of the professional in charge.

   Being a registered engineer or architect does not necessarily equate to having the expertise and experience required for this job. The professional in charge of the recertification must possess

demonstrated expertise in structural design and practical experience in this field of not less than five years.

The professional in charge must also possess expertise and practical experience related to the specific vulnerability of and anticipated impacts in this region. This means understanding what may happen when a building interacts with hurricanes, storm surge, wave impacts, coastal flooding, extreme rain, and other hazards plus the exacerbating influence of global warming and sea level rise.

It is only by possessing these qualifications that the registered professional in charge will be able to certify a building is structurally capable of performing under anticipated impacts from these hazards or recommend what measures to implement to make it reach this capability should it have been found lacking during the recertification process.

I recommend the following approach:

i) Stablish an especial ***Recertification Inspector License*** for registered professionals to undertake responsibility for the recertification process. Requirements for such a license to include demonstration of required expertise and knowledge, by having passed a *structural examination* test or by possessing a valid *structural engineering license*, by having passed a *test on the topics of climate change impacts, vulnerability, risk, adaptation*, and by submitting *proof of practical experience* in structural design and building inspection for a minimum of five years, and an application process and fee;

ii) Work with pertinent Professional Licensing Boards in Florida to approve a ***structural engineering license*** to certify specific expertise in structural design;

iii) Explore allowing licensed engineers (PEs) in fields other than structural design, and licensed architects to demonstrate expertise in structural design by successfully taking a test, such as the 16-hour ***NCEES*** (National Council of Examiners for Engineering and Surveying) ***structural examination***.

iv) Require the professional in charge of recertification to hold a valid Recertification Inspector License.

b) Being a registered engineer or architect does not necessarily qualify the professional for completing the required inspections involved in the recertification process.

Develop and implement a required online training program to educate licensed professional engineers or architects on the proper methodology to effectively complete inspections under the recertification process. This program could be modeled after similar training programs, such as for ***"Conducting Vulnerability Assessment"***, implemented by the American Institute of Architects (AIA) through their online training arm ***AIAU***, or what the State of Florida did prior to the adoption of the ***Florida Building Code*** in 2001, by instituting an online training program for building design and construction professionals to familiarize them with minimum requirements of the new code. This will ensure uniformity in the inspection methodology and should be a requirement for the recertification inspector license

c) Being a registered engineer or architect does not necessarily equate to a professional having pertinent knowledge of topics that may be relevant during the process of recertification, such as: vulnerability, risk, hazard mitigation, adaptation, climate change, global warming, sea level rise and others.

   Miami-Dade County should develop a required online and/or in-person course addressing such topics from the perspective of the built-environment and relevancy for the recertification of a building. Optionally the County could explore the offering of courses by FEMA (Federal Emergency Management Agency) and select one or two that could fulfill the need for this specific training.

d) Another flaw in the recertification process points toward ***difficulties in enforcing compliance***. Anecdotal and documented evidence informs of cases where the process has not been completed years after the notice of required certification to the owner. Correct this by increasing escalating penalties and fees for civil violations and stablishing shorter and stricter timeline for completing the recertification process, including submission of the require report.

e) The scope of the recertification process and the minimum procedural guidelines that go with it should be expanded, to include a site-specific assessment of vulnerability and either certification that the building has the structural capacity to sustain anticipated loads from hazard impacts during its estimated remaining service life or recommendation for actions to attain the required structural capability.

f) Waiting 40 years after a building is built to complete the recertification process is probably too long, especially in the aggressive marine environment of the coastal region, and in view of emerging anecdotal evidence of generally slack or often postponed maintenance practices to combat the adverse effects of the passage of time in such an environment. I recommend full recertification should be completed when a building reaches 25 years of service and every 20 to 25 years thereafter, and I further recommend these milestones should be preceded by interim inspections every five years from the time the certificate of occupancy was approved. This approach offers a more realistic opportunity for detecting problems and implementing remedial actions than the current requirement.

2) Project Approval

Approval of a new building projects starts with agreement between owner and the design team, followed by, zoning, planning board approval, plan review, building permit, building site inspection, and ends with the certificate of occupancy.

There is an entire network of individuals and agencies involved in a multi-phased review and approval process from before construction until the building is allowed to be occupied. This means there are several opportunities for alerts or red flags to be raised, and for correction and changes to be made during this process.

Each component of this network plays a critical role individually and as part of the collective whole, but it is critically important that all involved know and understand this, and that there is communication between the parts during the process. Each part must always have knowledge of what others previously involved have done, especially regarding alerts or concerns about specific aspects of the project.

One particularly weak link in this process is the role of the *Planning Board*. It appears the focus of project review by the Planning Board is on how the aesthetics of a new facility "fit" within the character of the surrounding community, or how it may affect vehicular traffic and demands on local infrastructure. But regarding risk the Board's review does little beyond issues of fire-safety and evacuation plans during emergencies.

Planning Board review offers the best opportunity to address critically important issues, because it takes place prior to the building design and construction documents being completed, regarding site-specific vulnerability of a new building to natural hazards during its projected service life, and how design criteria and building management plans will ensure the safety of occupants and property.

I recommend the County sets requirements for Planning Boards to review these issues of site-specific vulnerability and hazard mitigation plans and to request projects owners to respond with concrete answers on how they will effectively address these matters.

I also recommend the County establishes a database, if one does not exist already, where all parts of the project approval network can see what other parts have done prior to taking their own actions. This will ensure that concerns raised by the Planning Board have been addressed through effective measures incorporated by the design team, allowing the building department to consider this during plan review, prior to issuing a building permit.

3) Condominium Boards

The regulatory environment under which Condominium Boards operate is outside my area of expertise. What I know is entirely based on anecdotal information, and on media reports including several published after the Surfside disaster.

Based on such limited knowledge, I suggest the County should investigate the following areas where changes may be of benefit:

a) Require condominium boards, made largely of volunteers with little to no expertise, in structural building design, the site-specific vulnerability of their property, or the exacerbating influence of climate change, to have a remunerated *ex-officio* board member position filled by an engineer or architect, or subject-matter expert who would advise the board on issues related to structural and building vulnerability matters.

   Or as an option require condominium boards to retain the services of an *on-call* professional or subject-matter expert whom the board would be required to consult when structural damage or other building risk issues come before the board.

   This will help reinforce the capabilities of a condominium board for making informed decisions on topics where in most cases its members lack the required knowledge or expertise.

b) Require condominium boards to set-up an escrow account under the custody of a Bank's Trust Department to deposit funds to be held in reserve for needed structural repairs or improvements to the building. This will avoid the problem of assessed funds being used for other purposes.

4) Real Estate

Realtors play a significant role in the sale and purchase of properties, including condominiums.

I have participated in several realtor events over the last few years both as a speaker or subject-matter expert in the fields of adaptation to climate change, risk and vulnerability to hurricanes and hazard mitigation, including at least one organized by the Miami Association of Realtors, and by realtor groups in Broward and Palm Beach counties. Through these events, I have learned that realtors are quite concerned about how these risks and vulnerability issues may affect the value of properties, and their role in informing buyers or sellers.

The more knowledgeable realtors are about the condition of a building and its vulnerability to hazard, the better able they will be to inform clients for the benefit of everyone involved and the community at large.

The County should create a publicly accessible database where condominium boards and owners of property for sale would be required to post information on the current condition, vulnerability, and risk. Information such as: prior history of damage from hazard events, description of sustained damage, description and cost of repairs or enhancements, dates and amounts of assessments to fund needed structural repairs, findings, and recommendations from completed recertification of 40-year-old buildings.

Realtors should be required to disclose such kinds of information to potential buyers when first offering a property.

The suggested database, and requirement for owners to post risk data in it, and of realtors to disclose risk information will promote an environment of informed decision-making, which can only serve to protect life and property and avoid disasters such as the Surfside collapse.

5) Building Code

Miami-Dade County has the toughest building code in the nation when it comes to building design and construction in a region vulnerable to tropical cyclones. The current building code incorporates important lessons learned over the years from the impact of hazards.

Regarding the building code we must recognize that it only establishes the *minimum requirements* to legally build in this county. The code does not address all expected impacts during the projected service life of a building.

The County should work with the State Building Commission, the International Code Council, perhaps the American Society of Civil Engineers (ASCE) as a standards development organization, and the National Institute of Standards and Testing (NIST) to create a especial ***Marine Environment High Hazard Zone*** (***MEHHZ***) as a section of the Florida Building Code, along the lines of the existing ***High Velocity Hurricane Zone*** which sets especial structural requirements and prescribes methods of construction to enhance structural performance under the impact of hurricanes.

The MEHHZ would be used to set design and construction requirements to strengthen the structural capability of buildings in the coastal region. One such requirement should be the ***use of non-corrosive or corrosion-resistant reinforcement for reinforced concrete, or similar requirements for the protection of pilings and foundation against the corrosive effects of salt water intrusion***. Other requirements should address mitigating damage from the impact of storm surge, breaking waves, and flooding. The County would be well-served by engaging local structural engineers and other subject-matter experts to help draft the specific requirements and prescribed methods that would go into this section of the code.

6) Design Criteria

Design criteria used by architects and engineers to comply with the building code in the design of a new building are largely based on historical data, regarding external structural loading conditions during past hazard events, and on statistical probabilities regarding the frequency of occurrence or the exceedance of certain loading conditions.

Establishing design criteria in this manner leaves most buildings at risk of future damage from changing and increasingly more strenuous future loading conditions during their expected service lives. Certainly, save the exceptional cases where the design team exceeded code requirements, the entire stock of existing buildings is at risk of experiencing stronger external loading conditions in the future than what they were designed for. This is especially true with respect to buildings in the coastal region where the exacerbating influence of global warming and sea level rise will inexorably generate higher waves, higher and faster flowing storm surge, and stronger more damaging impact and hydrodynamic loads in the future.

A paradigm change in building design and construction methodology is clearly needed!

The County should require new projects to demonstrate their design criteria has considered anticipated maximum loading conditions, from hazard impacts, during a minimum projected service life of 75 years. These requirements could be set within the recommended MEHHZ or elsewhere within the various phases of a project approval process, but certainly before a permit is issued.

7) Professional Licensing

Making changes and establishing new requirements will only contribute to a solution to the degree that practicing building design and construction professionals understand the reasons for these, and proactively adopt them into their practices and implement them within their projects.

Toward that objective, the County should work with pertinent professional licensing boards to ensure professionals applying for licenses or re-licensing demonstrate robust knowledge of the issues involved and the purpose of various changes and new requirements. This will be achieved by including pertinent questions in the tests professionals must take.

The same approach should be used with licensing of realtors.

8) Education

New requirements and professional licensing procedures mean new graduating design and construction professionals will need to acquire new and relevant knowledge during their academic formation.

The County should work with the Florida State University system, and private universities, to enhance the curricula of building design and construction professions such as architecture, engineering, construction management, reflecting the need for new knowledge and a new philosophy of design and building construction that is relevant to Florida's particular vulnerabilities and requirements for a resilient built environment.

Subject matter such as: wind engineering, design and construction in a marine environment, vulnerability assessment, climate change adaptation, hazard mitigation, and similar ones would help equip new professionals with the necessary tools to confront the challenges of building in Florida's coastal region.

Collaterally with this, new outreach and continuing education offerings focusing on the same subject matter mentioned above, should be developed, and made available to practicing professionals.

9) Climate Action Plan

For the past fourteen years Miami-Dade County had joined Palm Beach, Broward, and Monroe counties in a unique collaborative effort known as the ***Southeast Florida Climate Change Compact*** (the *'4 County Compact'* for short).

Much that is of benefit has resulted from the work of the 4 County Compact, including new policies adopted by Statute, such as the ***Adaptation Action Areas*** planning tool to help Coastal Communities adapt to coastal flooding, other planning recommendations including ***Climate Action Plans*** adopted by resolution of the respective County Commissions.

The 4 County Compact could generate even more benefits by proactively and formally engaging the building design profession and related subject-matter experts in a concerted effort, perhaps by creating an ad-hoc working group, to develop design guidelines or prescribed retrofitting methods to strengthen the structural capabilities of existing buildings, enhance the performance of new buildings, under the expected impacts of future hazard events, and significantly reduce the possibility of repetition of incidents such as the Surfside collapse. The product of this work could be delivered in an annual report and become a topic of discussion during the 4 County Compact annual summits.

This added dimension to the 4 County Compact would be in line with how the ***National Climate Assessment*** by the *U.S. Global Change Research Program* (USGCRP) and the ***UN Climate Report*** by the *Intergovernmental Panel on Climate Change* (IPCC), have evolved to include entire sections on adaptation solutions for the built environment.

As a member of the 4 County Compact Miami-Dade should initiate this by proposing it to the other members, and by drafting and initial agenda for the workgroup.

10) Research

Given the numerous questions following the Surfside collapse much work needs to be done to provide answers and find solutions. Scientific applied research can be of significant help in finding answers and identifying solutions to existing or still undiscovered problems.

The investigation undertaken by NIST will involve research that is narrowly focused on the technical reasons for the partial building collapse. A much wider research agenda is needed to address building design and performance in the hazardous coastal environment of Miami-Dade County.

There are excellent research centers at public and private universities (University of Miami, and Florida International University) in Miami-Dade, including the International Hurricane Research Center, and throughout Florida. These institutions can certainly play a significant role in searching for the answers and solutions we seek.

But above and beyond that what is really needed is for Miami-Dade County to set its own research agenda to address the specific questions and issues arising not only from the Surfside disaster, but more amply from the vulnerability of this area, in particular its coastal region. Miami-Dade would do well to create a position of Science or Research Adviser within the Office of the County Mayor, much along the lines of the Office of Science and Technology Policy at the White House. One purpose of this office would be to establish and oversee a research agenda that responds to specific needs of this county in the field of building design and performance, the vulnerability of the area, adaptation, hazard mitigation and other related topics. The County would need to actively pursue funding and work with local and other research institutions to carry out needed research.

One specific topic of research to be included in the County's agenda is the limestone-porosity conundrum which has precluded for many years any consideration of coastal or offshore infrastructure to protect the region from the combined impacts of storm surge, waves, and sea level rise.

THE END