

How will the community of practice in historic conservation rise to the challenge and opportunity of Climate Chaos, now upon us?



Fig. 1. Former Don Valley Brickworks, Toronto, Ontario, built 1889, shown here ca. 2010, being adaptively reused as the Evergreen Brick Works, a community, education, event, and commercial mixed-use center. Included in its adaptation plan, the rehabilitation design and new use purposely allows the annual Don River flood to carry water over the property, respecting the laws of nature. Courtesy of Loozrboy, Flickr, <https://www.flickr.com/photos/loozrboy/5013030914/>.

The community of practitioners who deal with the built environment, like society in general, has now entered a defining moment. It is a period of great opportunity and great risk. The Intergovernmental Panel on Climate Change (IPCC) tells us we have only a decade to slow or stop the processes of “Climate Chaos,” to prevent what is otherwise the assured rapid acceleration of Earth’s destruction.¹

Make no mistake: This is the challenge of our lives. It renders pale all our otherwise noble professional efforts and technological advancements towards the conservation of historic places and with them our collective memory and understanding of who we are. This is our generation’s urgent clarion call, like President John F. Kennedy’s 1961 challenge to the United States to land a man on the moon. That challenge was fulfilled in less than a decade, 50 years ago. Will we be able to look back at a successful fulfillment of this new challenge, 50 years from now?

Today’s carbon challenge is much more complicated than a successful moon landing, with much more at stake. It must involve collaborative and strategic efforts by many professionals, including the conservation community. It requires significant “stepping up” by those whose particular skills and leadership

can provide major contributions to the required complex matrix of decarbonizing solutions. Our collaboration must occur throughout multiple disciplines, involving many nations.

Heritage-conservation professionals have developed advanced skills of questioning further, delving deeper into root causes, and probing wider to gain a clearer understanding of our projects. We have skills and experience in determining value and knowing how to protect it. We are truly cross-disciplinary and collaborative. We have honed these skills in our work with interventions to existing buildings. This is the very resource—existing buildings—that is determined to be the single largest contributor to carbonization and Climate Chaos.² “Stepping up” therefore is not just our opportunity; it is our urgent responsibility, now and for at least the next 10 to 30 years. It must become an integral part of the next 50 years of conservation.

This paper emanated from the special theme plenary entitled “Climate Chaos and Historic Building Environments: The Intersection of Preservation and Resilience,” which was one of the three opening plenaries for the APT Buffalo-Niagara 2018 Conference and contributed to the post-conference Next Fifty Symposium.

Introduction: Conservation and Decarbonization

The challenges of Climate Chaos and its symptoms are profound. Overcoming them will require reasoning with new frameworks and approaches; as Albert Einstein said, “We cannot solve our problems with the same thinking we used when we created them.”

In the face of these threats, the solutions for historic conservation will challenge the very foundation of its precepts, such as authenticity, context, and integrity. Fundamental questions arise. How will we:

- apply *The Secretary of the Interior’s Standards for the Treatment of Historic Properties* or Parks Canada’s

Standards and Guidelines for the Conservation of Historic Places in Canada in the context of new climate realities?

- mitigate impacts from severe weather events upon historic places and increased climate variabilities that are already happening?
- adapt our built heritage to new climate-disaster realities?

These areas of inquiry will be keystones in heritage-conservation work for the next three decades.

With the onset of the “low-carbon economy” with its associated “race to net-zero” and concerns for protecting built heritage from climate-based threats, heritage conservation must now fully integrate with, and adapt to, decarbonization and climate-protection planning.

Heritage conservation contributes to creating a sustainable built environment and resilient communities; but in a chaotically changing world, how can conservation persevere? Must we reimagine historic buildings and landscapes?

Prevention, Mitigation, and Adaptation

When it comes to understanding and fighting Climate Chaos resulting from escalating built-environment carbon emissions, there are generally three areas of endeavor: prevention, mitigation, and adaptation. Mitigation and adaptation are the foci of this article.

The term “prevention” is about finding ways to reduce embodied and operating carbon emissions to zero, or even to net-positive, through material decarbonization, the use of renewable energy sources, and carbon sequestering. The conservation community has a large role to play in prevention, especially in the adaptive reuse of older buildings and the development of a greater understanding of embodied carbon and its role.³ The Association for Preservation Technology’s Technical Committee on Sustainable Preservation (TC-SP), among its other mandates, delves into that task. The TC-SP, in turn, has a fo-

cus group that is specifically concerned with carbon reduction; its APT representatives are the current co-chairs of a five-organization strategic collaborative, the Zero Net Carbon Collaboration for Existing & Historic Buildings (ZNCC).⁴ The ZNCC is focused on research, solutions development, and networking of groups that are participating in the search for massive reductions of operating and embodied carbon toward a carbon-free world in 2050, as per the Paris Agreement targets.⁵ This is a significant task. APT’s role will continue to include ensuring cultural values remain central to objectives and planning in this field.

The term “mitigation” is the collective set of actions aimed at neutralizing the effects of carbon-generated Climate Chaos on existing and historic places. It is the development of “strengthening” interventions that can be undertaken to reduce impacts upon properties from climate-generated destruction, such as floods, excessive heat or cold, high winds, tornadoes, hurricanes, sea-level rise, and more.

The term “adaptation” is the collective set of actions aimed at modifying existing and historic properties in significant ways to reduce the need for more mitigation. Adaptation could involve, for example, raising historic buildings, moving them away from the coast, or taking other actions that may change the perception of the original building and its contextual relationship.

With both mitigation and adaptation, there are hard questions to be answered with respect to maintaining the character-defining elements that give a place its heritage value. Finding new, creative solutions are required for both. Over the last two centuries, we have increasingly used technology-based solutions to solve large challenges in overcoming natural processes or systems. Recently, we have seen exponential change brought on by rapidly advancing technologies.

The Anthropocene and Exponential Change

The Anthropocene has been defined as denoting “the current geological age, viewed as the period during which human activity is the dominant influence on the earth and its ecosystems, including, but not limited to, anthropogenic climate change.”⁶ This period continues through to the present and will do so until a massive paradigm shift in human nature occurs. This shift would be characterized by the willingness to work within natural processes and systems, rather than by a continuation of behavior that seeks to disregard, dominate, or overcome nature. In other words, such a shift would require embracing nature-based systems instead of applying only technology-based systems (Fig. 1).

Solutions: Technology, Ecology, and Hybrids

Some would have us rely on the imminent employment of rapidly advancing or “exponential” technologies to overcome the Climate Chaos problem, retaining business as usual.⁷ But if, for example, the technology solution is simply to cover properties with photovoltaic panels and wind turbines, how does that impact historic properties? Is that a heritage-conservation approach? Relying on technology alone to solve this problem is fraught with risk and may even prove disastrous.

Others would have us look to nature itself to generate solutions, that is, to develop biological or nature-based solutions (for example, cultivating forms of algae or natural building materials that store massive amounts of carbon), to reverse the natural destruction we have now ignited. The ecologist István Kenyeres has postulated, “We don’t have to save the environment—the environment is us.”⁸ That sentiment is compelling, but it does not equate to an imminent bio-solution to the carbon problem nor comfort us that humankind’s great disasters inflicted upon the planet can be fully overcome by nature itself.

Perhaps then, complex hybrids are the most likely conservation solution to achieve effective mitigation and adaptation, where we use both advancing technology and the lessons of nature to generate solutions, framed with a heritage-conservation approach. For example, “deep green” rehabilitation of a historic building—the use of advanced green technologies—will help us reduce carbon emissions; however, also harnessing the inherently and naturally sustainable features of the building itself (such as applying the natural principle of “hot air rises”) will put us over the finish line to zero-net carbon. The interconnectivities between culture, nature, art, and science, first identified by Alexander von Humboldt in the early nineteenth century, may be instructive here. In fact, the Prussian polymath, earth scientist, and cultural geographer “was the first person to describe the phenomenon and cause of human-induced climate change, in 1800 and again in 1831, based on observations generated during his travels.”⁹

APT’s 2018 Climate Chaos Plenary

Finding both technological and nature-based solutions for climate-related threats to heritage permeated the theme of the plenary session “Climate Chaos and Historic Building Environments: The Intersection of Preservation and Resilience” at the Buffalo-Niagara conference. The session examined mitigation and adaptation against extreme weather threats to historic places.

The question was posed: How can we simultaneously preserve our heritage and plan for climate resilience? Resilience has been defined as “the capacity to adapt to changing conditions and to maintain or regain functionality and vitality in the face of stress or disturbance.”¹⁰ Historic buildings and districts can be both supportive of community resilience and resilient themselves.

The panel of speakers and their presentations were:

- Mark Thompson Brandt, session lead, “Nexus of Preservation and

Elizabeth Kolbert, “From the Control of Nature: Can Engineers Save Louisiana’s Disappearing Coast?,” *The New Yorker Magazine*, April 1, 2019.

Ed.: Perhaps, when it comes to the base behaviors of the natural world, humans may be unable to simply apply technological engineering solutions for success, as we previously assumed. We may have to design with nature instead, or as well as, using technology. These excerpts from Elizabeth Kolbert’s cautionary tale about using only technology-based solutions are instructive to considerations about how best to mitigate and adapt historic properties for sea-level rise. <https://www.newyorker.com/magazine/2019/04/01/louisianas-disappearing-coast>.

Plaquemines Parish is where the river meets the sea. On maps, it appears as an . . . arm stretching into the Gulf of Mexico, with the Mississippi running . . . down the center. Plaquemines has the distinction . . . of being among the fastest-disappearing places on Earth.

(By the 1730s,) levees stretched along both banks of the river for nearly fifty miles. These early levees, made of earth reinforced with timber, failed frequently. But they established a pattern that endures to the present day. Since the city wasn’t going to move to suit the river, the river would be forced to stay put. With each failure, the levees were improved. (By) 1812, they ran along the river for more than 150 miles.

(Since 1930,) Louisiana has shrunk by more than two thousand square miles. Every hour and a half, Louisiana sheds another football field’s worth of land.

A variety of factors are driving the “land-loss crisis.” Thousands of miles of levees, flood walls, and revetments have been erected to “manage” the Mississippi. This vast system, built to keep southern Louisiana dry, is the very reason the region is disintegrating

During floods, sand and other heavy particles tend to settle out of the water first, creating what are known as natural levees. . . . In this way (the Mississippi) assembled the Louisiana Gulf Coast out of bits and pieces of Illinois and Iowa and Minnesota. . . . Because the Mississippi is always dropping sediment, it is always on the move, seeking new and faster routes to the sea. Its most dramatic leaps are called avulsions. In the last seven thousand years, the river has avulsed six times and each time it has set about laying down a new bulge of land. . . . The next avulsion is now overdue.

But New Orleans’s world-class drainage system, like its world-class levee system, is a sort of Trojan solution. Since marshy soils compact by de-watering, pumping water out of the ground exacerbates the very problem that needs to be solved. The more water that’s pumped, the faster the city sinks. And the more it sinks the more pumping is required.

A Mississippi that’s been harnessed, straightened, regularized, and shackled can still exert a godlike force; it’s no longer a river, though.

Resilience: Re-Imagining Historic Places for Climate Chaos”

- Robert Hotes, “Coastal Resilience: Strategies Addressing Sea-Level Rise in Historic Districts”
- Priya Jain, “Houston’s Buffalo Bayou: Present Challenges and Visions for the Future”
- Tom McGrath, “Resilience: A Preservation Response to Sea-Level Rise and Climate Change”

Brandt introduced the plenary by inviting attendees to think broadly about resilience, including consideration of Indigenous and nature-based approaches. For example, environmental scientist David Suzuki describes Indigenous peoples’ “deep attachment to place” as the ingrained sense or drive to automatically and simultaneously care for both natural and cultural conservation of a given place. This underscores the essence of our realization that historic conservation is inextricably linked with environmental realities, ecological processes, and natural conservation.¹¹

The speakers at the plenary explored various responses to sea-level rise and extreme storms driven by climate change, incorporating resilience measures into practice. We were provided insight through case studies into community preparation in anticipation of these events, actions in the aftermath of flooding, and other examples from the perspective of heritage professionals.

Robert Hotes reported on Weather It Together Annapolis, a model for community engagement in preparation for the anticipated 44-inch rise in the Chesapeake Bay within the next hundred years. Through a combination of subject-matter expertise and community engagement, Annapolis has established a collective vision with goals, objectives, and community buy-in that will shape the city’s response in the years to come (Fig. 2).

Hotes also shared the perspectives of the emerging generation of design professionals as they confront the issues of rising water levels in the neighborhood surrounding historic Bridge Street, in Newport, Rhode Island. Three student

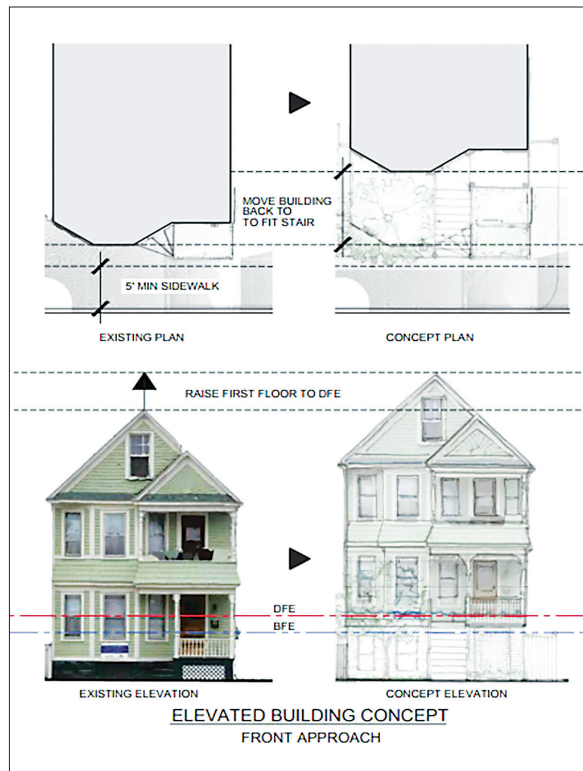


Fig. 2. In preparation for the anticipated 44-inch rise in the Chesapeake Bay within the next hundred years, models for community engagement—like this concept for adaptation, raising, and slight relocation of a historic house—helped establish a collective vision for Annapolis. This suite of shared goals, objectives, and community buy-in will shape the city’s climate-change response over the years to come. Courtesy of Lisa M. Craig, of The Craig Group, for Weather It Together Annapolis.

Fig. 3. Climate-smart interventions in historic places. “Grey Green Blue” is a project of Angelica Carvahales, Eder Romero, and Sneha Mathreja, then students in the master’s in adaptive-reuse program at the Rhode Island School of Design. It proposes a long-term strategy of turning streets into linear parks with built-in water-retention capacity; the parks would eventually become canals as the sea level rises. Courtesy of Liliane Wong, 2017.



projects, undertaken in a Rhode Island School of Design studio, approached the problem in very different ways. One presented a long-term strategy of turning the streets into linear parks with built-in water-retention capacity; the parks would eventually become canals (Fig. 3). Another, more theoretical project, provocatively relocated historic homes into a vertical exoskeleton. The

third strategy took a playful, educational-outreach approach as it created a virtual, augmented-reality game to allow players to see what the higher water levels would look like on Bridge Street and collaboratively try to “save the street.” Through all examples, Hotes made clear the necessity of working collaboratively across disciplines and within the community.



Fig. 4. Buffalo Bayou Park, Houston, Texas, 2018. Extreme floods in 1929 and 1935 devastated historic downtown Houston. A flood control district was created in 1937, and in the following decade, millions of dollars in public funds provided for an extensive drainage program throughout the bayou basin. The Buffalo Bayou Partnership's 2002 master plan established a new 20-year vision for the bayou centered on a series of linear parks through central Houston, including the rehabilitation of former industrial land, habitat restoration, and flood mitigation. The landscape design of the executed project allows for major diversion and runoff, and amenities are constructed with durable materials, like concrete and stainless steel, to withstand flooding and debris. Courtesy of Priya Jain.

Speaker Priya Jain described the geographical and historical context of Houston, Texas, and how Hurricane Harvey proved so devastating in 2017, despite the city's presumed readiness, given its long history of flooding. The city's flat topography and series of slow-moving rivers, or bayous, had led to flood mitigation and prevention strategies in the past, including the development of hardened reservoirs for water retention and control. Intense citizen action spared the Buffalo Bayou the fate of the city's other bayous, which had been straightened and lined with concrete and would worsen the flooding over time (Figs. 4 and 5).

Jain presented a series of case studies of adaptation designs in both buildings and landscapes along the Buffalo Bayou. Some examples, such as buyouts of developed flood-prone parcels to create bayou greenways, demonstrated the potential of thoughtful design to transform necessary adaptation and mitigation strategies into amenities and catalysts for improvements in the surrounding community. Other examples, such as building flood-proofing measures, illustrate the sobering reality that if not built to match the severity of the flooding, even the best intended adaptation measures may fail.



Fig. 5. Sunset Coffee Building, along the Buffalo Bayou, Houston, Texas, built 1910, photograph 2018. The building had been recently renovated when Hurricane Harvey hit in 2017. While the rehabilitation was designed to withstand flooding, the building did sustain damage to its elevators and electrical systems. Courtesy of Priya Jain.

Tom McGrath's presentation translated the effects of sea-level rise into the daily work of conservation professionals, including the need to incorporate resilience strategies into building evaluations for heritage properties. Through his observations and experiences working in Key West, Florida, and Nantucket, Massachusetts, after severe storms, he presented clear lessons learned, examples of flooding-resilience measures, and resources for technical guidance (Figs. 6 and 7).¹²

Cumulatively, the speakers raised important emerging concerns. Within the conservation community and the general public, awareness and comprehension are needed first. Far too often we

need to live through the effects ourselves before they are fully understood. But we must help develop that understanding in advance, through augmented reality, modeling, continuing education, and other tools.

This new awareness must turn quickly to collective, active response, in preparation for these threats. While many individual responses are necessary, it is through collective action that a cohesive and improved context will allow us to retain the integrity of our built environment. This preparation will then also shape prioritization of decisions made in the aftermath of severe weather events, when it is necessary, yet most difficult.



Fig. 6. Straight Wharf, Nantucket, Massachusetts, during flood in March 2018. Courtesy of H. Thomas McGrath Jr.



Fig. 7. Straight Wharf after the flood in April 2018. Courtesy of H. Thomas McGrath Jr.

Between the on-the-ground activities of communities building a body of knowledge and resilience and the sometimes radical next level of reimagining the long-term adaptation of historic places, one thing becomes clear: Much creativity, natural science, and technology need to be developed and applied before we get to a “comfort zone” for both the protection of and the adaptation for historic places in the face of climate threats. There is much to be done to both mitigate threat and protect heritage value.

The Vulnerability Assessment

The community actions against the impacts of Climate Chaos described at the APT conference show us what people are doing to mitigate for and adapt to climate change. Some of these efforts are projections for more extreme solutions, which will perhaps be the norm in the future. Practically speaking, how does a property owner or jurisdiction get started?

The first step is to understand and assess the situation on the ground. Climate-change vulnerability and adaptation (CCVA) assessments are relatively new methods of documenting conditions and outlining actions with respect to severe weather events and their impact, including those upon historic places. Conducted by scientists, engineers, and conservation professionals, CCVAs analyze “current impacts and projected future risks of climate variability, and to identify policies and programs to increase resiliency to these risks.” CCVAs provide property owners, “emergency management officials, stakeholders, and the public with information on the magnitude and pattern of current and future health risks” associated with severe weather events. They also identify opportunities to prevent or reduce the severity of future risks and “serve as a baseline analysis against which future changes in risks and in associated policies and actions can be monitored.”¹³

CCVA planning is currently being undertaken for a historic precinct for the Canadian city of Ottawa by MTBA Associates Inc., along with prime con-

sulting architects, engineers, and planners and earth-science and landscape specialists. MTBA’s role was to provide advice on how the heritage qualities and assets of the precinct are vulnerable or resilient.

The approach is holistic and integrated with wider approaches to combat the effects of Climate Chaos in, for example, public safety or urban planning. Holistic and integrated approaches are familiar to conservation professionals; this is another reason why the heritage-conservation community can take a leadership role in making wise decisions about mitigating the effects of climate change while minimizing long-term, irreversible impacts to the heritage value of buildings or districts. This CCVA concentrates on the early stages, where a vulnerability assessment helps us better understand the nature of the historic place (a primary tenet of the *Standards and Guidelines for the Conservation of Historic Places in Canada*, the national reference). In this case, the focus is on the broad range of potential vulnerabilities that the historic precinct may have.

To establish an organizing order for the overall assessment, the team used the PIEVC (“pie-vee-see”) Protocol, which was developed by Engineers Canada to create a framework that can identify risks, highlight areas to protect, and build resilience. Since its release, this protocol has been applied dozens of times in Canada and several times in Central America.

The protocol is not a software program, but a common-sense process with several steps:

- Define the boundaries to be evaluated. The boundary could be one specific building or a district.
- Collect information. Locate sources from which to get reliable data about the buildings and infrastructure, for example, from recent roof, foundation, or ventilation-system inspections.
- Determine the climate events that may impact the place. For example, prolonged heat is not an issue for concrete, but it could severely affect the building’s HVAC system.



Fig. 8. Parliament Hill, Ottawa, Ontario, built 1859–1927, on its escarpment above the Ottawa River, which is exposed to extreme west winds and storms. This 2020 view is from the historic Chaudière Bridge across the Ottawa River, a historic crossing that first joined Upper and Lower Canada. In 2018 a one-in-one-hundred-year flood, the second in only two years, caused the closure of the bridge and flooded the base of the escarpment. At right is the Booth Board Mill complex (built 1912, enlarged 1918 and 1928, closed 1980). It is part of the Chaudière Islands Historic District and an element of a \$1 billion district rehabilitation and mixed-use redevelopment and is particularly vulnerable. Courtesy of MTBA Associates Inc.

- Perform a risk analysis. This is often a huge matrix, with potentially hundreds of infrastructure components and a dozen or more potential weather-event elements. The protocol’s risk-assessment analysis helps eliminate the unimportant interactions among these components and elements, cutting, say, a thousand interactions down to a hundred. Establish an iterative process for managing and monitoring risks.
- Consider solutions (the adaptation step). Ask questions such as “How are we going to adapt?” “What are mitigative measures to minimize the impacts of those risks?” Look at how component failures will impact the building and the community. This is the creative part of the process. Integrate and collaborate widely with professionals from a variety of disciplines: planners, operators, policy experts, architects, engineers, conservationists, and other specialists. Examine potential benefits and hindrances of adaptation and mitigation options implemented in related sectors. Require rational logic sequences in developing of potential solutions to resilience enhancement. For example: How practical is it to disassemble and reinstall 150-year-old roof slates using a new technologically advanced

clip system? What are the relative advantages with elevating a building versus constructing a permanent flood-restraining perimeter wall?

Comparative scenarios could involve a protracted level of analysis, modeling, and sometimes even community input-gathering to ascertain the optimum solution. In each case, the alternatives for historic places are filtered through the lens of the physical and visual impacts upon heritage value. Otherwise, they go through the same filters as all infrastructure, including community, cost, and health impacts.

PIEVC Protocol can be applied to a wide range of infrastructure, including heritage structures. Establishing a “climate risk, vulnerability, and mitigation profile” focuses on actual key risks. Identifying these enables the development of useful solutions.

From a heritage-conservation perspective, the emphasis is on identifying character-defining features of the historic place. Threats to these features become the “key risks.” Risk assessment for historic properties may be able to benefit from many years of meteorological data, which may reveal patterns and resilience; for example, a one-in-one hundred-year flood or hur-

ricane that has previously threatened similar historic elements in the vicinity. On the other hand, the age of historic properties may lower their tolerance to impact, potentially increasing the degree of unknowns and risk with severe weather events not experienced to date (Fig. 8).

Defining Climate Hazards

The assets of the Ottawa historic precinct range from low-level heritage resources to some having the highest value in the country. There are many designated heritage buildings, plus many other historic resources, which together make up a significant (though not yet designated) cultural-heritage landscape. Therefore, any impact, not just to individual properties but to the entire area, is cause for concern.

Generally speaking, due to their age (90 to 160 years), these properties are more susceptible to impacts from weather events, despite an ongoing, intensive program of maintenance and rehabilitation of a number of buildings. Meanwhile, other damaging weather events can occur. This is a significant factor, as it will take more than another decade of rehabilitation to complete the current program.

Reed Karaim, “Miami Confronts Rising Seas,” *Architect Magazine*, July 2019.

Ed.: Climate Chaos is with us now. Studying how people have succeeded (or failed) to deal with it is mandatory to build a body of knowledge and management strategies within the heritage context. Reed Karaim reports that we may need to be nature-creative and site-specific, taking a “water world” approach to urban design that builds around ecological systems, rather than around “static environments defined by geopolitical boundaries” that defy nature. <https://pubhtml5.com/zhka/nnlu>, page 85.

Adaptation. Resiliency. Evolution. I heard these words over and over again as I met with architects, urban planners, and city officials.

The impact of climate change has already arrived in South Florida: increasingly severe storms, “sunny day” flooding (water rising up through the porous limestone that forms the bedrock), and rising sea levels—the ocean here has risen 8 inches since 1950. . . . By the end of this century, the seas breaking along the shore in Miami and Miami Beach could be as much as 81 inches higher.

In August 1992, after Hurricane Andrew ravaged Miami, causing billions in damage and leaving a quarter-million people homeless in Miami-Dade County alone, cities and counties in South Florida adopted some of the toughest building codes in the nation. They require buildings to be able to withstand winds up to 175 miles an hour, use shatterproof glass, and . . . straps to reinforce the connection between walls and roofs. (But) the rising seas are the focus. Among other things, they threaten to impair the city’s drainage systems . . . and lead to saltwater intrusion into the aquifer and . . . water supply. In other words, you can’t just build a sea wall, or simply raise the streets and sidewalks.

And yet people keep building and buying here. . . . Neither Miami nor Miami Beach has zoned its low-lying or oceanside areas to prevent new construction . . . many developers have no interest in the cost of building for ever-rising seas. There’s a lot of business as usual. And as for existing buildings constructed before the threat of climate change, the solutions can be even more difficult. Miami Beach is now grappling with how to protect or adapt the Art Deco and Miami Modernist architecture in its historic districts. . . . The issue is contentious, pitting preservationists against architects . . . who doubt the viability of adapting many of the historic structures.

The key hazards that will likely have a critical impact upon these heritage buildings include such phenomena as:

- severe heat waves (impacts upon roofs, windows)
- extreme temperature fluctuations, especially above 0°C (impacts upon roofs, windows) and freeze-thaw cycles (impacts upon entire building envelopes)
- heavy or intense rainfall (impacts upon doorways, drainage systems)
- snow accumulation (impacts upon roofs and, due to salting maintenance, to doorways and facades)
- extreme wind gusts, wind-driven rain, and ice storm/ice accretion (impacts upon entire building envelopes)

Vulnerability assessments will soon be common, as realities of the onset of Climate Chaos sink in and the need for mitigation and adaptation become increasingly apparent. Like building codes and the increasing use of sustainability codes, these assessments may become required by law.

Recommendations for APT’s Role

Over the next 10 to 50 years, the force of Climate Chaos issues will transform heritage conservation. To maintain its leadership position, APT will need to plan now for its role and take swift follow-up action, in at least four areas:

Data gathering and new frameworks. The conservation community needs evidence-based, defensible, and easily digestible data to articulate compellingly the critical need to vastly increase building reuse and decarbonization. When it comes to the heritage contribution to climate action, we need to explain why “deep green” rehabilitation matters and back it up with this data, in order to change minds of policy makers and build an onboard broad coalition in this work. APT must help its membership and the conservation community develop best practices to acquire the data needed to assist decision-making in the formation of optimal solutions to zero-carbon building rehabilitation, improved and more widespread use of life-cycle assessments,

new decarbonizing strategies (such as carbon calculators and design-assist tools), and new frameworks for climate adaptation and mitigation strategies.

Evolving the conservation standards. APT must help lead the discussion about how Climate Chaos may encourage us to expedite what Gustavo Araoz has called the “new paradigm” in historic preservation.¹⁴ This parallels the Historic Urban Landscape Approach (UNESCO HUL, 2010), where the standards for types of acceptability or levels of intervention address new realities of an intangible, fast-forward, rapidly urbanizing, climate-impact world. Conversely, can APT help foster development of technologies to address these impacts, while staying in front of safeguarding or evolving accepted standards and guidelines for the conservation of historic places? This is now a “front burner” issue.

Prevention. APT must help the conservation community take a leadership role in the “Race to Net-Zero,” using its members’ expertise in “managing change to existing buildings while retaining value.” This work must take a collaborative approach with other disciplines to address the required dramatic acceleration of context-sensitive rehabilitation of the massive stock of the world’s existing, abandoned, and heritage properties. A large task will be the sustainable rehabilitation of heritage buildings from the modern era, which collectively, mainly due to their abundance, are the greatest greenhouse-gas “culprits.”¹⁵

Mitigation and adaptation. APT must also help members lead in developing best practices for urgent actions, such as vulnerability assessments for historic places. APT should be a leader in supporting new research and development for creative mitigation and adaptation of climate effects and in supporting the reduction of greenhouse gases. This can also be accomplished through the rediscovery of traditional, nature-based solutions, as well as hybrid solutions. New policy development is also required. Given the collaboration imperative, should APT also help

lead best practices for education and outreach in this area?

Conclusion

Heritage-conservation professionals have strong insights to contribute to the planning, testing, and implementation of mitigation and adaptation that will be needed to address climate-change disruption. Experience in community planning, rationale development and vetting, envisioning of creative alternatives, logic sequencing of potential outcomes, and other skills developed by conservation architects and other professionals in their design and change-management practices for existing and historic properties—all will provide valuable foundational expertise for vulnerability assessment and adaptation solutions.

Both the U.S. National Park Service and Parks Canada have developed initial climate-change strategies for cultural properties and are slowly working them forward from policy to implementation. For example, Park Canada's "*Climate Change Adaptation Framework for Parks and Protected Areas*, and the accompanying adaptation workshop approach, were developed to support adaptation action across a range of protected places. The approach emphasizes the use of rapid vulnerability assessments, allowing practitioners to identify adaptation options as soon as possible and pinpoint those that meet the greatest climate-change risks and vulnerabilities." More importantly, "recent efforts at Parks Canada are focused on accelerating implementation of adaptation actions: translating lists into comprehensive action plans."¹⁶

Much of the understanding, planning, and executing of Climate Chaos mitigation and adaptation for historic places will be the discourse on what is appropriate. We do not have the luxury of time to explore this for long; urgent action is required, both for our responsibility to help lead the effort and for our responsibility to preserve our built cultural heritage. Developments in this field are already accelerating. Less-than-accelerated action may mean losing a place at the table as events overtake a lack of preparedness.

The APT Technical Committee on Sustainable Preservation (TC-SP) is already evolving, as evidenced in the program at the APT 2019 Miami Conference, where many paper sessions and a full-day symposium were dedicated to Climate Chaos intersection issues. But there is much more to be done. The TC-SP and APT's other technical committees must work collaboratively with others in the expanding climate-action communities to help develop nature-based and technology-based best practices for both mitigation and adaptation. For example, the ZNCC is currently co-coordinating with the California State Historic Preservation Office and Working Group 3 of the ICOMOS-generated Climate Heritage Network's Climate Action Plan.¹⁷ Also needed is help to develop best practices for when and to what degree more comprehensive changes to historic places are acceptable.

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Mark Thompson Brandt, OAA, RAIC, CAHP, APT-RP, LEED AP, AIA-IA, is the principal author and a senior conservation architect and urbanist at MTBA Associates Inc., in Ottawa. He is a former member of the APT Board of Directors and co-chair of the TC-SP and is now a co-chair of the ZNCC. He can be reached at mtb@mtbarch.com.

Cory Rouillard, AIA, LEED AP, is an associate partner at Jan Hird Pokorny Associates in New York. She is also a co-chair of the TC-SP and co-chair of the OSCAR initiative. She can be reached at rouillard@jhpokorny.com.

Notes

1. Regarding the nomenclature of this article, "preservation" (U.S.) and "conservation" (Canada and international) describe essentially the same process; both are used throughout this article. "Climate change" is a phrase that hardly describes the devastating impacts or the urgent nature of relief required. The author prefers to use the more technically accurate phrase "Climate Chaos." As it is a real phenomenon today, the author prefers to capitalize Climate Chaos, as a proper noun, to help communicate it as a clear and present danger. Similarly, the IPCC issued a special report entitled *Global Warming of 1.5°C*, in October 2018, where leading scientists provide statistics that affirm humanity has about a decade to hold global temperature increases to 1.5°C.
2. The IPCC has issued previous reports that indicate the various factors influencing carbon emissions. Existing buildings account for about 40 percent of the carbon emissions globally and related impacts upon our natural and cultural heritage (including embodied and operational carbon). The "deep green" rehabilitation of existing building stock is arguably the single greatest area for change to achieve worldwide goals for reducing emissions and maintaining the temperature of the planet. Heritage buildings are an important subset of existing buildings. Sharon C. Park, "Sustaining Historic Properties in an Era of Climate Change," *APT Bulletin: The Journal of Preservation Technology* 49, nos. 2–3 (2018): 35–44.
3. The recent improvements in the understanding of embodied carbon in existing buildings underscore the necessity of "recycling" buildings rather than building new. Life-cycle assessments help us better understand how the choices of materials and decisions to reuse and rehabilitate can dramatically decrease our carbon footprint. Interestingly, "mainstream" architecture and green-building construction have just recently started to embrace the fact that to "slay the carbon dragon," we need to be mostly focused on "deep green" rehabilitation of existing buildings, not new "green" buildings.
4. "The ZNCC is a strategic alliance committed to coordinating/monitoring technology development and integration for, and providing a unified resource for, the goal of responsibly bringing historic places to zero-net carbon (ZNC) and accelerating the ZNC of existing and historic buildings and places, accounting

for both embodied carbon and operational carbon emissions, through developing leadership in best practices for the ZNC rehabilitation of most existing buildings, and in the responsible reuse of built resources in general. The collaboration initially formed in October 2017 with five founding partner organizations: APT, the American Institute of Architects (AIA), the Royal Architectural Institute of Canada (RAIC), the International Council on Monuments and Sites (ICOMOS), and Architecture 2030; Mark Thompson Brandt, ZNCC co-chair; www.znccollaboration.org.

5. At the December 2015 United Nations Climate Change Conference, COP 21, held in Paris, parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached a landmark agreement to combat climate change. The *Paris Agreement's* central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century below 1.5°C above preindustrial levels. The agreement aims to increase countries' abilities to deal with the impacts of climate change, matching finance flows with low greenhouse-gas emissions. Park, 35–44.

6. The Anthropocene Working Group “voted in April 2016 to proceed towards a formal golden spike (GSSP) proposal to define the Anthropocene epoch in the Geologic time scale and presented the recommendation to the International Geological Congress”; “Anthropocene,” Wikipedia, accessed Sept. 19, 2019, <https://en.wikipedia.org/wiki/Anthropocene>.

7. Exponential technologies are “technologies that double in power or processing speed every year, while their cost halves”; Michael Haupt, “Exponential Technology Defined,” *Michael Haupt* (blog) March 30, 2016, accessed Sept. 19, 2019, <https://michaelhaupt.com/exponential-technology-defined-374e2db882b0>.

8. Hungarian creative ecologist István Kenyeres is a founder, inventor, former CEO, and chairman of Organica, a wastewater-treatment, environmental, industrial-ecology, and ecological-engineering company. His view is that the planetary ecosystem's sustainability relies on our unique mental capabilities to create tools, technologies, and complex social structures to develop and maintain the delicate balance between natural, economic, and social forces. He is currently the president of Biopolus, an organization that promotes systemic reengineering of our urban metabolic systems to address economic and global warming crises.

9. Between 1799 and 1804, Friedrich Wilhelm Heinrich Alexander von Humboldt traveled around the Americas, exploring and describing them for the first time from a modern scientific point of view. Details and descriptions of his journey were featured in a “multi-volume treatise, *Kosmos*, in which he sought to unify

diverse branches of science, art, and culture. This groundbreaking work also motivated a holistic perception of the universe as one interacting entity”; “Alexander von Humboldt,” Wikipedia, accessed Sept. 19, 2019, https://en.wikipedia.org/wiki/Alexander_von_Humboldt.

10. Oruba Alwan, “The Impact of Emerging Technologies in Supporting Urban Resilience Planning in Canada” (honor's thesis, Univ. of Wolverhampton, March 2016), 14–15, <https://wlv.openrepository.com/bitstream/handle/2436/617781/Oruba%20Alwan%20Final%20Submission%20June%202016.pdf?sequence=1&isAllowed=y>.

11. “The future of environmentalism will be led by First Nations—because their fight is about a way of life, but it comes from a deep attachment to place”; David Suzuki, environmental scientist, interviewed for the 2017 Canadian Centre for Architecture exhibit in Montréal, *It's All Happening So Fast: A Counter-History of the Modern Canadian Environment*.

12. FEMA P-348: *Protecting Utility Systems from Flood Damage Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems*, 2nd ed. (Washington, D.C.: U.S. Dept. of Homeland Security, FEMA, 2017), https://www.fema.gov/media-library-data/1489005878535-dcc4b360f5c7eb7285acb2e206792312/FEMA_P-348_508.pdf. “Floodproofing Info #1: What is Flood Proofing?” (New York Southern Tier Regional Planning & Development Board, June 2019), http://www.stcplanning.org/usr/Program_Areas/Flood_Mitigation/Floodproofing/FPProof_01_Floodproofing.pdf. John Fidler, Chris Wood, and Brian Ridout, *Flooding and Historic Buildings Technical Advice Note*, 2nd ed. (London: English Heritage, 2004), <https://www.ncppt.nps.gov/wp-content/uploads/Flooding-and-Historic-Buildings-Technical-Advice-Note-2004.pdf>.

13. Kristie Ebi, Vidya Anderson, Peter Berry, Jaclyn Paterson, and Anna Yusa, *Ontario Climate Change and Health Toolkit* (Ontario: Queen's Printer for Ontario, 2016), https://peel.andornot.com/PDF/Climate_Change%20Health%20Toolkit.pdf.

14. Gustavo Araoz, “Preserving Heritage Places Under a New Paradigm,” *Journal of Cultural Heritage Management and Sustainable Development* 1, no. 1 (2011): 55–60. This paper called for expansion and evolution of the theories and practice of modern heritage conservation, based upon contemporary global trends. It suggested that this “new paradigm” requires new tools to protect heritage.

15. See also Mark Thompson Brandt, “Buildings and Stories: Mindset, Climate Change and Mid-Century Modern,” *Journal of Architectural Conservation* 23, nos. 1–2 (2017): 36–46, [\[loads/2017/06/Buildings-and-stories-mindset-climate-change-and-mid-century-modern.pdf\]\(http://loads/2017/06/Buildings-and-stories-mindset-climate-change-and-mid-century-modern.pdf\).](http://mtbarch.com/wp-content/up-</p>
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16. Elizabeth Nelson, Elyse Mathieu, Julia Thomas, et al., “Parks Canada's Adaptation Framework and Workshop Approach: Lessons Learned across a Diverse Series of Adaptation Workshops,” *Parks Stewardship Forum* 36, no. 1 (2020): 77–83, <https://escholarship.org/content/qt4jf7c0x1/qt4jf7c0x1.pdf?t=q45jbe>.

17. “The Climate Heritage Network (CHN) is a voluntary, mutual support network of arts, culture and heritage organizations committed to aiding their communities in tackling climate change and achieving the ambitions of the Paris Agreement.” Part of the CHN vision includes this regarding heritage and adaptation: “21st century heritage administration includes both addressing the impacts of climate change and planning for adaptation, contributing to disaster risk reduction, and helping to leverage heritage values to enhance communities' adaptive capacities and reduce vulnerability via participatory approaches guided by science and traditional, indigenous and local knowledge.” Working Group 3 (also known as the Working Group on Making the Case for Building Reuse Through Better Metrics) is one of eight working groups undertaking the CHN's Climate Action Plan, with the first deliverables expected at COP 26, the UN Climate Change Conference in 2021; Climate Heritage Network, <http://climate-heritage.org/>.



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