Building resilience: Helping structures to weather the storm

The problem

Designing buildings that are resilient to volatile and unpredictable weather is a growing necessity. Three decades from now, more than a billion people will be experiencing once-a-century weather catastrophes every year.

The increased frequency, intensity and impacts of extreme weather events requires buildings to be designed for protection—against physical damage and expense—in addition to offering occupant comfort.

In many regions, cities, and facilities around the world, this challenge is heightened by an information gap.

In 2018, an RWDI study into the impacts on building energy performance using the historic, current and future weather files, drove many conversations around their correct use in the practice of energy modelling. We found the most commonly used climate data for building energy simulation and studies in Canada are no longer sufficient, and showed how traditional climate variables—foundational inputs to most engineering disciplines—need to be seriously reconsidered around the world.

So, as designers, architects and engineers aim to mitigate and adapt, they must also ensure that they are working with up-to-date information that is placed in a broader context. They must weigh patterns of the past with the challenges of the future.

They must also act quickly.

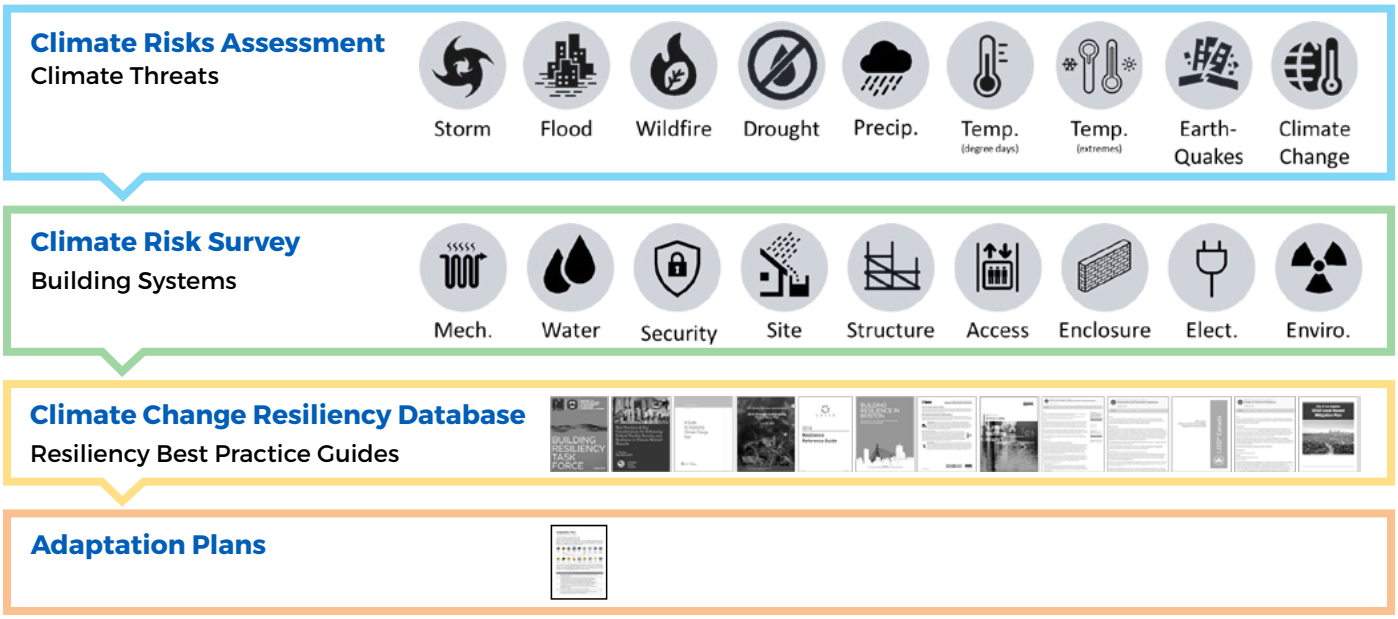
The solution

In Toronto, Ont., a city hit hard over the last decade by unprecedented flooding, city planners knew that they needed to take steps to protect their buildings and infrastructure. Like many of their global counterparts, Toronto's leaders are among a growing number of decision makers around the world who are taking steps to better prepare their buildings for a more unpredictable environment.

In 2018, the city enlisted RWDI to develop effective adaptation approaches for approximately 150 of their existing facilities, ranging from historic buildings to power-generation stations. RWDI is uniquely positioned to bring expertise and resources in both building performance engineering and climate analysis to such assignments. Our staff includes meteorologists, engineers, climatologists, experts in numerical modeling and scientists across several related fields.

Even still, Toronto would prove to be a unique challenge: With mixed terrain and a wide diversity of building typologies and ages, developing one solution to apply universally was both necessary and complex.

Through research, data collection, and on-site interviews with operators and managers, we gained crucial insight into each facility's unique characteristics. Next, building on our groundbreaking studies, frameworks published by governing engineering bodies, as well as climate forecast studies previously completed by the city, we developed a sophisticated method to identify regional climate hazards and building specific vulnerabilities and, most importantly, recommended steps to enhance each building's resiliency.



Above: Components and flow of RWDI's Rapid Resiliency Assessment Tool.

Each of the facilities posed unique challenges: some were more vulnerable to precipitation and flooding, while others faced issues around wind gusts, and increased freeze/thaw cycles. Using our innovative new Rapid Resiliency Assessment Tool, we were able to identify hazards and risks, and to outline the most effective response for each building in an easy-to-read report.

Taken as a whole, however, we were also able to help the city see the big picture. Now, work is being done to make the entirety of its built environment more resilient, and better able to protect its citizens and occupants against the next inevitable extreme weather event.

Building resilience across North America

Of course, working to adapt to a changed climate isn't only a challenge in Toronto, or the sole responsibility of the public sector to solve.

In 2019, BentallGreenOak engaged RWDI to help them boost the resiliency of 187 of their existing building assets located across North America.

To safeguard this portfolio of 38-million square feet and worth billions of dollars, we worked to both identify threats and deliver a set of concrete, implementable actions for building operators.

To begin, we built a database of 423 resiliency practices, drawing from over a dozen leading resiliency standards. We then prepared a climate change vulnerability survey and administered it to operators at each property.

Survey responses, as well as regionally identified climate threats, were fed into the resiliency database, which rapidly generated 187 property-specific climate change adaptation plans. To help operators prioritize, we developed algorithms that weighted input variables to generate a unique top-ten list of actions for each facility.

Developing effective adaptation approaches for large portfolios of existing buildings is vital to continued progress toward a more sustainable and resilient built environment.

The result

In 2019, RWDI's work with BentallGreenOak was recognized with the prestigious Green Building Pioneer award from the Toronto Chapter of the Canadian Green Building Council.

There is much work to be done to enhance the resilience of the built environment to an ever-changing climate. We look forward to the next opportunity to apply our scientific and engineering skills to continue to tackle some of the world's largest challenges.

This is the latest post in our ongoing climate changed blog series. We encourage you to follow RWDI on Linkedin to stay informed of future posts and to reach out if you have a challenge you would like to discuss.

Building sector capabilities

- Wind engineering
- Micro-climates
- Noise, Acoustics and vibrations
- Computational fluid dynamics
- Sustainability
- Building enclosures
- Building air quality
- Mass damping systems