Adaptation Platform Webinar
(March 29th, 2021)

Progress towards a Climate Resilient Built Environment

Webinar Presenters

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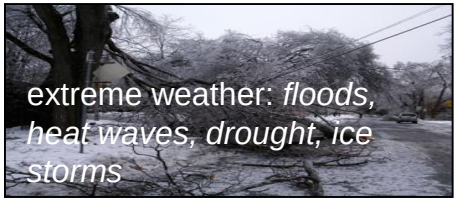
Progress towards a Climate Resilient Built Environment

Opening Remarks

Chad Nelson
March 29, 2021

Impacts of Climate Change across Canada



Policy Drivers

- National Adaptation Strategy
- National Infrastructure Assessment
- Increasing Costs of Climate Impacts
- Global & Domestic Frameworks
- National Risk Profile
- Infrastructure Deficit
- Historic & Long-lived, cost-shared investments
- Legal, Financial, Private Sector (e.g., insurance)

Future-Proofing: Data, Guidelines, Standards

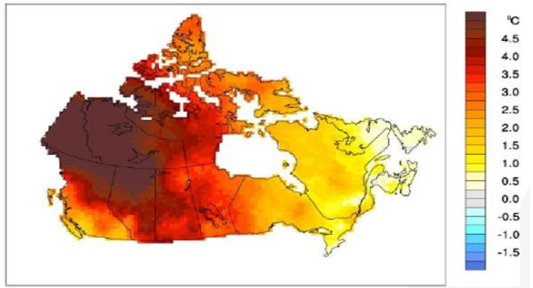
- Federal Flood Mapping Guidelines and Standardisation
- Climate Resilient Buildings and Core Public Infrastructure
- Future-looking Climate Design Data
- Climate Lens

Challenges

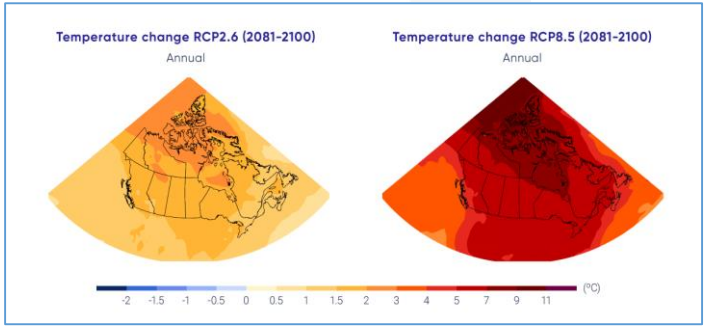
Vision and Culture Change
- Institutional and cultural change required to consider future climate planning
- Need to foster innovation

Emergent Knowledge of the Risks Posed to Public Infrastructure
- Need for definition and best practice exchange on managing climate risks to public infrastructure: location, design/build, planned operation & maintenance
- Locally-specific threats and solutions

Capacity Gaps
- Climate-adapted knowledge products are being developed, but are not yet widely available (e.g. data, tools, guidelines)
- Many communities lack capacity to assess climate risk to infrastructure



Winter temperature changes (C) 1948-2016



Projected temperature change in Canada for the 2081-2100 period for low and high emission scenarios (left and right images, respectively, ECCC 2019).

Canada

Canada's Climate Change Adaptation Platform

Infrastructure and Buildings Working Group (IBWG)

- Climate change threatens Canada's infrastructure and buildings, which can result in loss of life, personal injuries, physical damage, and economic disruptions. Much of these risks and impacts can be prevented through appropriate design, construction and maintenance.
- The IBWG builds capacity, generates evidence and provides outreach to increase the capability of infrastructure managers, builders, insurers, engineers and other stakeholders to adapt to climate change.
- The IBWG is co-chaired by Infrastructure Canada and the Institute for Catastrophic Loss Reduction.

Infrastructure Canada

Institute for Catastrophic Loss Reduction

Canada

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Progress towards a Climate Resilient Built Environment

Webinar: Canada's Climate Change Adaptation Platform

Marianne Armstrong

National Research Council Canada
March 29, 2021

CLIMATE RESILIENT BUILDINGS & CORE PUBLIC INFRASTRUCTURE (CRBCPI)

Developed world-leading research and foundational science to advance the field of climate change adaptation for buildings and infrastructure

Translated this science into decision support tools, including codes, guides and models for the design of resilient new, and rehabilitation of existing, buildings and core public infrastructure in key sectors to ensure that climate change and extreme weather events are addressed

Climate Data • Roads
Buildings • Bridges
Water/Wastewater
Transit • Decision
Support Tools
LCA

Responding to Climate Change

In partnership with INFC, the CRBCPI Initiative has:

- Established a network of international expertise including over **200 different collaborators**
- **Mobilized NRC expertise:** infrastructure & building science, coastal & river engineering, hydrology, aerodynamics, codes
- Significantly advanced the field of climate change adaptation for buildings and infrastructure, and is at the **leading edge of this effort internationally**
- Developed a **suite of evidence-based guidance documents** on how to adapt

Outline

- Future looking **climatic design data**
- Advances in prevention of damage from **flooding**
- Advances in prevention of damage from **wildfire**
- Updates to the **Canadian Electrical Code**
- Highlights for each of 5 infrastructure areas: **buildings, bridges, water/wastewater, roads** and **rail transit**
- Advances in **Life Cycle Environmental Assessment** (LCA) of infrastructure
- New **capabilities**
- Where to next…

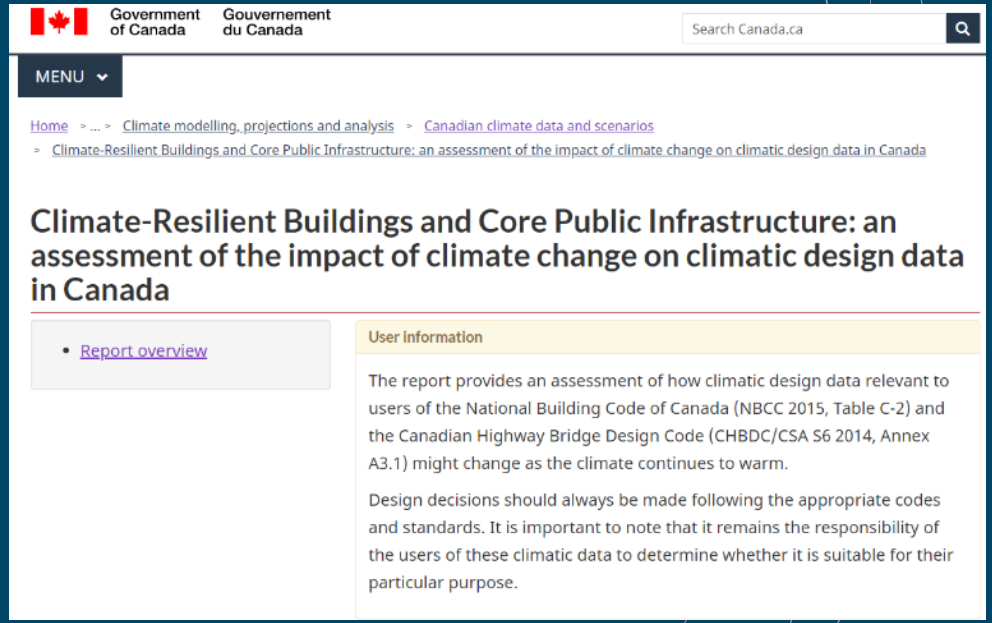
Developing Future Climatic Design Data

- **Partnership** with Environment and Climate Change Canada (ECCC) and Pacific Climate Impacts Consortium (PCIC)
- **Forward-looking climatic design data** is published!
- **climate-scenarios.canada.ca**
- General guidance on how to use this data will be available soon.

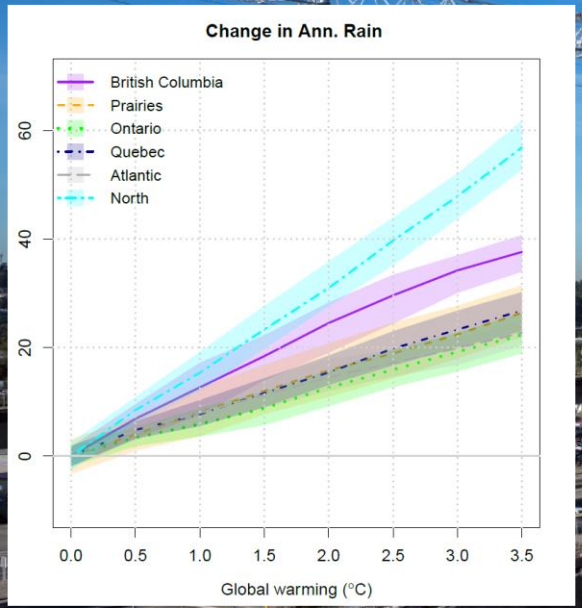
Peace tower weather station

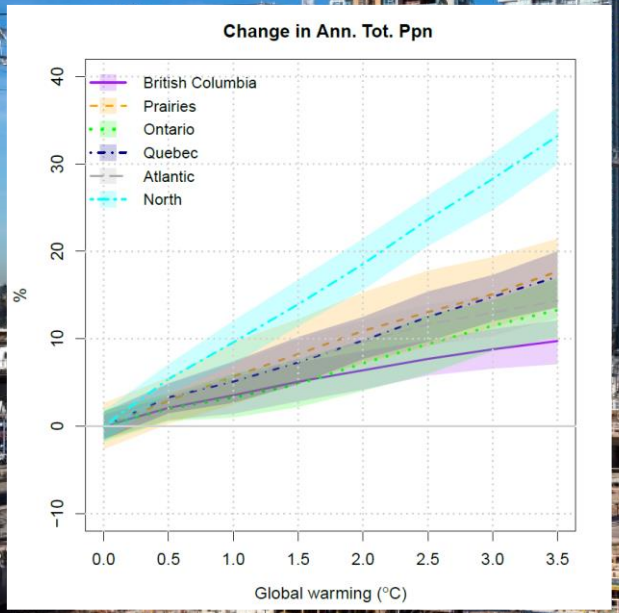
Key Findings

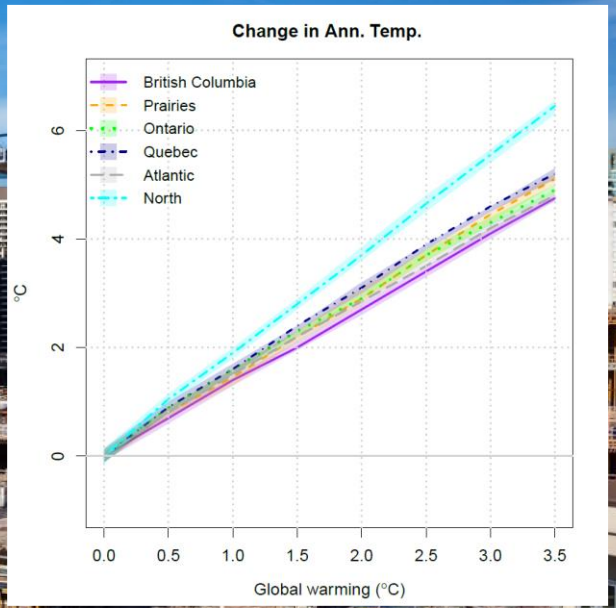
- Temperature ↑
- Extreme high and low temperatures ↑
- Precipitation ↑
- One-day Rain ↑
- Wind Pressure ↑
- Snow and Ice ↓ except in the North
- Snow cover duration ↓
- Permafrost temperatures ↑



Regional Projections for Climate Design

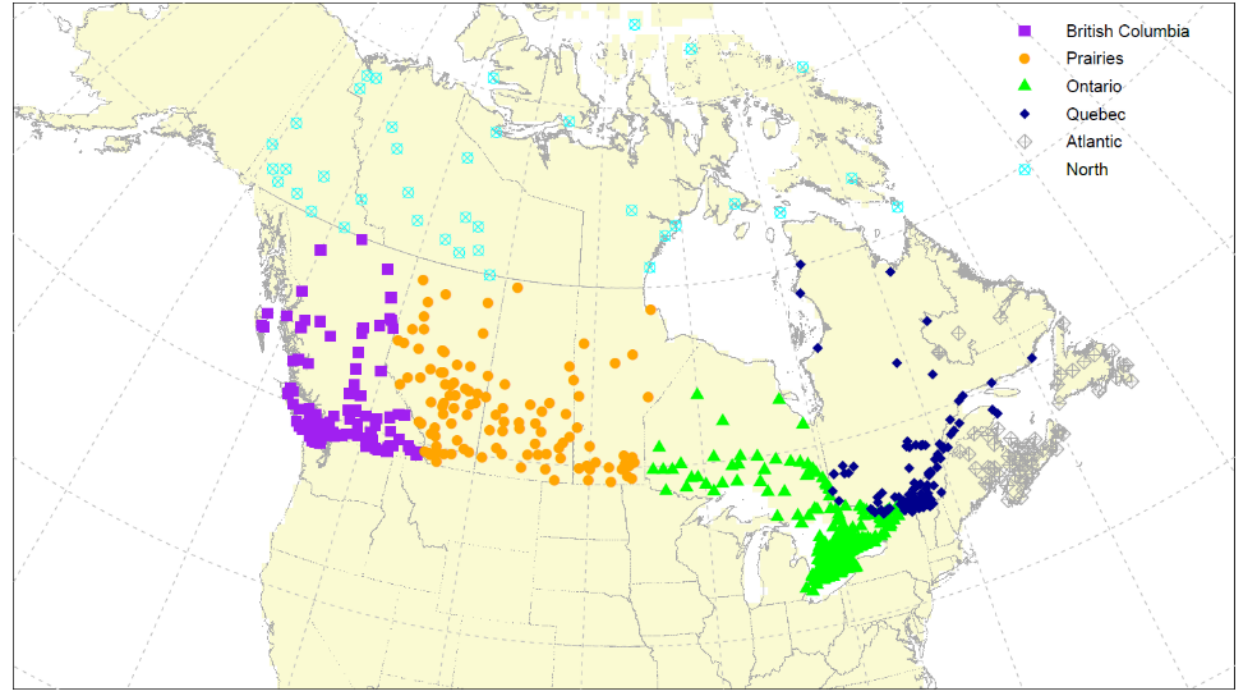






Regional Projections for Climate Design

- **~660 locations**
- Design data for all locations in the building codes (~660 locations)
- All parameters in the National Building Code and Canadian Highway Bridge Design Code



Flooding

- Best practices for flood risk reduction in **existing residential communities "Weathering the Storm"** was published (Intact Centre and Standards Council Canada) https://www.intactcentre.ca/wp-content/uploads/2019/01/Weathering-the-Storm.pdf (seed document for CSA standard W210 – currently out for public review)
- **Four new CSA standards related to flooding** have been published: bioretention systems (CSA W200/W201), basement flood protection and risk reduction (CSA Z800), and climate change adaptation of wastewater treatment plants (CSA S900.1).
- The University of Waterloo has developed guidance for the **design of buoyant foundations** for new build and retrofit. One prototype foundation was also completed.

First prototype buoyant foundation built at University of Waterloo

Flooding continued

- NRC with oversight from a technical committee developed new **Guidelines for Conducting Coastal Flood Hazard and Risk Assessments.**
- A Technical Committee and a Steering Committee on flood-resistant buildings were established and guided the development of **Guidelines for the design of flood-resistant new buildings, and improved flood resistance for existing buildings**
- CRBCPI has triggered a discussion at the **Canadian Commission on Building and Fire Codes (CCBFC)** on the role of National Construction Codes in addressing flooding.

National Guide for Wildland-Urban Interface (WUI) Fires – Coming Soon

1. Introduction

- General Background
- Objectives and Functional Statements
- Purpose and Scope of the Guide
- Content of the guide
- Use and Audience of the Guide
- Administrative Provisions
- Terminology

2. Hazard and Exposure

- Hazard and Exposure Factors
- Hazard and Exposure Assessment
- Use of Hazard and Exposure Levels

3. Community Resources and Design

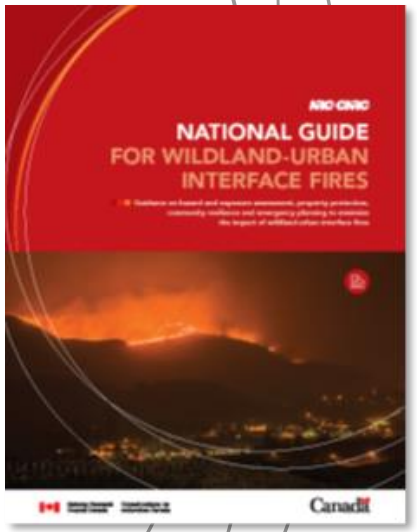
- Planning the WUI
- Access and Egress Routes
- Resources

4. Mitigation in Structure Ignition Zone

- Exposure Levels
- Construction Requirements
- Priority Zones

5. Planning and Outreach

- Community Emergency Planning
- Public Outreach and Education

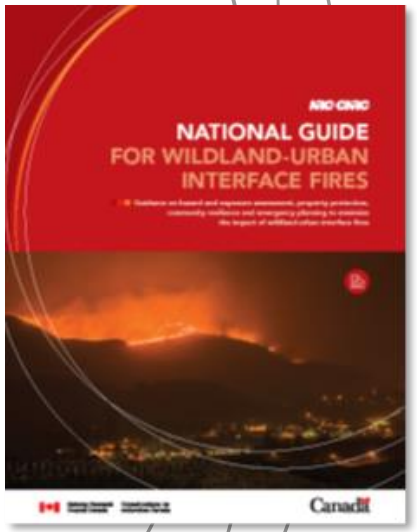


WUI Guide Impact Analysis

A Comprehensive Impact Analysis was conducted by ICLR/SPA Risk

Key Findings:

- **New Houses** built to comply with the Guide save up to **40:1** (can be below $5/ft^2$)
- **Retrofitting saves up to 14:1** (~$10 to $20 per ft^2)
- Neighbourhood cooperation to **control vegetation** reduces costs by 2/3rd
- **Communities save up to 14:1** when the costs to homeowners, municipalities, and utilities are accounted for
- **National Adoption saves up to 4:1**, avoiding $500 billion in future losses at a cost of $125 billion, creating 20,000 long-term jobs, savings 2,300 lives, avoiding 17,000 nonfatal injuries and cases of post-traumatic stress disorder, and increasing tax revenue by $1 billion

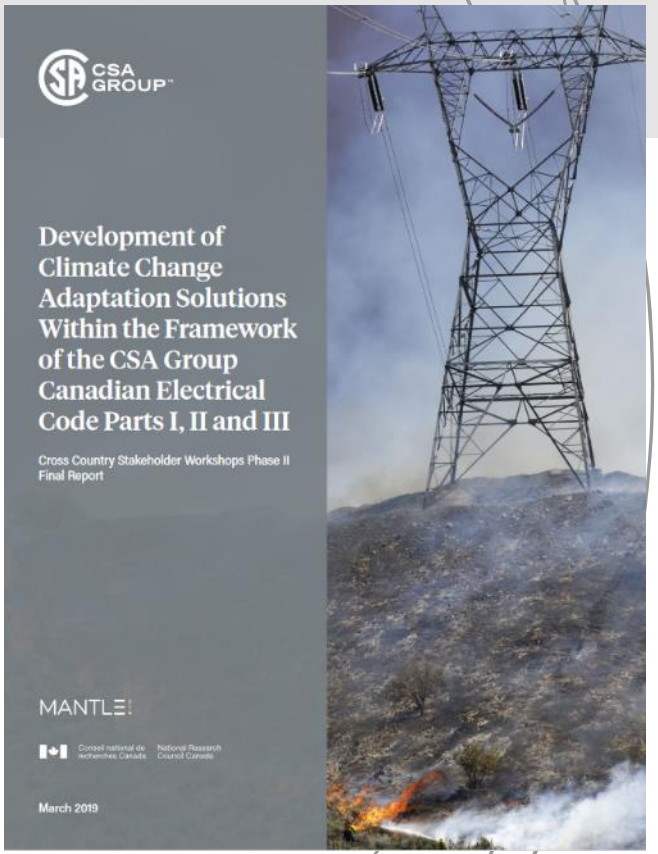


Canadian Electrical Code

Following a series of Cross-Canada workshops, **50 proposals for change** were prepared and submitted to the Committees of the CEC

https://www.csagroup.org/wp-content/uploads/CSA-RR_CEC-ClimateChange.pdf

25th Edition of the Canadian Electrical Codes Part 1 (released in January 2021) incorporates 5 accepted proposals for change including the new terms “Flood hazard zone”, and “Flood elevation” and new requirements for equipment installation



Buildings Highlights

Climatic Design Data, Flooding and Wildfire Guidelines

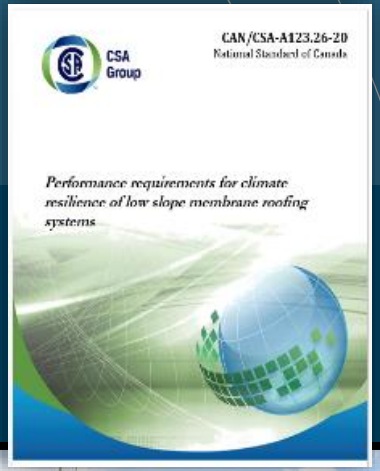
Developed the first standard addressing climate resiliency of roofing in the world: **Performance Requirements for Climate Resilience of Low Slope Membrane Roofing Systems (CSA A123.26-20)** and the associated web-based **Climate Roof Calculator**

Evolved the Guideline on **Durability in Buildings (CSA S478) to a Standard**

Developed **Guidance for prevention of overheating in interior spaces,** linked to human physiological response, and including future impacts of urban heat islanding.

2020 National Building Code (NBC) will include updated climatic design data, new provisions for snow loading on roofs, updates to referenced standards

Proposed climate change provisions for the **2025 National Building Code** (NBC)



Bridges Highlights

Updated Climatic Design Data and Sustainability provisions in the 2019 Canadian Highway Bridge Design Code (CHBDC)

Developed full provisions for the **2025 CHBDC to include design for future climate loads**

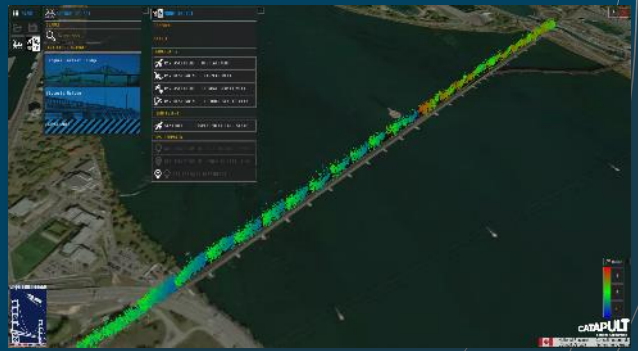
Assessed the Impact of extreme climate loads on **new & existing bridges,** and of ice and debris on **bridge pier stability**

Developed models of accelerated **deterioration of bridges & service loads**

Demonstrated the **Brigital software: Satellite-based** bridge performance assessment – guidelines and tools

Investigated the **vibration of bridge stay cables** in wet, icy and dry conditions, triggering potential updates to the Post Tensioning Institute Stay Cable Design Guidelines

2019 CHBDC Data for Ice Accretion replaced 1974 data in CHBDC 2014



Satellite-measured thermal displacements of Victoria Bridge (Montréal, Canada)

Roads Highlights

Developed a novel **Climate Adaptation and Asphalt Selection Tool (CAAST)** to guide selection of a resilient performance based asphalt binder

Developed a decision-making tool for adaptation of flexible and rigid pavement design and construction to climate change: **Pavement Adaptation Support Tool (PAST)**

Developed a new test method for **water permeability of laboratory cast pervious concrete**

Guidance for the design of climate resilient roads (new and existing)

Jointed Plain Concrete Pavement project in Ontario (MTO)

Water/Wastewater Highlights

- Two **national workshops** on adaptation to climate change impact on rainstorm flooding (February and June 2018)
- CSA Standard S900-1 on **Climate Change Adaptation for Wastewater Treatment Plants**
- Developed a **National Guideline on the comprehensive cost benefit of flood prevention infrastructure:**
  - Undertaking a comprehensive analysis of **benefits, costs and uncertainties of storm drainage** in a changing climate
  - Estimating post-flood event **economic, legal, social, and indirect costs**
  - Estimating post-flood event **environmental impact**
- Assessed the impact of CC on **water distribution** and **wastewater treatment systems**

Rail Transit Highlights

- Studied **extreme weather effects on tunnels and stations** with the Toronto Transit Commission (TTC)
  - Over 120 temperature and humidity monitoring stations along 40 sites in Toronto Subway
  - Novel temperature logger to collect data from trains travelling through tunnels/stations
- Investigated the impact of **freeze-thaw cycles** on railway tracks, including impacts on safety, operation and passenger comfort
- Compared different methods for **measuring stress/strain in rail tracks**

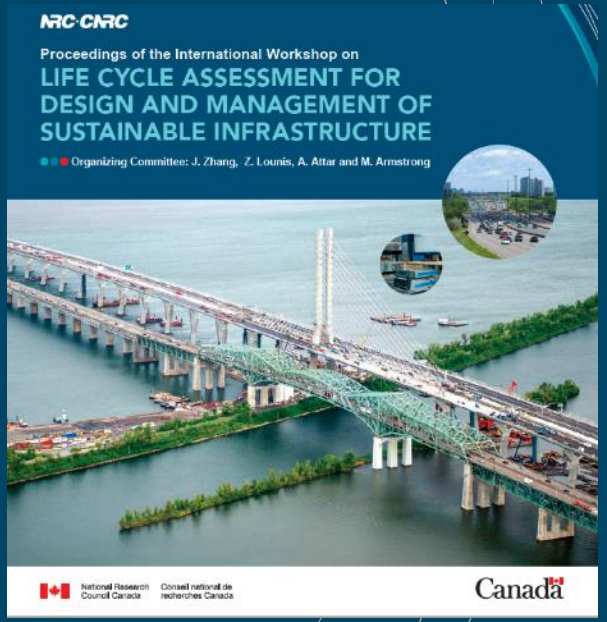
Life Cycle Environmental Assessment

• Held an **international workshop** on Life Cycle Assessment for the Design and Management of Sustainable Infrastructure in September 2019

• Developed **Guidelines of Conducting of Environmental LCA for Adaptation of Buildings and Core Public Infrastructure to Climate Change**

• Conducted **case studies of road, bridge, buildings and storm water** infrastructure

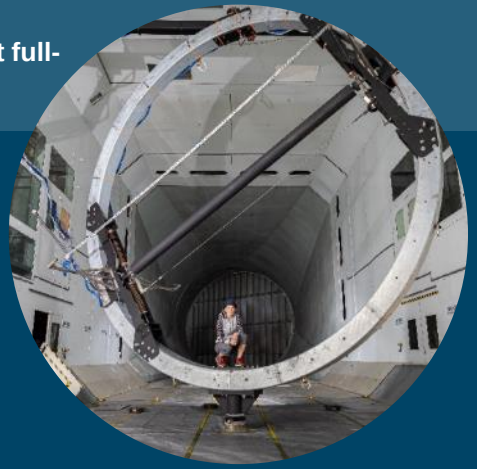
• Triggered the development of a **Canadian Life Cycle Inventory (LCI) database**, as NRC's Low-carbon assets through life cycle assessment initiative (LCA^2)



NRC Capabilities

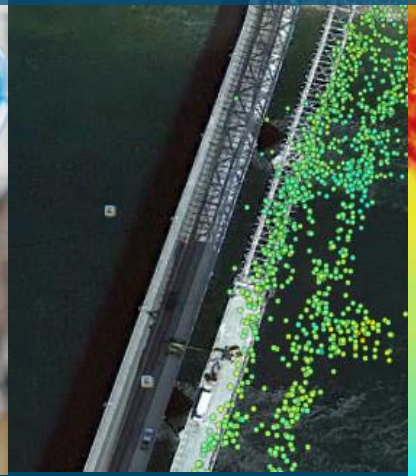
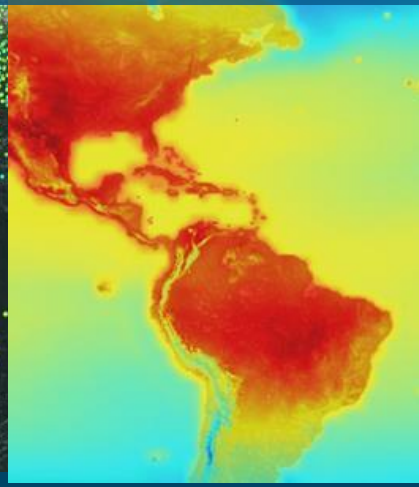
- **Expertise in assessing performance under a changing climate** for technology related to buildings, roads, water/wastewater, bridges, rail
- **National network of expertise**
- **Modeling for future Canadian climate scenarios** can be applied to durability, energy performance, comfort
- **Full-scale facilities for performance assessment** under different climate conditions (aging, wildfire, wind driven rain, flooding, ice)
- **Field trials** and data collection/analysis

NRC Facility to weather-test full-scale bridge cables



NRC's Ember generator (Baby Dragon)

What's next?
Climate Resilient Built Environment (CRBE) Initiative

Generating Knowledge	Supporting Evidence-Based Decision Making	Enabling Regulation	Advancing Technical Solutions	Building Capacity in Canada and Abroad
				

Climate Resilient Buildings and Core Public Infrastructure Initiative
https://www.infrastructure.gc.ca/plan/crbcpi-irccipb-eng.html

Canadian Centre for Climate Services
www.canada.ca/climate-services

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THANK YOU

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https://climateriskinstitute.ca/platform-webinars/

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