



Climate Resilient Retrofits

Adapting Canada's existing building stock to withstand a changing climate



Database Legend

How to find the info you need to adapt your home to climate change

Explore ClimateResilientRetrofits.ca—your one-stop for multi-hazard resilient residential retrofits!

Climate Resilient Retrofits is a project of Partners for Action (P4A), a research initiative in the Faculty of Environment at the University of Waterloo, with founding support by Co-operators and Farm Mutual Re. The database was developed from 2023-24 in partnership with and funding by Halifax Regional Municipality for the HalifACT Climate Action Plan, and National Research Council of Canada, as part of the Resilient Residential Retrofit theme under the Climate Resilient Built Environment Initiative, supporting the Government of Canada's Adaptation Action Plan and towards achieving commitments under the National Adaptation Strategy.



PARTNERS FOR ACTION

HalifACT Acting on Climate Together

HALIFAX



National Research
Council Canada

Conseil national de
recherches Canada



RETROFIT / MEASURE

- A change you make to a building for a specific purpose – in this case, to be climate-adaptive. For an existing building, this is called a 'retrofit,' where the change retroactively 'fits' conditions and objectives the building was not originally designed for.

≡ Retrofit/Measure

Roof to wall connection
(additional connectors)

ID#

- A code and number assigned to a retrofit/measure.
- This allows you to identify connections to other measures (by adaptation objective).
- The ID#s are not listed in order of importance or impact; however, more common measures are listed first.

A ID#

EW1

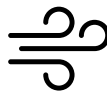
Hazard Codes:



F = Floods



EH= Extreme Heat



EW= Extreme Wind



IS = Ice & Snow



WF= Wildfire

BUILDING AREA

- Describes which part(s) of the building the retrofit/measure affects:

- **Building Structure**—Elements that support the weight/loads on a building (e.g., joists, trusses, load-bearing walls, and sheathing) and keep a building upright. These are the ‘bones’ of a building

Building Structure—Roof

Building Structure—Walls

Building Structure—Foundation

- **Envelope**—The exterior shell/skin of a building designed to maintain an indoor climate that is separated from the outdoors. Elements include shingles, insulation, the foundation, and waterproofing. This is the ‘skin’ of a building

Envelope—Roof

Envelope—Walls

Envelope—Foundation

Envelope—Windows & Doors

- **Mechanical, Electrical, Plumbing (MEP) Systems**—Any set of parts that work together within a building or on a property that service occupants and building functions (e.g., Heating, Ventilation and Air Conditioning (HVAC), gas, water). These are the ‘organs’ of a building

Mechanical, Electrical, Plumbing Systems

- **Landscaping**—Natural and/or human-made features surrounding a building (decorative and/or functional; e.g., trees, gardens, paving)

Landscaping

- **Exterior Structures**—Any standalone structure on a property that is not the primary building (e.g., sheds, playgrounds, storage units, etc.)

Exterior Structures

- **Interior/Finishes**—Elements installed and strategies and finishes within a building, which are not necessarily structural

Interior/Finishes

☰ Building Area

Building Structure - Roof

HAZARD

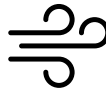
- A natural hazard of concern, for which the building may need to be adapted



Floods



Extreme Heat



Extreme Wind



Ice & Snow



Wildfire

 Hazard(s) 

Extreme wind

PROBLEM

- The damage a hazard can cause, or a sub-hazard of concern (e.g., smoke from wildfires), which the retrofit/measure aims to address

 Problem 

Wind uplift

ADAPTATION OBJECTIVE

- What a retrofit/measure aims to achieve to address the problem caused by a hazard
- There are 5 to 8 overarching adaptation objectives for each hazard

 Adaptation objective (Concise) 

Create continuous load path

IMAGE

- A visual of the retrofit measure

CLICK TO
ENLARGE



OBJECTIVE DESCRIPTION

- Provides high-level guidance or action to decrease vulnerability against the hazard of concern

Objective description (comprehensive) ▾

Need to provide continuous load transfer of wind uplift force to foundation or part/complete building can be damaged.

HOW THE RETROFIT ADDRESSES THE OBJECTIVE

- Explains what the retrofit does to help protect against hazard impacts

How retrofit addresses the objective ▾

3.7 kN connection for studs on 16" centres.
Options: metal straps, 3 proper toes nails, continuous sheathing

CONSIDERATIONS

- What to keep in mind so that the retrofit works as intended (e.g., appropriate conditions for application, example locations); advantages and disadvantages

Considerations ▾

Requires access underneath shingles to roof sheathing to replace inadequate panels.

CONFLICTING

- A measure that works against another. This could mean a measure that negates or decreases the effectiveness of another measure, or it could increase the risk of impacts from another hazard.
 - *For Example:* Trees and shrubs can help cool and provide shading during extreme heat, but can help a wildfire spread to a building if placed too close and the leaves are dry

⇒ Conflicting

F22: Breakaway walls

F23: Flood openings

COMPLEMENTARY

- A measure that applies to multiple hazards or helps achieve multiple objectives
 - *For Example:* Airtight insulation helps reduce the impacts of extreme heat, wildfires, floods, and extreme cold (ice, snow)

⇒ Complementary

F1: Sump System

F3: Eavestroughs and downspouts

F11: Site grading F20: Rain gardens

COORDINATED

- A measure to consider for cost and time savings and practicality (that is, if you do A, you could also do B at the same time to achieve multiple objectives)
 - *For Example:* When replacing exterior siding, consider adding exterior insulation and performing air sealing to the building envelope, coordinating for fire resilience, air quality, impact resistance, and energy savings where applicable.

⇒ Coordinated

EW4: Wall to wall connections

EW5: Sill plate connections to framing

EW6: Wall to floors connections

COST (MATERIAL)

- An estimated range of what materials might cost (labour costs vary greatly, so are excluded)

\$ = less than \$500 \$\$ = \$500-\$5000 \$\$\$ = greater than \$5000

☰ Cost (Material) ▾

\$\$

TIME / EFFORT

- An estimate of the overall duration, amount of work, and planning required to complete installation

🕒 = small project/little effort with no or little planning

🕒🕒 = mid-size project/some effort and planning

🕒🕒🕒 = large project/considerable effort and planning

☰ Time/Effort ▾



EXPERTISE REQUIRED

- Approximately how much specialized knowledge, skills, and experience are needed, with the caveat that these can vary depending on the complexity of the building and site conditions
- The range is between retrofits that could potentially be done by residents to those that require more specialized skills and a contractor

🔨 = no expertise required

🔨🔨 = some expertise or skills required

🔨🔨🔨 = specific expertise or skills required

☑ Expertise Required



INVASIVENESS

- The degree to which the retrofitting process disrupts or impacts the existing structure, its occupants, and daily life

 = no/little disruption

 = some or extended disruption to daily life

 = major disruption or temporary move required

☰ Invasiveness ▾



ENERGY USE / EMISSIONS

- Immediate or obvious energy use, energy efficiency gains, or greenhouse gas emissions
 - For Example:* Retrofit Exterior Insulation → Adding exterior insulation decreases the amount of heat transfer to and from a building, decreasing the energy required to condition the indoor environment → Increases energy efficiency

≡ Energy Use/ Emissions ▾

Increases energy efficiency

PARAMETER TO EVALUATE

- A unit of measurement against which to assess a retrofit or what is to be measured

⌵ Parameter to Evaluate ▾

Wind speeds

DESIGN VALUE

- A specified numerical value, standard, range, or desired outcome that represents the conditions the retrofit should adhere to / how it should perform
- Where possible, values are included to guide the design and installation of a retrofit so that it meets safety and performance standards

Design Value

EF2 Tornado (approximately 1kPa press

RETROFIT TYPE

- **Physical**—Changes or additions to the building itself
- **Behavioural**—Behavioural changes and practices that either:
 - a. are related to a physical retrofit, or
 - b. decreases the hazard impacts on people and animals within a building

Retrofit Type

Physical

IMPLEMENTATION STAGE

- **Proactive**—preparedness to reduce risk before a hazard event **and/or**
- **Reactive**—during or after a hazard event

Implementation Stage

Proactive

BUILDING ARCHETYPE

- The type of building the retrofit applies to:



Single-family house



Municipally owned and operated



Multi-unit residential



Commercial

Building Archetype(s)

Municipally owned & operated

Commercial Multi-unit residential

Single family house

REFERENCES

- Full citations are provided in a separate document

☰ Reference(s) ▼

Sandink et al. (2019) Palladium Insurance (2022)

Bruton (2021) FEMA (2023a) FEMA (2011b)

CSA S520:22

FIGURE REFERENCE

- Citation (i.e.. Author and Date) or URL link

☰ Figure Reference

CSA S520:22, Sandink et al. (2019)

Have questions or want to get in touch?

Email us at p4a.info@uwaterloo.ca

For more related resources, visit us at:

floodsmartcanada.ca

<https://uwaterloo.ca/partners-for-action/>

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