Institute for Catastrophic Loss Reduction
Building resilient communities

Institut de prévention des sinistres catastrophiques
Bâtir des communautés résilientes

Understanding Barriers and Opportunities for Implementing High-Wind Protection for Part 9 Buildings in Canada

Technical note to support *High-wind design of new woodframe houses has an average benefit-cost ratio of 6:1 in Canada*

By Dan Sandink, ICLR

December 2023

Barrie, ON, 2021 EF2 Tornado Event. Credit: GA Kopp, UWO.

1. Barriers and Opportunities for High-Wind Protection in Canada

This document serves as a technical note to accompany the report *"High-wind design of new woodframe houses has an average benefit-cost ratio of 6:1 in Canada"* by K. Porter (2023). This technical note explores challenges and opportunities associated with adopting enhanced high-wind protection measures for National Building Code (NBC) Part 9 buildings in Canada and makes recommendations to enhance uptake of high-wind protection interventions. This assessment relies largely on key informant interviews, supplemented with reviews of recent literature focused on practical adoption of high-wind risk reduction practices.

1.1. Methods

A questionnaire schedule was developed by the author in collaboration with Institute for Catastrophic Loss Reduction (ICLR) partners involved in the development of the 2019 high-wind foundational document and interested stakeholders from the CSA S520:22 Technical Committee. Topics in the questionnaire included:

- Technical factors acting as barriers or motivators for adoption of high-wind protection interventions (e.g., perceived conflicts with existing construction code requirements [barrier], existing weaknesses in codes that could be addressed by full or partial application of wind-protective measures [motivator]);
- Regulatory factors that may hinder or promote adoption of progressive building practices;
- Administrative factors that may delay or affect changes in construction (e.g., code change request processes, code objectives);
- Industry or stakeholder factors that may limit adoption of progressive practices (e.g., stakeholder interests, the drive to limit cost of construction); and
- Suggested or proposed methods to overcome barriers.

Upon consultation with key informants, who typically possess significant expertise in their fields, we decided to adopt a relatively open interview format to collect information, which allowed informants to define the structure and topics of interviews. Further, informants had varying degrees of familiarity with the subject of the interviews (i.e., advancing Part 9 high-wind resilience in Canada).

We interviewed 25 informants in late 2022 and early 2023. Informants all had significant backgrounds that included developing code change requests, participating in standing or technical advisory committees that reviewed code change submissions concerning high-wind protection for Part 9 buildings, and/or were directly and significantly involved in the development of CSA S520 and/or code change requests for the Ontario Building Code (OBC) and NBC that concerned high-wind protection for Part 9 buildings.[1] Others had only peripheral knowledge of high-wind protection for Part 9 buildings, but had considerable expertise in other aspects of construction in Canada. Information collected during interviews has been supplemented and/or verified with more recent discussions held with the expert stakeholder committee that supported Porter's (2023) aforementioned benefit-cost assessment.

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[1] See:

Canadian Board for Harmonized Construction Codes. 2023. Proposed Change 1475. Ottawa: Codes Canada/National Research Council.

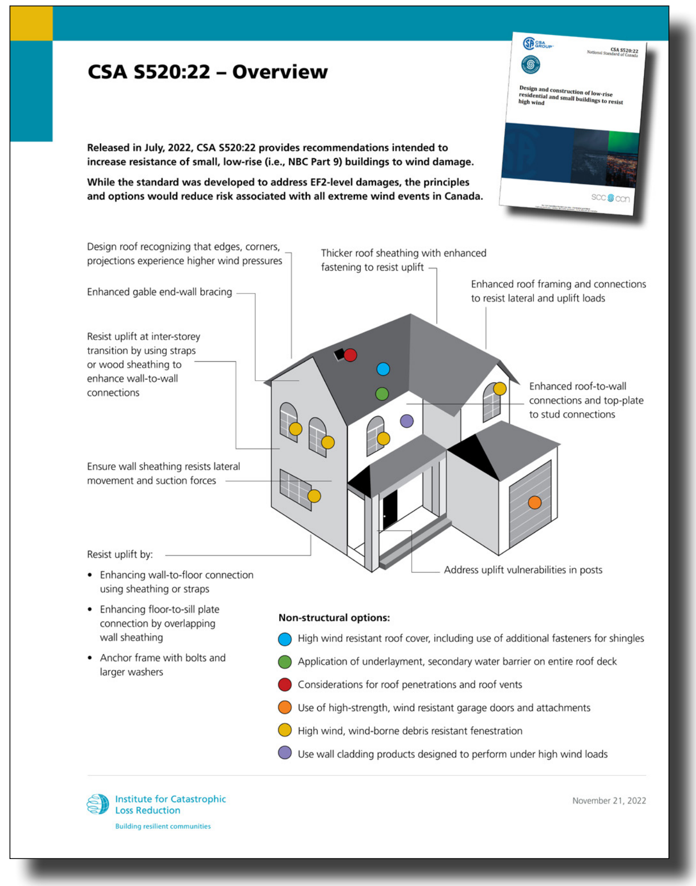
City of Barrie/Michael Janotta. 2022. Improving the Structural Resiliency of Part 9 Buildings in High Wind Events. Submitted to Ontario MMAH, May 2022.

Ontario Ministry of Municipal Affairs and Housing. 2022. PROPOSED CHANGE TO THE 2012 BUILDING CODE O. REG. 332/12 AS AMENDED. Toronto: MMAH.

Before each interview, we distributed an email to interviewees that included an introductory letter on Standards Council of Canada (SCC) letterhead, signed by ICLR and SCC leadership (Appendix B). The letter provided a brief background on the project and potential next steps (i.e., how the outcomes of interviews may affect future planning by SCC). Interviewees were provided with a high-level summary/overview of CSA S520 (Figure A). This document was specifically prepared for interviewees who had either not participated in or were not familiar with CSA S520 or Part 9 construction measures associated with extreme/ high-wind protection. Interviews were one hour long and conducted via web meeting.

Interview results are summarized here. A detailed summary of interview results is provided in Appendix C.

Figure A: High-level summary of CSA S520:22 provided to interviewees in advance of interviews.



2. General Summary of Interview Outputs and Recommendations

Based on identified barriers and opportunities concerning high-wind resilience – and climate resilience for Part 9 buildings in Canada in general – high-priority recommendations were developed, including:

1. Increase awareness of resilience topics in the construction industry generally, specifically among those involved in installation of building components (e.g., trades workers and contractors), and improve understanding and promotion of resilience interventions that provide the greatest benefit relative to cost. Resilience is viewed as a new and progressive topic in the building industry. Climate and disaster resilience are conflated with multiple existing and competing priorities for progressive building practices, notably energy efficiency and greenhouse gas mitigation.
2. Apply an incremental approach to adoption of resilience interventions, which involves an initial focus on interventions that can be applied while introducing very little to no incremental cost and risk for builders. Focus on greatest vulnerabilities of buildings, rather than full application of resilience practices, including those outlined in CSA S520. Related to this recommendation, develop and mobilize accessible, simple supporting material that emphasizes low-risk, low-cost solutions for builders, renovators, and households.
3. Improve awareness and knowledge mobilization of high-wind protection and resilience in the industry, which may include engagement with educational institutions, trade schools, and professional associations.
4. Develop incentivization opportunities (e.g., municipal and insurer incentives for high-wind protection), and leverage incentives to motivate builders and homeowners to voluntarily adopt high-wind protection options.
5. Conduct pilot projects of resilience options in collaboration with key building industry players, and include stick- or site-built and modular builders. Pilot projects would be beneficial to identify and develop builder champions. Post-disaster pilots provide discrete, high-priority opportunities to test and report on implementation of high-wind protection options.
6. Build on the content of CSA S520 and develop a set of measures focused specifically on existing buildings (e.g., opportunities for renovations, repair, reconstruction).
7. Coordinate the introduction and socialization of progressive building practices with a single agency acting as the coordinating body. For example, develop packages that address multiple climate change priorities in the building industry (e.g., carbon, energy efficiency, climate adaptation and mitigation). Improve coordination when issuing guidance to the building industry that is specifically related to resilience (e.g., provide simple, straightforward guidance that advises on resilience across a range of hazards, including high wind, flood, hail, wildfire).
8. Develop a coordinated strategy to integrate resilience into Canada's National Model Construction Codes. This strategy should include collaborative development and submission of a code change request concerning resilience objective(s) and continued engagement of the construction industry to build understanding and acceptability of resilient construction practices.

Further to the high-level findings above, many interviewees identified a need to develop a robust benefit-cost assessment to support implementation of CSA S520 and high-wind protection options in general. Porter's (2023) benefit-cost assessment is intended to fulfill this recommendation.[2]

[2] Porter, K.A. 2023. High-Wind Design of New Woodframe Houses Has an Average Benefit-Cost Ratio of 6:1 in Canada. Toronto: Institute for Catastrophic Loss Reduction.

3. Results

3.1. General

General observation: Short timelines and multiple priorities for the building industry

Any new building practice needs to progress from idea to concept to guidance to an implementation program. While development of a concept progresses, it is informed by implementation, piloting, and application in the field. This approach allows users to refine the building practice and identify a "sweet spot" for broad application (i.e., an approach that fulfills objectives of the building practice while limiting cost and risk of the intervention). Piloting and implementation are critical; however, multiple resilience topics – including substantive application of high-wind protection interventions – lack substantive piloting and implementation. Previous examples of this type of approach have taken decades, as exemplified through the building industry's adoption of R2000; however, as a result of societal concerns related to climate change impacts and adaptation, there is a drive to shorten the application process of new building practice to a very short time period (e.g., three to four years). Several interviewees noted that the building industry is facing pressure associated with implementation of multiple new building practices related to societal goals for climate change mitigation and adaptation, accessibility, affordability, embodied carbon, and performance-based design (Sidebox 1). In light of these multiple pressures and accelerated timelines, interviewees generally considered it impractical for the building industry to fully adopt the suite of high-wind resilience measures outlined in CSA S520 at a broad, national scale.

Limited awareness of high-wind risk and resilience in the industry

Interviewees noted a need to increase awareness of resilience issues in the construction industry, particularly for high-wind protection – including CSA S520. Regular, ongoing efforts to present resilience topics at events hosted by key construction industry groups, including architecture associations and Net Zero workshops, could facilitate increased awareness. Further, interviewees reported a need to understand and balance carbon implications of resilient buildings. For example, incorporating additional construction materials to increase a building's resilience may increase embodied carbon, but would potentially reduce overall carbon emissions, as the need to replace building components or rebuild destroyed buildings would be reduced. Whole-building life cycle analysis assessments should be considered in order to better understand carbon issues and help present the benefits of resilience in reducing carbon emissions associated with repairs or reconstruction of damaged buildings.

Sidebox 1: Priorities for the 2025 and 2030 Code Cycles

Strategic priorities for the 2025 National Model Codes cycle include harmonization, climate change mitigation and adaptation, alterations to existing buildings, and fire and life safety. Climate adaptation topics include heat-health/extreme heat in buildings and updating climate indices to account for potential climate change impacts.

Strategic priorities for the 2030 National Model Codes include climate change mitigation, climate change adaptation, accessibility, and performance-based codes. The Advisory Council for Harmonized Construction Codes (ACHCC) submitted input to the Canadian Board for Harmonized Construction Codes (CBHCC) indicating that labour and supply chain constraints and a need for public information about climate-related hazards present challenges to the implementation of climate change adaptation interventions; however, opportunities exist to leverage the existing work of local authorities and integrate standards that have been developed through the National Research Council's (NRC's) Climate Resilient Buildings and Core Public Infrastructure program. The ACHCC also identified a need to expand code objectives to include climate change adaptation and resilience. Other recommendations to the CBHCC included improved coordination among agencies involved in all 2030 strategic priorities, a need to increase consumer awareness and acceptance of potential changes, and a need to train building code officials.

Sources: ACHCC. 2023. Memorandum to Canadian Board for Harmonized Construction Codes – Implementation Considerations for the 2030 National Model Codes Strategic Priorities. NRC. Unpublished.

CBHCC. 2023. 2025 Code Priorities. https://cbhcc-cchcc.ca/en/2025-code-priorities/*. Accessed Nov. 23, 2023.*

3.1.1. Barriers

Challenges of implementing new construction practices

Implementing changes in construction practice is challenging, as existing construction methods prioritize cost efficiency and construction speed. Introducing new provisions that increase costs or diminish construction pace will inevitably generate resistance from the building industry, and inertia in the system is generally a major obstacle to adopting progressive building practices of any type.

A need for piloting

Pilot projects and monitoring are necessary to assess capital costs, practical issues related to implementation, and potential risks associated with implementing new construction practices. A thorough understanding of the intricacies of options – which should be developed through piloting – is needed before they can be scaled and promoted throughout the industry.

A lack of piloting and application in resilience options is a significant barrier to implementing high-wind and climate-resilience options. At a policy level, interviewees argued that competing construction industry priorities – including greenhouse gas reduction and accessibility, as well as other resilience topics related to heat-health and implementation of future/climate change–adjusted climate data – may overshadow resilience topics associated with hazards like high wind (see Sidebox 1).

Science and supporting information

CSA S520 specifies that buildings could be designed to withstand high wind equivalent to a tornado with an Enhanced Fujita (EF) level 2; however, the EF2 design goal may be considered too severe for many builders or homeowners. Further, a lack of mature science linking climate change to increasing frequency of high-wind events or tornadoes may cause some to question the need for high-wind protection. Though a long-standing program at Western University collects data on high-wind damage in Canada,[3] interviewees argued that limited data collection on wind damage of homes and specific damages experienced for building elements may make it difficult for builders and homeowners to understand the potential risks and prioritize the implementation of high-wind resilience measures.

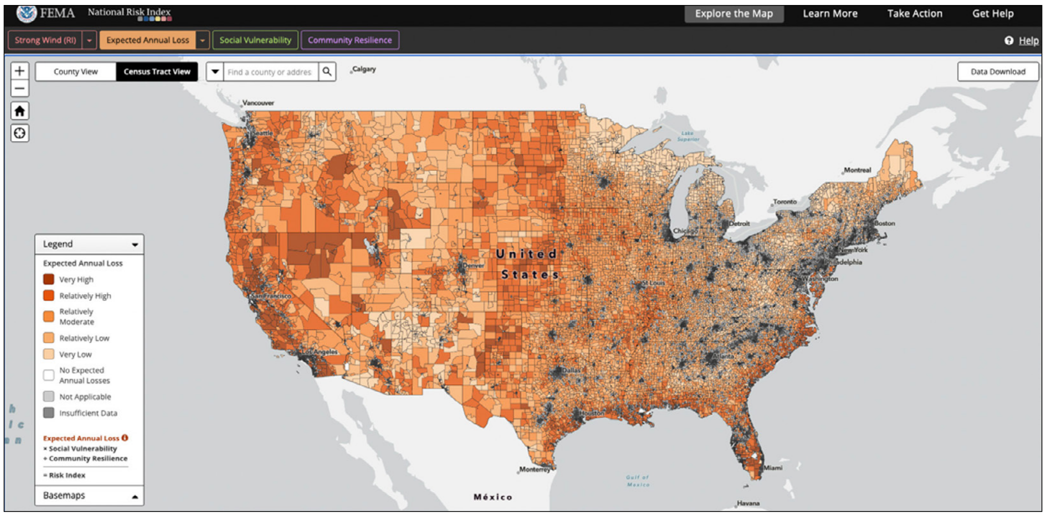
Accessible public hazards information

Interviewees noted that accessible data on many of Canada's important drivers of disaster risk, including high wind, hail, wildland fire, and pluvial flood, are not readily available to the public and the building industry. Though resources that provide both historical data and future projections are available, some of the more well-known resources, like Environment and Climate Change Canada engineering datasets and ClimateData.ca, are quite complex, which may discourage building industry professionals and homeowners from using them. Simple and accessible tools to identify regions where resilience measures should be applied, such as ClimateCheck,[4] are needed. The Federal Emergency Management Agency's (FEMA's) National Risk Index (Figure B) may also provide an example of accessible public hazard information that can inform disaster risk reduction practices.

[3] See the Northern Tornadoes Project: https://www.uwo.ca/ntp/

[4] See https://climatecheck.com/

Figure B: FEMA National Risk Index is an open online platform that provides public hazard information for the US.



3.1.2. Opportunities

Engaging the building industry

Engaging all relevant players, such as builders, insurers, code development agencies, inspectors, consumers, and regulated and unregulated trades, is necessary when proposing and adopting new construction practices. Specifically, in Ontario, larger builders need to be involved in the development and implementation of new construction practices. Increasing awareness of CSA S520, extreme wind resilience, and climate resilience across the codes, standards, and construction industries is necessary. Increased awareness could be partially achieved through webinars, conference presentations, and targeted communication to professionals such as architects, engineers, builders, and trades workers.

Recent and growing interest in high-wind protection

Interviewees reported a general perception that climate change and high winds are significant concerns in the building industry, and interviewees reiterated that the building industry should move forward with resilience practices. Long-serving practitioners and professionals in the construction industry reported an observed increase in discussion of high-wind resilience for Part 9 construction, mainly due to recent high-wind events such as Hurricane Fiona, which caused significant damage in the Atlantic provinces in 2022, and the tornado that hit Barrie in 2021.

Non-regulatory and voluntary adoption of CSA S520

Professional organizations, cited by insurers, architecture organizations, and government agencies, could reference the new CSA S520 standard before it is adopted into construction codes.
The barriers to uptake of high-wind resilience options are similar to the barriers for other issues related to new and progressive building practices, such as Net Zero and wildland-urban interface fire. One approach to increasing awareness in the industry may include construction of a demonstration house that can be used to educate the industry on key wind resilience options like enhanced continuous vertical load path. Development of resources outlining simple, low-cost wind protection

solutions that introduce minimal risk for builders, developers, and manufacturers would facilitate voluntary adoption. Promotion of wind protection through voluntary adoption and simple/accessible support documents may reduce the need for additional promotion of these types of solutions, as the industry may adopt them organically.

Piloting

To demonstrate the costs and practicality of high-wind protection, interviewees recommended engaging in pilot applications with builders, municipalities, or public building portfolio owners. A small number of homes should be designed and built according to CSA S520 or related guidance documents, following the model of Doug Tarry Homes, to refine practices based on experience and better understand the "true cost" of new building practices (see Sidebox 2).

Interviewees further recommended that governments should act as early adopters and implement these practices in their own portfolios, such as Part 9 community housing. Interviewees suggested that funding for pilot studies should be provided directly to builders, owners of buildings should be engaged in pilot studies, and owners of commercial Part 9 buildings may be more open to progressive building practices than homeowners.

Post-disaster opportunities

Groups promoting high-wind protection and general climate resilience should be prepared to use post-disaster opportunities to promote wind safety construction practices. For example, interviewees noted that, due to insurer contract arrangements, insurers may not cover the additional cost of relatively simple high-wind protective options, like adding underlayment to roof decks where it was not present before a loss event. The experience of the roofing contracting industry indicates that homeowners will likely not choose to bear the additional cost of resilience measures in these instances. Therefore, insurer-led, default application of resilience options may serve as an opportunity to increase resilience following disaster events. ICLR's Insurers Rebuild Stronger Homes program has provided the basis for several insurers to engage in post-disaster resilience practices, including installation of impact-resistant roof cover and basement flood protection options in the post-loss period. A similar approach may be used as a method to pilot and apply high-wind risk reduction options.

Sidebox 2: Doug Tarry Homes Ltd. – ICLR – Western University High-Wind Pilot Project

Doug Tarry Homes Ltd. and the Institute for Catastrophic Loss Reduction are partnering to install risk reduction measures in 100 new homes in the Harvest Run Community in St. Thomas, Ontario.

Measures are intended to increase the resilience of homes to high wind and tornado events and are based on research conducted at Western University. Measures include enhanced roof sheathing fasteners and enhanced connections between roof framing and supporting walls to protect both individual building structures and neighbouring buildings through reduction of flying debris during high wind and tornadoes.

Image: D. Sandink

Source: Doug Tarry Homes Ltd. 2023. https://www.dougtarryhomes.com/resources/pilot-project-wind-safety/. Accessed April 2023.

3.2. Construction Industry Acceptance and Awareness

3.2.1. Barriers

Introduction of cost and complexity

The influence of tract builders is a key factor in the adoption of a new construction practice. Builders tend to build to code (i.e., treating construction codes as both minimum and maximum). Introduction of new costs and complex construction practice may result in builders pushing back on trades, distributors, and manufacturers to minimize costs. Additionally, the insulation industry may push back on lateral load provisions (i.e., where wood structural panel is advanced as a lateral load enhancement option). Understanding cost implications of new interventions through piloting is important, particularly in high-growth markets where unionization of key trades is prevalent (e.g., the Greater Toronto Area).

As discussed above, piloting by builders is important for them to understand the "true cost" of new construction practices. Builders may argue that the actual implementation costs will be higher than those estimated in any benefit-cost or impact assessment submitted with the code change requests. For example, it has been argued that installation of exterior floor-to-floor structural connections requires additional equipment and labour and does not fit well within the typical workflow of home construction. These considerations should be identified by collaborative application of measures with the building industry.

3.2.2. Opportunities

Development of local ambassadors

Local construction industry ambassadors and champions could be developed to promote and help with adopting progressive building practices. For example, modular builders could be champions for low-cost high-wind risk reduction, as they have been applying several practices advanced in CSA S520 for 20 to 30 years as common practice. In Newfoundland, wind resistance measures may already be widely applied by default due to existing high-wind exposure, providing further opportunities to collect and report data on practical aspects of high-wind resilience and identify builder champions. Following publication of CSA S520, important players in the construction industry, notably the Canadian Wood Council (CWC), have already been promoting application of high-wind protection (Sidebox 3). Local engineering and architecture firms could also be educated on the objectives and recommendations in CSA S520 and related guidelines to provide them an opportunity to develop business focused on resilience practices.

Sidebox 3: Adoption and Promotion of High-Wind Protection by the Construction Industry

A strategy to increase construction industry adoption of high-wind protection is to allow the industry to drive change. Key industry players, such as the Canadian Wood Council, have been engaged in promoting high-wind protection following the release of CSA S520:22.

Image: Robert Jonkman, personal communication, December 2022.

Interviewees who were involved in the CSA S520 Technical Committee suggested a practical approach for increasing capacity in the construction industry for implementation of resilience options, including high-wind resilience:

- Source construction plans for typical Part 9 buildings from a home builder;
- Provide the construction plans to an engineer or designer to have them incorporate recommendations from CSA S520;
- Compare the cost of construction of the modified and unmodified building plans;
- Incorporate the findings of the exercise into a simple guidebook;
- Ask multiple engineers from firms across Canada to complete the above exercise, and ensure that resilience options accommodate local building practices and hazard conditions.

The above process could be conducted at relatively low cost, notably where Part 9 building plans can be sourced from a home builder. Involving designers from multiple locations in Canada would increase knowledge of resilience topics and provide for "resilience ambassadors" that could inform their clients of resilience options.

Educating and involving trades workers and contractors

Trades workers and contractors should be educated on the purpose of structural load paths and how their work affects the safety of occupants. A "travelling road show" could be developed to explain the protection options and engage technical representatives to answer specific questions about installation methods (Sidebox 4). This approach could be applied where there exists no central body through which trades can be reached (e.g., in the case of unregulated trades).

Engaging and aligning with existing influential building industry programs

Interviewees, as well as others in the construction industry, frequently recommended exploring the incorporation of resilience in the Natural Resources Canada (NRCan) Local Energy Efficiency Partnerships (LEEP)[5] program and engaging manufacturers to develop cost-effective solutions for resilience, including high wind, through the program. They noted that the Canadian Home Builders' Association was engaged in a LEEP initiative, which may be expanded to include climate resilience. Interviewees further suggested engaging with existing Net Zero initiatives and workshops, as well as adopting successful educational practices from the United States (for example, interviewees identified the US/Insurance Institute for Business and Home Safety (IBHS) Fortified program as a model program for high-wind protection of residential buildings). Incorporating resilience measures into the NRCan Greener Homes program could be accommodated by expanding the program's scope of measures beyond climate change mitigation.

Sidebox 4: ICLR Climate Resilience Centre

ICLR has developed a resilience display centre composed of several physical models and kiosks designed to demonstrate Part 9 resilience measures, including protection options for high wind, hail, wildfire, and basement flood.

The display models could be used to establish temporary, regional display centres across Canada.

Climate Resilience Display Centre Event – London, October 2023.

[5] See https://natural-resources.canada.ca/energy-efficiency/homes/local-energy-efficiency-partnerships-leep/17338.

Engaging with manufacturers and suppliers

There is a need for groups promoting resilient construction to work with suppliers and manufacturers, including building component manufacturers, notably construction hardware producers such as Simpson Strong-Tie, MiTek, and roofing manufacturers. Engaging manufacturers may involve providing suppliers with marketing opportunities and engaging installers in programs that promote construction practices that exceed code minimums.[6] Manufacturers and suppliers must also be prepared to support scaling up the application of these measures in both renovations and new constructions. The garage door industry, represented by the Door and Access Systems Manufacturers Association (DASMA), should also be engaged and encouraged to facilitate labelling of wind-resistant garage doors.

Local markets and building permit processes

Interviewees suggested that CSA S520 was unlikely to be adopted in full, but incremental approaches to adoption of high-wind protection measures, and climate resilience in general, should be pursued. To facilitate incremental change, they considered it important to work with motivated local builders such as custom builders and individual homeowners who could be engaged through the building permit process. The program initiated by ICLR and Dufferin County may provide a baseline for further engagement of custom builders in key aspects of high-wind protection (see Sidebox 5).

Sidebox 5: County of Dufferin Hurricane Clip Rebate Program

Dufferin County's Hurricane Clip Rebate Program provides a model for builder and resident engagement on resilience practices. Through the program, building permit applicants are offered a rebate on hurricane tie installation while submitting permit applications at municipal offices.

From 2017 to 2021, nearly 30,000 structural ties were installed in approximately 480 structures as part of the program. New residential buildings installed an average of 76 ties. Funding was provided by building department reserves (generated through collection of permit fees) and by ICLR at $4.50 per hurricane tie.

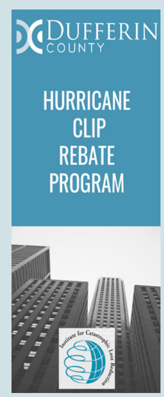


Image source: County of Dufferin. 2023. https://www.dufferincounty.ca/sites/default/files/building/Hurricane%20Clips%20Brochure%20FINAL.pdf. *Accessed May 2023.*

3.3. Consumer Demand

3.3.1. Barriers

Consumer demand remains a barrier to adopting new home construction practices related to high-wind and climate resilience. Interviewees indicated that consumers do not recognize climate resilience as a desirable feature of homes and/or assume that environmental loads are fully reflected in construction code requirements. Consumers will instead focus on interior finishes, regardless of the relative increase in home price associated with integration of resilience options. Household budgets are determining factors in the features incorporated into new or existing construction. Interviewees suggested that even small increases in costs for specific projects, for example, an extra $150 for a re-roofing contract, could be a determining factor for homeowners when selecting a contractor. Increasing resilience to multiple hazards, including wind along with flood, wildfire, etc., can add significant costs, potentially approaching tens of thousands of dollars if all resilience practices are incorporated into construction of a new home.

[6] See, for example, IKO's CodePlus initiative: https://www.iko.com/na/document-library/codeplus-application-manual-en.pdf.

3.3.2. Opportunities

Consumer marketing and incentives

A consumer marketing approach should be developed to allow builders and manufacturers to market resilience to consumers and clients. For example, builders and renovators could be involved in collaborative development of a high-wind or resilience "protection package" that could be presented to clients as an option for new construction and renovation. Where available, insurance and municipal financial incentives could also be included in marketing materials to encourage homeowners to voluntarily adopt resilience packages.

Similar to recommendations for the building industry, simple and accessible materials should be developed and promoted to increase consumer awareness of high-wind protection practices. Sales representatives can provide awareness and market resilience options. Specifically, builders or sales staff may be engaged in offering upgrade packages for high-wind protection (e.g., a $5,000 package that includes structural connections), as well as providing background engineering information and promotional materials that support builders in offering this type of package.

Building department reserves have been applied to develop municipal incentive programs, as seen in Dufferin County, Ontario, and Calgary, Alberta (Sideboxes 5 and 6). Interviewees indicated that consumer and roofing industry interest in hail-resilient roof cover did not exist in Calgary until the city implemented the Resilient Roofing Rebate program. Respondents provided several recommendations related to ensuring that incentive programs are progressive and address equity issues, including tying incentives to roof area rather than providing a standardized or flat incentive disbursement for all homes.

3.4. Enforcement, Inspections, Regulation – Barriers and Opportunities

Capacity to inspect – barriers and opportunities

Multiple interviewees identified challenges with engaging codes and inspection staff in the implementation of high-wind protection measures, including insufficient capacity of code enforcement to inspect all elements of homes (e.g., inspectors will not "count nails"), code officials lacking training in uplift load resistance, inspectors being restricted from using ladders to inspect structural connections, lack of regulation in several key trades (specifically roofing and framing), and lack of clear mechanisms for inspecting several construction practices related to high-wind protection.

Sidebox 6: City of Calgary Hail-Resilient Roofing Initiatives

Following a severe, damaging hail event that resulted in $1.3 billion in insured losses in June 2020, the City of Calgary engaged the insurance and building industries in the development of education, subsidies, and regulatory initiatives to increase adoption of hail impact-resistant (IR) roof cover. The programs included public education, provision of direct rebates to households that installed IR roofing, and development of a provincial working group to develop code change requests focusing on hail-resilient roofing practices for hail-prone areas of Alberta and Canada.

The rebate program directly supported over 1,600 Calgarians with installation of IR roof cover. The program involved multiple players, notably local roofing contractors' associations, which resulted in increased installer capacity to educate customers on the benefits of IR roof cover. The City allocated $5.25 million for the initiative. When the program concluded in May 2022, approximately 1,600 more households remained on a wait list, should the program be re-instated.

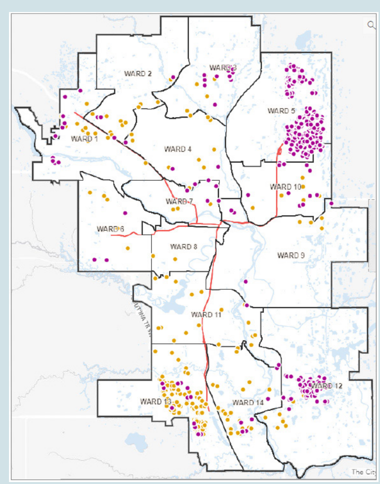


Image: Adoption of the rebate program in Calgary (dots represent homes where an IR roof cover rebate was provided). City of Calgary, 2022. Resilient Roofing Rebate Program – Third Quarter Update. Calgary: City of Calgary.

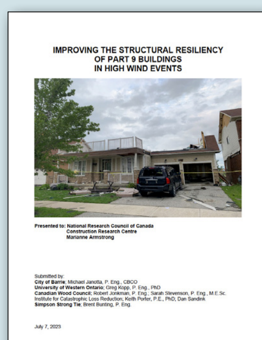
Conversely, interviewees indicated that several proposed wind-protection practices, particularly truss screws and hurricane ties that are observable from the ground (unlike toe-nailed roof-to-wall connections), may assist code officials in ensuring that structural connections are in place. A building inspector noted further that additional efforts associated with inspections alone would not be significant enough to forgo implementation of wind-protection options.

Information on OBC code change requests concerning high-wind protection has been circulated through various building officials' associations, including the Ontario Building Officials Association, via building officials engaged in the City of Barrie code submission (see Sidebox 7).[7] An Ontario code official had previously submitted a code change request for application of enhanced roof-to-wall connectors (i.e., hurricane ties) to ease inspection of these structural connections. The code official reported to the code development agency that "current practice is difficult to inspect and enforce … builders don't often comply with the minimum nailing requirement …" and cited recent evidence from high-wind events in Ontario that missing structural connections contributed to structural damage to buildings. The submission further identified concerns related to the effectiveness of toe-nail connections even when installed properly (e.g., splintering of wood reduces effectiveness of the connection), and noted that use of mechanical fasteners in place of toe-nail connections would "[reduce] inspection time" and provide for "greater potential for voluntary compliance."[8]

Though the submission did not result in a change in the code, it indicates how some resilience options may serve to streamline specific aspects of building inspections.

Sidebox 7: City of Barrie: High Wind/Tornado Code Change Proposal for the Ontario and National Building Codes, 2022-2023

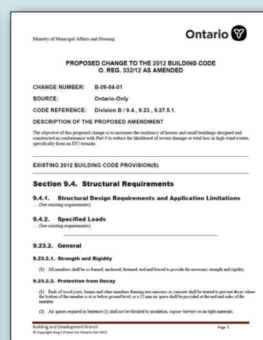
Following damages experienced in the 2021 Barrie tornado, the City of Barrie, supported by several key partners, developed code change requests for the Ontario and National Building Codes. The requests were designed to address specific vulnerabilities in the structural and lateral load paths of Part 9 buildings.


IMPROVING THE STRUCTURAL RESILIENCY OF PART 9 BUILDINGS IN HIGH WIND EVENTS

Presented to: National Research Council of Canada
Construction Research Centre
Marianne Armstrong

Submitted by:
City of Barrie; Michael Janotta, P. Eng., CBCO
University of Western Ontario; Greg Kopp, P. Eng., PhD
Canadian Wood Council; Robert Jonkman, P. Eng.; Sarah Stevenson, P. Eng., M.E.Sc.
Institute for Catastrophic Loss Reduction; Keith Porter, P.E., PhD; Dan Sandink
Simpson Strong Tie; Brent Bunting, P. Eng.

July 7, 2023


Ministry of Municipal Affairs and Housing
Ontario

PROPOSED CHANGE TO THE 2012 BUILDING CODE
O. REG. 332/12 AS AMENDED

CHANGE NUMBER: B-09-04-01
SOURCE: Ontario-Only
CODE REFERENCE: Division B / 9.4., 9.23., 9.27.5.1.

DESCRIPTION OF THE PROPOSED AMENDMENT

The objective of this proposed change is to increases the resiliency of houses and small buildings designed and constructed in conformance with Part 9 to reduce the likelihood of severe damage or total loss in high wind events, specifically from an EF2 tornado.

EXISTING 2012 BUILDING CODE PROVISION(S)

Section 9.4. Structural Requirements

9.4.1. Structural Design Requirements and Application Limitations
… (See existing requirements)

9.4.2. Specified Loads
… (See existing requirements)

9.23.2. General

9.23.2.1. Strength and Rigidity

(1) All members shall be so framed, anchored, fastened, tied and braced to provide the necessary strength and rigidity.

9.23.2.2. Protection from Decay

(1) Ends of wood joists, beams and other members framing into masonry or concrete shall be treated to prevent decay where the bottom of the member is at or below ground level, or a 12 mm air space shall be provided at the end and sides of the member.

(2) Air spaces required in Sentence (1) shall not be blocked by insulation, vapour barriers or air tight materials.

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City of Barrie/Michael Janotta. 2022. Improving the Structural Resiliency of Part 9 Buildings in High Wind Events. Submitted to Ontario MMAH, May 2022.

City of Barrie/Michael Janotta. 2023. Improving the Structural Resiliency of Part 9 Buildings in High Wind Events. Submitted to NRC, Construction Research Centre, July 2023.

Ontario Ministry of Municipal Affairs and Housing. 2022. PROPOSED CHANGE TO THE 2012 BUILDING CODE O. REG. 332/12 AS AMENDED. Toronto: MMAH.

3.5. Construction Code Development

3.5.1. Barriers

Construction code development process and lack of resilience objectives in construction codes

The construction code development process is risk-averse and conservative, and it favours adoption of matured construction practices that have been well-tested in the field and are already supported by the construction industry. Even where progressive practices are adopted in national codes, administrative and regulatory barriers may delay the adoption of new codes (e.g., provincial adoption of national codes can take several years). Further, construction codes lack clearly defined resilience or climate adaptation objectives, participants in the code development process may be somewhat skeptical of future

[7] City of Barrie/Michael Janotta. 2022. Improving the Structural Resiliency of Part 9 Buildings in High Wind Events. Submitted to Ontario MMAH, May 2022.

Ontario Ministry of Municipal Affairs and Housing. 2022. PROPOSED CHANGE TO THE 2012 BUILDING CODE O. REG. 332/12 AS AMENDED. Toronto: MMAH.

[8] 2012 Building Code Change Request Form. Ontario Building Code Official, personal communication, November 2022.

climate projections, and other construction priorities are more dominant than high-wind protection (e.g., climate change mitigation, accessibility, and other climate risks including extreme heat/heat-health).

As mentioned above, a set of code change requests concerning high-wind protection was submitted for consideration in the OBC, and proposed changes were issued for public review in October 2022. Public response to these changes has not been released for the study team to review; however, it was suggested by interviewees that, due to the complexity of the proposed changes and expected public comments, the changes may not be considered in time for the next edition of the OBC. Where code changes are not implemented in time for publication of new editions of codes, interim amendments may be issued for critical issues, which may include high-wind protection.

A consultant who was tasked with providing a benefit-cost assessment of the proposed changes to the OBC discussed above indicated that the narrow scope of the assessment process did not allow for comprehensive reporting of potential benefits of the code change proposal (see Sidebox 8). Further, the effort to increase harmonization of codes across Canada acts as a barrier to adoption of changes to provincial codes, as code development agencies seek consistent approaches for Part 9 construction across the country, especially where these changes concern structural design. As a result, the City of Barrie submitted a further code change request to the National Research Council (NRC) in 2023 for consideration in future national model construction codes (Sidebox 7).

Interviewees suggested that CSA S520 has potential to be referenced as a voluntary standard that addresses uplift resistance in the NBC; however, referencing any new standard in construction codes is typically a lengthy process. Interviewees, including those involved in provincial code development agencies, further suggested that a tiered or stepped approach to implementation should be considered for high wind, due to the difficulties associated with referencing a standard as comprehensive as CSA S520.

Sidebox 8: Excerpt of Note from Consultant to Provincial Building Authority Concerning Completion of a Benefit-Cost Analysis for High-Wind Resistance

… In the course of pulling together the climate data and insurable losses for the cost-benefit analysis [builder/consultant] recently did for [provincial agency], the direction given was to focus solely on high-wind data, specifically for the PCF [Proposed Change Form]. I pulled together the info I could find but found insurable loss data consolidates the losses per event, not peril type within each event, resulting in an inability to provide conclusive loss figures specific to high wind if the proposed PCF measures are not employed.

My concern is related to the cost-benefit procedure as follows:

1. The procedure asks for very narrow, precise and specific data/information only for the exact PCF components and peril (high wind).
2. There is limited data/information on high wind.
3. Although we could quantify the cost part, we couldn’t quantify the benefit of instituting the PCF measure because insurable losses are measured in aggregate by storm vs by peril within the storm.
4. There are clear trendlines related to an increase in insurable losses (notwithstanding significant uninsurable losses, losses to municipal revenue streams, property devaluations, and societal impacts (PTSD, displacement, etc.)).
5. However, because of the way in which the cost-benefit procedure requests very narrow information that hasn’t been measured or has limited data (high wind), the benefit is not adequately quantified.
6. My fear is the PCF could be ruled out because of this.
7. I would like to suggest that when it comes to resilience/adaptation measures, we need to relook at how the cost-benefit analysis approach is undertaken and broaden the view to avoid the risk of measures being dismissed because the cost-benefit scope is too narrow (e.g., focused on high wind only) and there isn’t enough data to provide conclusive evidence on the financial benefit.

Provincial code development processes are often opaque and may limit the opportunity of code change proponents to engage in code development processes and defend or provide context for code change requests. Previous code submissions (e.g., high-wind code change submissions made to the OBC in 2010[9]) have indicated that practical and cost-related concerns of the construction industry will likely continue to inhibit adoption of high-wind protection provisions in construction codes.[10]

Lack of a clear objective concerning climate resilience is a recurring barrier to incorporation of construction code provisions concerning resilience, including high-wind protection. In December 2023, the Canadian Board for Harmonized Construction Codes (CBHCC) issued a public review of proposed changes to the 2020 National Model Codes, which included a new objective and functional statement directly related to greenhouse gas emissions presented for public comment (see Sidebox 9). Those involved in the national model code development process have indicated that a similar objective should be developed for consideration by code development agencies.

3.5.2. Opportunities

The need for regulation to protect public safety and support on national committees

Regardless of abovementioned challenges, interviewees generally accepted that voluntary measures alone will not be effective in engaging the construction industry in climate resilience and consistent practice via regulation is necessary to scale up wind and climate resilience for buildings. Interviewees indicated that policy discussions were ongoing at NRC concerning priorities for future iterations of national construction codes. This work included a survey issued to provincial code development agencies, as well as input from Codes Canada codes committees (Canadian Table for Harmonized Construction Codes Policy and the CBHCC). Interviewees involved in the CBHCC indicated that there is support for considering extreme wind resilience in construction codes, and advocacy from within the CBHCC and the Advisory Committee for Harmonized Construction Codes (ACHCC) at the national level has supported continued discussion of the need for high-wind resilience in codes. Cost-benefit assessments will be required for consideration of code change requests, and impact analyses for proposed measures should cover administrative aspects and costs/benefits in order to be considered for adoption in construction codes.

Sidebox 9: Lack of Code Objectives for Climate Resilience

Currently, national or provincial construction codes in Canada have no clear objective for climate resilience. This serves as a barrier for codification of any resilience-oriented code change request. Only recently has a clear objective for greenhouse gas emissions been presented for public review for the National Model Construction Codes. A similar objective should be developed to facilitate resilience-oriented code provisions.

Proposed Greenhouse Gas objective (December 2023 public review):

Proposed Objective: *OE2 Greenhouse Gas Emissions. An objective of this Code is to limit the probability that, as a result of the design or construction of the building, greenhouse gas emissions will have an unacceptable effect on the environment. The risks of unacceptable effect on the environment due to greenhouse gas emissions addressed in this Code are those caused by –*

OE2.1 – excessive emissions of greenhouse gases

Proposed functional statement: *F101 To limit operational greenhouse gas emissions.*

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9 Sandink, D., Kopp, G., Stevenson, S., and Dale, N. 2019. Increasing High Wind Safety for Canadian Homes: A Foundational Document for Low-Rise Residential and Small Buildings. Toronto/Ottawa: ICLR/SCC.

10 Martin, G., & McKay, R. 2022. Transparency and efficiency in building code review. The case of Ontario, Canada. *Canadian Journal of Civil Engineering* 49(9), 1471-1482.

Submissions to OBC and NBC and related code change proposals

Provincial code development staff involved in the interview process indicated that they had advocated for high-wind protection at the national level through their participation in the CBHCC. Others at the national level, including those involved in construction code policy, had also indicated that high-wind resistance should be a priority for residential construction. Interviewees indicated that the OBC submission should lead to a submission to the NBC. At this stage, an extreme wind Code Change Request may be considered a placeholder for national construction codes, as wider resilience considerations will likely not be considered for the 2025 codes cycle. In 2023, an NBC code change request, led by the City of Barrie and supported by a number of partners, was submitted to NRC (see above discussion – and Sidebox 7).[11]

A set of lateral load code change requests are currently being considered for NBC Part 9.[12] Currently, lateral loads are not considered systematically, if at all, for Part 9 buildings for most of the country. Proposed changes to the OBC, as well as CSA S520, would complement lateral load changes proposed for NBC by introducing uplift load provisions for Part 9 buildings.

3.6. Technical and Construction

3.6.1. Barriers

Common factors in the construction industry

Multiple ongoing factors in the construction industry will inhibit adoption of new or innovative construction practices that exceed code minimums. These factors include shortages in trades workers, ongoing supply chain issues that limit availability and increase the cost of construction materials, home affordability, and regulatory barriers. Inspections interviews specifically raised occupational safety as a barrier. Specifically, floor-to-floor connections that require ladders for installation will be difficult, as construction sites are generally moving away from use of ladders due to safety issues for both builders and inspectors.

Practical considerations

Implementing high-wind protection measures in construction is not always straightforward due to practical considerations. The construction industry may deem some measures, such as lapping rim board with exterior wood sheathing or applying both wood sheathing and continuous exterior insulation, as impractical. In addition, addressing the continuous load path may require enhancements to trusses (which are largely constructed off-site) along with other elements of the continuous vertical load path. Further, the building industry may require more information to determine where extreme wind provisions should be applied (e.g., hazard and exposure mapping tools).

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[11] A consortium comprising the City of Barrie, Western University, the Canadian Wood Council, Simpson Strong-Tie and ICLR is supporting the development of an NBC code change request based on the request submitted for consideration in the OBC in 2022.

[12] Canadian Board for Harmonized Construction Codes. 2023. Proposed Changed 1475. Ottawa: Codes Canada/National Research Council.

A specific, recurring vulnerability of Part 9 construction in high-wind events is damage to roof cover under wind loads, including relatively moderate wind loads. This vulnerability may be related to installation practices, including cold-weather installation of asphalt shingles, as cold weather inhibits shingle adherence. Ideally, sealant strips would tack in cool temperatures and stay sealed in warmer temperatures. However, making sealant perform well in areas with large temperature swings (e.g., warm summers and cold winters) is difficult, which necessitates alternative options to ensure shingle sealing.

3.6.2. Opportunities

Modular construction

Modular and pre-fab construction provide opportunities for improved construction methods, quality control, and high-wind risk reduction. Large tract home builders are increasingly adopting pre-fab construction because components can be inspected in the factory rather than on site, allowing for improved quality control. This increase in scope presents an opportunity to develop specific recommendations for pre-fab construction and to address issues concerning how additional connections, such as lapping of exterior wood sheathing, can be incorporated into pre-fab components like walls. It is also necessary to understand the inspection opportunities and barriers associated with integrating extreme wind protection into pre-fab components. The sheathing industry could be approached to develop sheathing that can accommodate lapping of rim joists. For example, longer sheathing (9 feet long) could be incorporated into pre-fab wall panels, facilitating rim board lapping during installation on site. As discussed in Section 3.2.2., the modular and factory-built home construction industry has already applied high-wind protection measures for years, as homes are shipped with ties and other components already incorporated to withstand high-speed transportation on highways.

Incremental implementation targeting low-cost, low-risk options

An incremental implementation of wind resilience measures would make the transition more manageable and affordable for the construction industry. For example, starting with "low-hanging fruit" measures that provide a good return on investment without significantly affecting home affordability could be more easily implemented as an initial step toward comprehensive wind risk reduction (Sidebox 10). A step-wise breakdown of the full set of measures, along with impact analyses, could be developed to support an incremental approach. Presenting interventions in this way would allow for a clear understanding of the requirements and objectives and help identify compliance packages by all involved in the construction industry.

Sidebox 10: Loss of Roof Cover Is a Recurring Vulnerability of Part 9 Housing in Canada

Addressing vulnerability of roof cover to wind damage through widely available measures that exceed code requirements (e.g., underlayment and secondary water barriers) is often advanced as a low-cost, effective solution to increasing wind resilience.

Images: Homes in Barrie following the 2021 tornado. Credit: Northern Tornadoes Project.

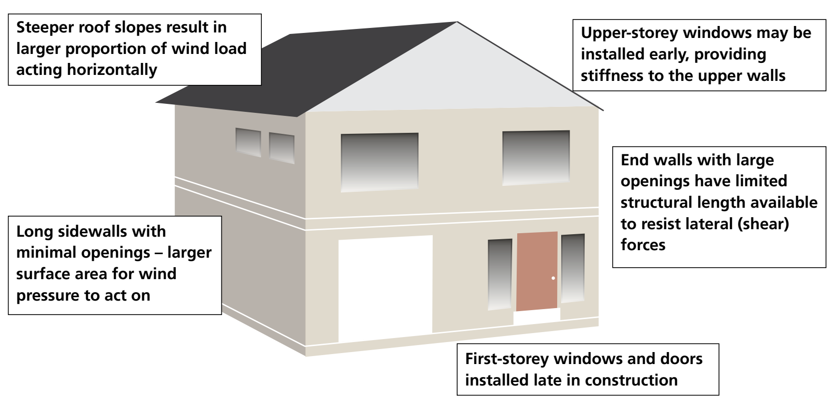
Low-cost, simple measures could be prioritized for wide-scale adoption. For example, re-roofing contractors will typically install underlayment for a small additional fee, as this is an easy sell to homeowners. Incremental cost to apply high-wind-rated shingles is modest, and installation requirements are similar if not the same as typical base shingles, making it a simple and affordable additional measure. Underlayment offers multiple co-benefits (e.g., provision of fire, high-wind, and hail-resistance benefits) that should be highlighted to increase consumer acceptance.

Builders who are already using exterior wood sheathing may find the additional cost of lapping rim joists and sill plates to be low. Additionally, implementing additional fasteners for roof and exterior wall sheathing will likely be relatively straightforward, with low incremental cost and time requirements. Simplifying options and measures such that structural design is not required for implementation can further increase the feasibility and accessibility of low-cost options.

Simple, accessible presentation of resilience options

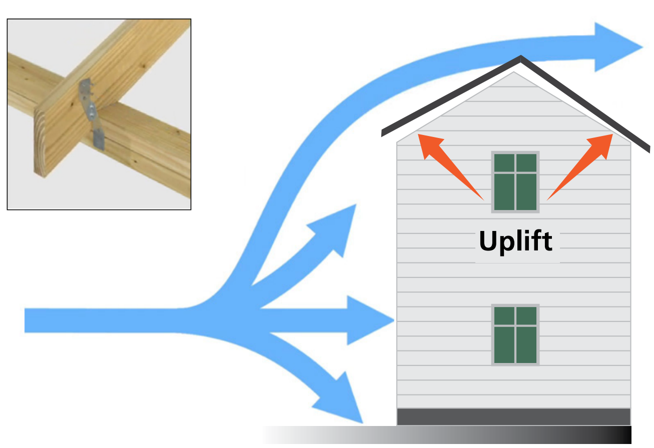
Interviewees reported that consumers and builders need simple summaries of high-wind protection practices, standard specifications, and drawings that they can easily understand and adopt. Interviewees identified several "good examples" of simple presentations of resilience options that are typically easily understandable by both the public and the building industry (see Figures C, D, and E and Sidebox 11).

Figure C: Example of a clear, accessible summary: High-wind protection for partially constructed homes.



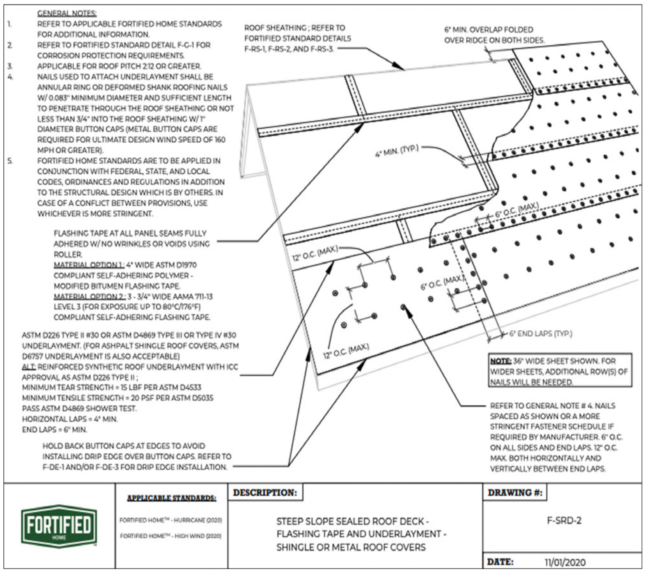
Source: Stevenson/ICLR, 2022

Figure D: Simple demonstration of uplift force and the role of roof-to-wall connection in resisting uplift.



Source: Simpson Strong-Tie, 2022

Figure E: Standard specification indicating installation practice for sealed roof decks using flashing tape and underlayment (a method included in CSA S520).



Sidebox 11: US Department of Housing and Urban Development "Designing for Natural Hazards" Guides

The "Designing for Natural Hazards" guides are intended to provide "technical content in a very straightforward manner that is easy for a layperson to understand while also providing references for design professionals, builders, developers, and public officials to dive deeper into the necessary details," with a focus on residential buildings. Guidance is provided in a series of double-sided one-pagers that can be applied as stand-alone documents and allow builders to specify disaster resilience options that exceed code requirements.

As reported in the Wind guide (2023):

> *The front of each document identifies (1) the damage expected by the hazard (as shown in the photo); (2) the frequency that a specific type of damage occurs; (3) a description of the resilient construction practice that can minimize damage; (4) a description of the mitigation strategy; and (5) a summary of the cost and benefit of implementing the resilient construction practice. The back of the document provides additional design guidance details, including (1) multiple design variations and supplemental resilient construction practices; (2) the corresponding level of difficulty associated with implementing alternative resilient construction practices; (3) the relative cost of implementing the various options; and (4) technical references that provide more information for each design option.*

Example one-pager:

Source: US Department of Housing and Urban Development. 2023. Designing for Natural Hazards: A Resilience Guide for Builders and Developers. Volume 1: Wind. Washington, D.C.: US Department of Housing and Urban Development.

3.7. Training and Awareness: Professions and Trades

3.7.1. Barriers

Limited understanding about the importance of continuous load path elements among trades workers and installers could discourage them from implementing high-wind protection practices. Additionally, a shingle manufacturer reported that shingle installation often does not comply with manufacturer guidelines, which makes homes more vulnerable to high-wind damage. Conversely, installers may argue that manufacturers should change the design of their products to better facilitate installation. Generally, the drive to keep costs down to secure project contracts acts as a barrier to wide-scale adoption of innovative construction practices, and adding just a few hundred dollars to the cost of any job may impede securing future contracts for installers. Interviewees also noted that engaging unregulated trades, such as roof installers, in resilience practices would be difficult.

3.7.2. Opportunities

Training could help to reduce the perceived complexity of wind safety and promote the availability of accessible technologies for achieving high-wind protection objectives. Interviewees highlighted specific opportunities associated with integration of modules into trades education at Canadian colleges. They further argued that high-wind modules could be incorporated into professional training for architects and engineers, and these modules could be used as resources for manufacturers providing training initiatives for engineers. Non-regulated, non-unionized trades can also benefit from accessible courses on the installation of wind safety options, which may have to be delivered site by site (see Sidebox 4); unregulated trades could also be encouraged to register with local industry associations that may be more open to facilitating training of members.

3.8. Existing Homes and Renovations

Though CSA S520 focuses largely on new construction, multiple interviewees highlighted the need to consider high-wind protection for existing construction. They further argued that climate-resilient construction presents an opportunity for the renovation industry. To support work on existing construction, interviewees advised that cost-benefit assessments should identify cost-effective measures that could be incorporated into renovations or during windows of opportunity (e.g., adding fasteners and structural connections when roof cover or siding is replaced). Simple, prescriptive, homeowner-oriented guidance should be developed to support integration of high-wind safety into existing construction, and future editions of CSA S520 should include more material and practical guidance concerning existing construction.

Appendix A: List of Interviewees

#	Interviewee	Organization	Interviewee category
1	Municipal Building Inspections Official	Municipal building services	Code official – incentive program
2	Municipal Building Inspections Official	Municipal building services	Code official – incentive program
3	Municipal Official	Municipal emergency management department	Municipality – incentive program
4	Municipal Building Inspections Official	CBO, building services (retired)	Code official
5	Municipal Building Inspections Official	CBO, building services (retired)	Code official
6	Standards Development Official	Standards development organization	Codes and standards development
7	Code Development Official, Technical	Code development agency (federal)	Codes and standards development
8	Research Officer	Federal research agency	Codes and standards development
9	Technical Staff	National construction industry association (materials), member of CSA S520 TC	Industry Associations, codes and standards development
10	Engineering Consultant	Engineering firm, member of CSA S520 TC	Consulting engineer, codes and standards development
11	Technical Staff	National construction industry association, member of CSA S520 TC	Industry Associations, codes and standards development
12	Technical Staff	Manufacturer of structural connections, member of CSA S520 TC	Manufacturer, codes and standards development
13	Technical Staff	Roofing materials manufacturer	Manufacturer
14	Academic, policy	University	Academic
15	Academic, wind engineering	University, member of CSA S520 TC	Academic
16	Academic, wind engineering	University, member of CSA S520 TC	Academic
17	Research Officer	Federal research agency	Researcher
18	Research Officer	Federal research agency	Researcher
19	Builder & Former Codes Official	Ontario tract builder	Builder, codes compliance
20	Code Development Official, Lead	Provincial code development agency	Provincial code development
21	Code Development Official, Policy	Provincial code development agency	Provincial code development
22	Code Development Official, Technical	Provincial code development agency	Provincial code development
23	Code Development Official, Technical	Provincial code development agency	Provincial code development
24	Code Development Official, Technical	Provincial code development agency	Provincial code development
25	Technical Staff, Industry Association	Regional roofing contractors' association	Roof cover installation

Appendix B: Interview Information Letter

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November 25, 2022

Barriers and opportunities for increased high wind resistance of Canada's small buildings

High wind is one of the most important drivers of catastrophe loss in Canada. Out of 139 recorded insurance catastrophe events between 2009 and 2022, 111 (80%) had a wind loss component. Recent, major damaging tornado events that occurred in Ottawa/Gatineau in September, 2018 and in Barrie in July 2021, resulted in $344 M and $107 M in insured loss respectively. A combination of flooding and high wind resulted in nearly $700 M in losses during 2022's Hurricane Fiona in Atlantic Canada. In Canada, most catastrophe losses result from damage to residential buildings.

High wind protection provisions for low-rise, residential, and small buildings are included in national and provincial construction codes. These provisions, however, are only applied in a small number of communities that are considered to be wind hazard areas. Recent work sponsored by the Standards Council of Canada has sought to increase adoption of practices that can increase high wind resistance for small buildings across Canada, including publication of a foundational document concerning high wind protection for small buildings, and supporting the development of a new National Standard of Canada: CSA S520:22: *Design and construction of low-rise residential and small buildings to resist high wind*.

ICLR has been retained by the Standards Council of Canada to conduct a two-part project. Part A of the project concerns development of a comprehensive benefit-cost assessment of high wind protection measures, including those presented in CSA S520:22. Part B of the project is aimed at generating information on barriers and opportunities for adoption of high wind protection practices for small, low-rise buildings, based largely on key informant interviews.

We would appreciate your participation in Part B of this project. Specifically, **we request your participation in a 1 hr interview that will focus on your perspectives concerning barriers and opportunities for adoption of high wind protection measures for small, low-rise (i.e., Part 9) buildings**, including recommendations outlined in CSA S520:22. This work will inform future projects and activities of the Standards Council of Canada aimed at increasing disaster and climate change resilience of Canada's built environment.

Kind regards,

Pierre Bilodeau
Vice-President, Strategy and Stakeholder Engagement
Standards Council of Canada

Paul Kovacs
Executive Director
Institute for Catastrophic Loss Reduction

Standards Council of Canada
Open a world of possibilities.

Conseil canadien des normes
Un monde de possibilités à votre portée.

Canada

Appendix C: Detailed Interview Results, Draft, to April 2023

General

Barriers

General comments	• There is a general lack of awareness of resilience topics and CSA S520 in particular across the construction industry. There is a general need for ongoing, regular interaction with stakeholders to increase awareness (e.g., connecting with professional associations, presenting at conferences, lunch-and-learn presentations, etc.). • Any change in construction practice is difficult to implement. Existing approaches in construction favour keeping costs low and building quickly. Introducing new provisions that will increase costs to any degree and potentially slow construction, even initially, will be met with resistance. • Inertia in the system will prevent change/progressive building practice.
Limited application, limited examples of pilots and application	• Across resilience options, a lack of piloting and application is an important barrier. • Pilots and monitoring are required to appropriately assess capital costs, implementation issues. Intricacies of interventions need to be understood before they can be scaled and appropriately promoted through the industry.
Piloting	• Municipalities have limited resources and, therefore, pilots must generate value. Generally, industry has to come to them with the pilot idea and then the City will help them on the permitting side.

Opportunities

General	• Long-time members of the construction industry observed that there is a general increase in awareness in the topic of high-wind resilience for Part 9 construction, motivated by recent high-wind events (e.g., Hurricane Fiona in the Atlantic provinces and tornado events in the Barrie and Ottawa areas). • There is a need to engage, entice all relevant players when proposing and adopting new practices. This includes builders, insurers, code development agencies, inspections, consumers, regulated and unregulated trades, etc. • In Ontario, larger builders need to be engaged in development and implementation of new construction practices. In general, engaging builders in implementation was considered to be an important priority. • There is a general need to increase awareness of CSA S520, extreme wind resilience, and climate resilience in general across the codes, standards, and construction industries. Pursue webinars, conference presentations, target communication to professionals (architects, engineers, builders, trades). • New standards could be referenced by professional organizations, in RFPs, cited by insurers, architecture organizations, government agencies, etc. before being adopted into construction codes. • Perception that climate change, high wind are meaningful concerns and that the industry should move forward on resilience practices. • Barriers to high-wind resilience are consistent with any other issue that concerns new, progressive building practices, including Net Zero, WUI fire, etc. • A general approach to increase awareness in the industry: Demonstration house, getting message out concerning improving the continuous load path. • There is a need for simple, low-cost solutions that introduce minimal risk for builders, developers, and manufacturers. Where the solutions are simple, low-cost, and present minimal risk to builders themselves, promotion may not even be necessary.

. . . continued

Post-disaster opportunities	• Be prepared to use post-disaster opportunities to promote wind safety construction practices. • Hail protection approach applied in Calgary focusing on education, incentives, and promoting regulation followed directly on a disaster occurrence. • City of Barrie efforts concerning construction code submissions were initiated following 2021 tornado event.
Develop demonstration, pilot projects	• Demonstrate costs, practicality of high-wind protection by engaging in pilot applications with builders, municipalities, or public building portfolio owners. • Design and build a small number of homes according to CSA S520, and refine practices based on this experience. • Provide funding directly to builders to pilot measures. • Follow model of previous builder pilots to better understand "true cost" of new building practices. • Governments should act as early adopters, and implement practices in their own portfolios (e.g., Part 9 community housing). • Build on the Net Zero pilot program, apply similar methods: Application of incentive programs through permit processes. • It is best to have owners of buildings on side for pilots before engaging builders. • Commercial owners may be more open to better roof installations (e.g., pursue a pilot with strip mall owners/strip malls that fall under Part 9). • NRC may be willing to pursue testing of options identified in CSA S520.
Involve municipalities	• Municipalities will develop programs focused on progressive building practices, e.g., Net Zero, energy efficiency, etc. • Municipal building inspectors need to understand risks associated with new building practices.
Coordinated approach to climate resilience	• There is a need to address climate resilience in a coordinated way (e.g., wind, wildfire, heat, flood). • Develop coordinated information packages for this purpose. Other elements may have to be considered, including accessibility, fire safety, Net Zero. ○ While overarching package of resilience options would be helpful, there is still a need for guidebooks that cover individual topics (e.g., high wind, WUI fire)
NRC, National Adaptation Strategy	• National Adaptation Strategy (NAS) includes new funding for continued development of codes and standards. • Targeted funding for retrofit of existing homes included in the NAS for NRC. • Initial work exploring gaps in construction codes related to high wind, and consideration of US approaches to tornado resistance has been initiated at NRC.
Carbon impacts	• There is a need to understand, balance carbon implications of resilient buildings. May be increasing overall carbon load by incorporating additional features into buildings, but would also reduce risk of loss of buildings (and therefore reduce carbon impact associated with reconstruction/repair). • Pursue building Life-Cycle Assessment concerning carbon.
Groups to regularly engage with respect to resilience, including high wind	• Ontario Association of Architects • Construction Specifications Canada, Canadian Spec Writers • Canadian Society of Civil Engineers; present at CSCE conference, etc. • Focus on architects that work with structural engineers • Licensing & Consumer Services (formerly Homeowner Protection Office (HPO)) – a branch of BC Housing, provide ½-day sessions on new topics for building officials. • Present to specific consulting companies – WSP, Morrison Hershfield • Alberta Roofing Contractors Association, Roofing Contractors' Association of BC, related regional associations • Colleges and trade schools – support communication with colleges and trade schools, e.g., Algonquin, Humber, Red River, George Brown – a matter of approaching the right instructor. These interactions should focus on single elements, rather than comprehensive measures presented in S520 (suggestion is to start with roof cover).

Construction Industry Acceptance and Awareness

Barriers

Incremental cost	• Tract builders are highly influential and will push back on any practice that may introduce new costs in construction. • On new construction, builders will build to the lowest possible common denominator. They push back on trades, they push back on distribution and manufacturers to push costs down. • Good practices (e.g., installation of underlayment) should be incorporated into construction codes.
Manufacturers	• Manufacturers may also push back against new regulation and quality control approaches (e.g., truss manufacturers), notably when they do not fully understand the benefits of additional measures. • There may be pushback on lateral load provisions that reduce application of rigid foam insulation in favour of wood panels.
Standards	• Testing procedures for shingles (e.g., ASTM 3161) may not reflect real-world parameters and may not offer the best procedures to ensure high-wind resistance of shingles. Testing of shingle products mostly completed in southern US.
Specific engagement with trade unions to assess cost	• Unionization of key trades is more prevalent in high-growth markets, e.g., the Greater Toronto Area. Unions set prices and need to be engaged to fully understand the cost of new construction measures.

Opportunities

Champions	• Need for champions to move progressive construction practice forward, including builders and inspectors that support the measures. • Modular builders could be the champions of these options – low-cost options to achieve high-wind risk reduction. • Support, encourage influential construction industry associations to increase awareness of high-wind protection. • Re: Guidebook development, involvement of engineering firms from across the country. Develop resilience ambassadors, similar to energy ambassadors.
Benefits to manufacturers, builders	• Identify and highlight the advantages of high-wind protection that are beneficial to home builders.
Let the building industry drive the change	• Allow the building industry to identify the appropriate technical solutions (rather than standards community). • Process for increased uptake: Impact analysis, simple presentation of measures, industry/builder engagement via LEEP, identification of builder champions.
Engaging the building industry (builders, professionals, inspections)	• Opportunities to engage the building industry: Presentations, articles, workshops. • Opportunities to engage trades and contractors – education on the purpose of structural load paths and how their work makes a difference to the safety of occupants. • Regular engagement with contractors is important. • Installation of measures “needs to be easy” for contractors. • Develop a “travelling road show” for multiple builders – explain the protection options and the value they provide. Engage technical representatives to answer specific questions about installation methods. • Information on OBC code change request has been circulated through the Ontario Building Officials’ Association, Ontario Large Municipalities Chief Building Officials group, and Simcoe County Building Officials Association. • Explore incorporation of resilience in the NRCan LEEP program, and engage manufacturers as part of this program to develop cost-effective solutions for resilience, including high-wind. Canadian Home Builders’ Association is currently engaged in a LEEP initiative, which may be expanded to include climate resilience. Workshops are typically initiated by NRCan.

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Simple guidance documents	• Develop simple, accessible promotional materials, similar to those developed for consumers. Promote these in the industry (e.g., simple illustrated guidance on structural connections). • Focus guidance documents on uplift resistance options first. • Provide cost-benefit information along with simple guidance documents. • Guidance documents should include practical implementation examples. • Involve key construction industry groups in development of guidance documents (e.g., Canadian Wood Council). • Use APA – The Engineered Wood Association documents as examples. • As an initial step, have a designer design the building. Use an existing plan for a Part 9 building and spec in the S520 connections. Ideally, a pilot project would involve two buildings: Design a sample home for Part 9, and then re-design it for wind loads for S520. Provide a quote for the two buildings to understand differences in cost. Incorporate the examples into simple guidebooks. ○ Involve engineers from different parts of the country; the project would result in knowledgeable/ trained engineers that could advise on high-wind protection in different parts of the country. ○ Cost of designing the building(s): $2,000-3,000 ○ Approach an Ontario builder for building plans, incorporate S520 into these plans to understand costs.
Work with suppliers and manufacturers	• Identify opportunities to work with suppliers – provide suppliers with marketing opportunities. • Work with manufacturers to explore opportunities to engage installers in "Code+" programs. • For renovations and new constructions, manufacturers and suppliers must be prepared to support scaling up application of measures. Involve major building component manufactures (e.g., Simpson, MiTek).
Availability of construction materials	• Work with suppliers, manufacturers to ensure availability of construction materials (e.g., ring shank nails; specific materials for high-wind resistant garage doors; less expensive options for hardware, e.g., galvanized or zinc coated nails rather than stainless steel). • Engage with DASMA to begin labelling doors in Canada for high-wind resistance.
Working with custom builders, individual builders	• Facilitate incremental change by working with motivated builders – e.g., custom builders, individual homeowners who apply for building permits (as demonstrated in Dufferin County).
Specific opportunities for increasing uptake and awareness identified in interviews	• Capitalize on specific opportunities identified by interviewees: Engage with existing workshop/Net Zero initiatives, adopt US education practices to Canada. • NRC used to have a group that would communicate simply new developments in construction: Construction Technology Updates (CTU). • Area of Practice publication – similar to high-wind protection during construction document.
Existing, model programs	• US/IBHS Fortified program often identified as a model program for high-wind protection of residential buildings. • Incorporate resilience measures into NRCan Greener Homes program; NRCan Greener Homes program should consider measures beyond climate change mitigation.
Methods may already be applied in some jurisdictions	• Builders in NFLD apply these measures by default. • Modular builders argue that they have been applying high-wind interventions for 20–30 years. Could get them to champion these ideas since they have been applying them already by common practice (they have to transport homes at high speeds down highways, etc.).

Construction Cost

Barriers

Cost, resource barriers, conflicts with home affordability	• Additional cost of construction associated with high-wind protection. • There is a need to understand the "true cost" of implementation of new construction practices (though pilots, including implementation in markets where trades are unionized). • Builders may argue that actual implementation costs will be higher than those estimated in any accompanying BCA submitted with code change request (e.g., for OBC change request).

Consumer Demand

Barriers

Consumer demand	• Consumers do not recognize climate resilience as a desirable feature of homes. • Manual tabbing with six fasteners will allow standard laminates to achieve 130 mph wind resistance. Hand tabbing is typically required to reach 130 mph resistance. However, hand tabbing is messy, and homeowners are not often willing to pay for it. • Home buyers do not care about roofing – it's not a marketable item. • High-wind protection options need to be promoted by the insurance industry (e.g., through incentives) to increase consumer demand. • Homeowner budget will determine what is incorporated into new, existing construction. Wind alone will add significant costs. Potential cost to address multiple hazards could approach $100K for a homeowner. • For re-roofing jobs, the primary factor of concern for consumers is cost; even a $150 increase will make a difference. • It doesn't matter if it's a $400K starter home or $2M custom homes, they only have to meet minimum code requirements – so $2M homes have no underlayment or metal drip edge. • Builders and designers focus more on the finishes than the building components that affect the performance and durability of buildings.

Opportunities

Increase consumer demand	• Develop a consumer marketing approach – allow builders, manufacturers to sell resilience to consumers. • Provide capacity to builders, renovators to sell "high-wind protection package" – the product would be a building method and information supplied to a buyer/homeowner. Allow builders to develop their own simple approach to achieve the objective of high-wind resilience. • Apply insurance and municipal financial incentives. City of Calgary: Homeowner and builder action didn't come into play until there was an incentive. • Use Building Department Reserves, generated via building permit fees, to develop incentive programs (as in Dufferin County, ON, and City of Calgary, AB). • Develop simple, accessible materials, and engage in promotion to increase consumer awareness. • Provide awareness through a number of avenues – directly to consumers, but also to sales representatives (e.g., allowing them to market wind-safety products). • Provide an opportunity for builders to offer upgrade packages for high-wind protection: Develop a $5,000 upgrade package that includes structural connections. Develop background information (e.g., engineering information) and promotional materials to support builders in offering this type of package.

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Opportunities… continued

Incentives: Administration and application	• Avoid flat fees for incentives, create progressive programs where possible. For example, adjust incentives to reflect roof area. Adjusting incentive for Calgary IR roof cover rebate would have increased administrative burden but would have been more equitable. • Incentive programs may require households to conduct, pay for work first; however, this approach may result in exclusion of many households. Provide assistance for up-front costs as necessary. • Ensure that incentives are not over-allocated to larger homes. • Establish a baseline before implementing incentive programs; understand level of public interest before implementing programs. • Involve social agencies to assist households in application for incentive programs. • Consider property tax relief rather than up-front disbursements. • Involve condo owners where possible. • Involve contractors' associations in delivery of incentive programs. • Ensure inspections are conducted for measures incented by municipalities – understand potential workmanship issues with "fly by night" contractors.
Commercial building opportunities	• Commercial re-roofing customers are less price sensitive; may be willing to invest in better installation, materials, etc.

Enforcement, inspections, regulation

Barriers

Enforcement, inspection barriers	• Code enforcement does not have capacity to inspect all elements of homes, especially non-structural elements (inspectors will not "count nails"). • In several jurisdictions, inspections officials are not permitted to inspect structural connections using ladders. • Inspectors will not go on roofs. • Codes officials are not trained in uplift load resistance. • Roof cover is not inspected. Even if it were, the mechanism for inspection is not clear (e.g., would inspectors have to break the seal to ensure nails are in place; inspections would have to be conducted during installation process). Miami-Dade has a multi-step inspection process for roofs (e.g., underlayment is first inspected, then shingle installation).
Regulation of installers	• Roofing is not a regulated trade. Some provinces (e.g., MB) have been working to implement a roofing installer certification program, but not yet implemented. • Framers are not regulated or unionized – this increases difficulty in engaging framers in an organized manner (e.g., through trade schools).

Opportunities

Improvement in technology	• Wind-protection practices offering improvement in construction practice (e.g., visibility of structural connections).
Inspection methods	• New options may be available to inspect buildings – e.g., drones to inspect roofs. • It may not be necessary to inspect all measures – e.g., ice and water shield.

Construction Code Development

Barriers

Construction code development process	• It is necessary to implement common/good practices in codes to avoid many barriers; however, the codes development process is difficult to navigate. • The move toward harmonization of codes across Canada will/may act as a barrier to high-wind protection options in Ontario (e.g., the City of Barrie OBC code change requests). • Proposed changes for 2030 NBC would not be adopted in Ontario until 2032. This introduces a delay, but also allows for collection of more data over 10 years. • Policy discussions are required for consideration of climate resilience in national model construction codes. • Referencing any new standard in construction, building codes is a long process. • Provincial code development processes are a "black box" (i.e., limited opportunity for proponents of code change requests to become involved in the process, defend or add context during meetings where code changes are deliberated).
Competing priorities	• Other priorities of the codes, construction community will overshadow climate resilience and high wind: Accessibility, greenhouse gas mitigation, embodied carbon, etc. • Other resilience priorities are taking precedence over high wind – e.g., extreme heat, future climate data – at the national level.
Experience with previous code submissions	• Previous code submissions have demonstrated unwillingness of code development agencies to implement high-wind protection options.
Narrow focus of BCA studies requested by code development groups	• The limited scope of benefit-cost assessment/impact assessment studies commissioned or recommended by code development agencies may not generate necessary supporting information to advance climate and disaster resilience-oriented code changes.

Opportunities

Code development, integration into construction codes	• It was argued that CSA S520 could be referenced in NBC as a voluntary standard (e.g., wherever CWC Engineering Guide is referenced in NBC, there could also be a reference to CSA S520, or could be referenced in a specific clause that deals with uplift); though others argued that voluntary measures alone will not be effective – consistent practice via regulation is also required. • Policy discussions are ongoing at the National Research Council concerning priorities for construction codes. This work included a survey issued to provincial code development agencies, as well as input from Codes Canada codes committees (Canadian Table for Harmonized Construction Codes Policy – CTHCCP and the Canadian Board for Harmonized Construction Codes – CBHCC). • Initial survey results indicate that there is support for consideration of extreme wind. • Ontario members of the CBHCC have advocated for increased consideration of high-wind risk reduction in national model codes. • Members of the national Advisory Council for Harmonized Construction Codes (ACHCC) have advocated for climate resilience in national model construction codes during the March 2023 meetings. • Cost-benefit assessment is required for any consideration of a standard like CSA S520. • The response of MMAH/Ontario to proposed changes will have implications for consideration of wind resilience at national level. • Impact analyses for proposed measures should cover the administrative aspect as well as the cost/benefits of proposed measures. • An ongoing barrier related to all resilience-related code change proposals is lack of a clear objective that deals directly with climate resilience in the national construction codes. This should be addressed ahead of planning for the 2030 national model construction codes.

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Opportunities*…* *continued*

OBC code change request	• A code change request was submitted to Ontario MMAH in 2022 by the City of Barrie. • If code change request was not accepted in spring/summer 2023, it might be a candidate for an interim amendment. • It was suggested that multiple parties at different levels of government have expressed a new interest in high-wind protection, including at the policy level. • Suggested that referencing a high-wind standard would be a good approach to addressing code provisions; however, also noted by most interviewees that CSA S520 may be too complex for this purpose.
Submit Ontario/ OBC change request to NBC/ National policy and priorities	• All parties interviewed and involved in the OBC code change request indicated that the Ontario submission should/could lead to a submission to the NBC. A code change request for NBC, led by City of Barrie and supported by a number of partners including ICLR, was submitted to NRC in July 2023. • The OBC submissions communicates to the codes/user communities high-wind protection details that may be considered for codes. • Future code change requests should address more components of the building – e.g., OBC change request did not directly address high-wind vulnerability of gable end walls. • Groups like ICLR should also work to increase awareness/interest and involve municipal and building sectors. • When moved to national level, NRC will initiate/require an Impact Analysis (including administrative and cost implications of proposal). • With respect to structural issues, OBC should not deviate substantially from NBC – increasing need to submit changes nationally.
Proposed Change 1475 – for National Building Code	• A set of lateral load code change requests were being considered for NBC Part 9 (as of mid-2023). • Uplift resistance focused proposal (e.g., OBC proposals) should be aligned with lateral load proposal (e.g., proposed change 1475). • Currently, lateral loads are not considered systematically, if at all, for Part 9 buildings for the vast majority of the country. Proposed changes for OBC, as well as CSA S520, would serve to complement lateral load changes proposed for NBC by introducing uplift load provisions for Part 9.
Implement an incremental or tiered approach to high-wind safety	• Many in the industry, including CSA S520 TC members, indicated that the standard was extremely comprehensive and would be difficult to implement. A tiered approach was recommended to gradually introduce measures contained in CSA S520. • Ontario MMAH staff supported a staged approach to implementation. Provincial code officials must facilitate building of 1.5 million homes; cost considerations will be important.

Technical, Construction

Barriers

Construction, practical barriers	• Specific measures may be considered impractical (e.g., lapping rim board with exterior wood sheathing, applying both wood sheathing and continuous exterior insulation).
Wider industry barriers	• Multiple industry barriers inhibit adoption of progressive practice: Trades shortages, supply chain issues, regulatory barriers, etc. • Floor-to-floor connections that require ladders for installation will be difficult. Generally, there is a movement away from use of ladders on construction sites due to safety issues.
Technical limits	• Sealant for shingles: If you change the sealant formula so that it tacks well in cold weather, this makes it more difficult to install, and when it heats up, it may let go. Sealant needs to tack in cool temperatures and stay sealed in warmer temps. It is difficult to make sealant perform well in areas with large temperature swings (e.g., Winnipeg). • Manual tabbing is a big barrier. Alternative options to ensure shingles remain sealed are necessary. • Need additional information concerning hazard assessment – where should extreme wind provisions be applied? • Addressing the continuous load path may also require enhancements to trusses (e.g., once the key elements between structural components are addressed, trusses may become the weak point in construction).

Opportunities

Modular construction, pre-fabrication	• Opportunities afforded by modular construction, factory-built homes, pre-fab wall panels. • There is an increase in the adoption of pre-fab construction for large tract home builders. Components are inspected in the facility rather than on site. Pre-fabrication allows for improved quality control and construction methods. Re. CSA A277. • Increase scope of high-wind risk reduction work to include specific recommendations for pre-fab construction. Work to understand issues concerning how additional connections (e.g., lapping of exterior wood sheathing) could be incorporated into pre-fab components, such as walls, and understand inspections opportunities or barriers associated with integrating extreme wind protection into pre-fab components. • Approach sheathing industry to develop sheathing that would accommodate lapping of rim joists – e.g., if longer sheathing (9’) could be incorporated into pre-fab wall panels, these could be installed easily on site. • Modular construction industry has applied high-wind protection measures for years. Homes shipped with structural/hurricane ties, etc. already incorporated, as they are transported down highways at high speeds.
Additional construction practices to consider	• Miami-Dade, IBHS Fortified System: Roofing starter strips are used to seal down the entire perimeter of the home, helping to prevent uplift. This may be cost prohibitive for a new home, but an easy sell for re-roofing.
Incremental adoption of wind-protection options, identified through BCA	• Moving forward on the full CSA S520 package is impractical/CSA S520 is too severe – an incremental approach to high-wind resilience should be adopted. • Consider a step-code approach. • Start with “low hanging fruit,” including measures that provide very good return on investment, in a manner that does not affect affordability of homes. The BCA should identify high-impact individual components to provide basis for incremental approach. • To support incremental approach, consider a step-wise breakdown of the full set of measures, and break down impact analyses based on the steps. • Apply a model similar to OBC SB-12: Identify the requirements or objectives, identify packages for compliance, with simple presentation (e.g., 10 points).

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Opportunities*… continued*

Improvements over standard approaches to construction	• Some wind-protection measures are easier to install than standard practice (e.g., roof-to-wall connections/hurricane ties/truss screws). • Hurricane ties are easier to inspect than toe-nails.
Identify and support low-cost options, options that do not have installation barriers	• Some critical aspects can be addressed with limited effort, expense by installers. • Re-roofing contractors will typically install underlayment. With a small additional fee, this is an easy sell to homeowners. Underlayment is the least expensive alternative to provide additional water barrier. • Cost difference to apply high-wind rated shingles is modest – material increment is 10% typically, there are no differences in installation requirements, and underlayment is an inexpensive additional measure. • For builders already using exterior wood sheathing, the additional cost of lapping rim joists and sill plates should be low. • Additional fasteners (e.g., for roof and exterior wall sheathing) will likely be relatively easy to implement, as incremental cost and time requirements will be low. • Simplify options, measures such that structural design is not required for implementation.
Develop simple, accessible, practical documentation	• CSA S520 is too complex. A need for: Simple summaries of high-wind protection practices, standard specifications and drawings – resources that can be readily understood and adopted by consumers and builders.
Identify construction measures with co-benefits	• Installing roof cover underlayment provides multiple benefits, including high-wind protection, hail protection, and increased fire resistance (depending on the product).

Technical, Supporting Information

Barriers

Design goals of S520, Barrie code submission	• EF2 level design goal considered too severe. • Low probability of any individual building encountering high wind or tornado events.
Science, data, hazard assessment limitations	• The science linking climate change to increasing frequency of high-wind events, tornadoes is not mature. • Data collection on wind damage of homes, including specific damages experienced for building elements, is limited. More data collection is needed. • ClimateData.ca is too complex for building industry, homeowners. Simple tools (e.g., ClimateCheck) are needed to identify regions where resilience measures should be applied. Ideally builders, homeowners would have access to simple "single indicators" of hazard, risk.

Opportunities

Use previous examples	• 2022 Ontario derecho provided an example of high wind loads across a large section of the province; may affect discussions concerning whether EF2 level protection is too severe.
Usable resources	• Provide usable/accessible resources on hazard assessment – e.g., high-wind-prone regions.

Training and Awareness: Professions and Trades

Barriers

Trades, installers	• Trades and installers do not understand the function of continuous load path elements, will be unwilling to engage in these practices. • A large shingle manufacturer reported that installation often does not comply with manufacturer guidelines, increasing vulnerability to failure in high-wind events. It is difficult for installers to hit the common bond area in shingles (3/8 inch to 1 inch area). Conversely, installers argue that manufacturers need to increase the size of the nailing area. • Contractors (e.g., roofing) need to keep costs down to secure project contracts – adding a few hundred dollars to the cost of a job is significant. • Roofing industry is largely unregulated; difficult to educate the industry. • Outside of major urban centres in Alberta, there are difficulties in accessing quality roofing contractors.

Opportunities

Training for professionals and trades	• Incorporating high-wind modules in professional training (e.g., architects, engineers). • Manufacturers (e.g., construction hardware) have been involved in training initiatives in the US (Florida, Texas, North Carolina, East Coast) for engineers. • Training will help reduce the perception of complexity and communicate the fact that construction methods are simple and the technology is available.
Non-regulated, non-unionized trades	• Offer accessible courses on installation of wind safety options. • Register roofing companies with reputable associations, involve associations in quality control; industry associations may encourage progressive practices that exceed code requirements and are aligned with resilience, e.g., roofing associations may encourage use of underlayment, drip edge as part of a quality roof cover installation.
Roof cover installation quality	• Recognition that resilience of roof cover is often related to quality of installation, rather than material performance.
Learn from installers	• Installers in Lethbridge and NFLD will be more familiar with high-wind protection options – e.g., hand-tabbing and increased number of fasteners for shingles.

Insurance

Barriers

Insurance claims process	• With respect to underlayment: Insurers will repair the roof to pre-damage specifications (typically excluding underlayment). The contractor and homeowner will likely not choose to bear the additional cost of underlayment installation.

Opportunities

Insurance claims process	• Insurers increasingly willing to participate in incenting, promoting resilience as part of the claims process.

Existing Homes, Renovations

Opportunities

Existing homes, structures, renovations	• A strong need to identify solutions directly relevant for existing, rather than new, homes. • Understand the benefit-costs of addressing existing homes, as well as new construction. • Explore retrofit programs, similar to those applied on the West Coast for seismic safety. • Develop guidance, approaches on simple measures that can be incorporated into existing construction (e.g., installing truss screws through drywall into truss/top-plate connections). Engage manufacturers to develop options and promote retrofit programs. • Resilience options, including high wind, present a big opportunity for renovators. Include consideration of highly cost-effective items that could be incorporated into renovations. • Move from standards to very simple, prescriptive, step-by-step, homeowner-oriented applications. • It would have been beneficial for S520 to include more content concerning renovations. • For existing construction, identify windows of opportunity for increasing resilience for wind – e.g., how to install additional structural connections when siding is being replaced. • Guidelines like the existing ICLR/Western U guide on reducing wind risk during construction process provide a good model for accessible materials for renovation. • Incorporate high-wind provisions into municipal guidance documents for homeowners (e.g., Calgary and Edmonton guides).

Appendix D: Barriers and Opportunities Literature

Guidance documents, straightforward high-wind protection guides/regulations

American Wood Council. 2013. Guide to Wood Construction in High Wind Areas for One- and Two-Family Dwellings. 130 MPH Exposure B. Leesburg, VA: American Wood Council.

APA – The Engineered Wood Association. 2014. Use of Wood Structural Panels for Energy-Heel Trusses. System Report 103. Tacoma, WA: APA – The Engineered Wood Association. Available from https://www.apawood.org/publication-search?q=SR-103&tid=1

APA – The Engineered Wood Association. 2016. Raised Heel Trusses for Efficient, Cost-Effective, Comfortable Homes. R330. Tacoma, WA: APA – The Engineered Wood Association. Available from https://www.apawood.org/publication-search?q=R330

APA - The Engineered Wood Association. 2018. Building for High Wind Resistance in Light-Frame Wood Construction. Form No. M310D. Tacoma, WA: APA.

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US Department of Housing and Urban Development. 2023. Designing for Natural Hazards: A Resilience Guide for Builders and Developers. Volume 1: Wind. Washington, D.C.: US Department of Housing and Urban Development.

Florida Div. of Emergency Management. Gable End Bracing. Accessed December 2022 from https://apps.floridadisaster.org/hrg/content/roofs/bracing.asp

Insurance Institute for Business Home Safety. Technical Documents (accessed December 2022). These include:

- 2020 Fortified Home Standard
- IBHS Documentation Requirements – Evaluator Checklists:
  - Re-Roofing Checklist – Hurricane
  - Re-Roofing Checklist – High Wind and Hail
  - Re-Roofing Checklist – High Wind
  - General Flashing Guidelines for Steep-Sloped Roofing
  - Fortified Roof Repair Checklist
  - Evaluator Checklists – Full Set
  - Evaluator Checklist – Roof Only
  - Evaluator Checklist – Re-Designation
- Calculators:
  - Fortified Porch/Carport Uplift Calculator
  - Fortified Wind Uplift Design Pressure Calculator (ASCE 7-10)
  - Fortified Uplift Design Pressure Calculator (ASCE 7-16)

Technical Bulletins:

2022-06: Foundation Requirements for FORTIFIED Home Eligibility

2022-05: Requirements for Re-Roofing Over Existing Self-Adhered Membranes

2022-04: Product Substitution Due to Supply Chain Issues and Product Availability

2022-03: FORTIFIED Home Requirements for Elevated Roof-Mounted Decks

2022-02: The FORTIFIED Definition of Roof

2022-02: Fortified Roof Identification

2022-01: Roof Sheathing Nail Pattern Documentation Requirements

2022: IBHS Guidance: Choosing the Right Tape

2021-03: Sealed Roof Deck for Wood Shake and Shingle Roof Systems

2021-02: Corrosion Resistant Fasteners

2021-01: PA – Vycor Product Advisory

2020-01: Design Pressure Guidance for Roof Coverings

2019-01: Metal Panel Roof Covering Guidance

2017-01: Roof Flashing

2015-04: Sealed Roof Deck Supplemental Deck Attachment

Standard Details Concerning:

Chimney tie downs

Drip edges

Gable ends

Steep slope roofing

Re-roofing

New roof

Soffit retrofit

Sealed roof deck

Sealed roof deck and steep slope roofs

Insurance Institute for Business and Home Safety (IBHS). 2015. High Wind Standards. Tampa, FL: Insurance Institute for Business and Home Safety.

Ramseyer, C., Holliday, L., and Floyd, R. 2016. Enhanced residential building code for tornado safety. *Journal of Performance of Constructed Facilities*, 30(4), 04015084.

Stevenson, S. 2022. Preventing the Collapse of Partially-Constructed New Homes. Toronto: ICLR.

Further to the above, interviewees identified several “accessible” resources that may serve as examples for development of Canadian resources designed to engage the construction sector in high-wind protection. These include promotional and education videos developed by organizations in the construction sector.

Resources from Simpson Strong-Tie, focused on application of hardware to improve high-wind resistance (US focus):

Preparing for a Hurricane: The Engineering Behind Your Home – YouTube

Surviving A Hurricane: A Hurricane-Resistant Construction Solution – YouTube

Lessons Learned from Hurricane Katrina – YouTube

Continuous Load Path – Resisting Wind Forces – YouTube

Continuous Load Path – Tying a House Together – YouTube

How to Use the Strong-Drive® SDWC Truss Screw – YouTube

Regulatory documentation

Janotta, M. 2022. Improving the Structural Resiliency of Part 9 Buildings in High Wind Events. City of Barrie submission to Ontario Ministry of Municipal Affairs and Housing, May 2022.

Martin, G., and McKay, R. 2022. Transparency and efficiency in building code review. The case of Ontario, Canada. *Canadian Journal of Civil Engineering*. DOI: https://doi.org/10.1139/cjce-2021-039

Ministry of Municipal Affairs and Housing. 2016. Fire Safety During Construction for Five and Six Storey Wood Buildings in Ontario: A Best Practices Guideline. Toronto, ON: Queen's Printer for Ontario.

Ontario Ministry of Municipal Affairs and Housing. 2022. PROPOSED CHANGE TO THE 2012 BUILDING CODE. O. REG. 332/12 AS AMENDED. CHANGE NUMBER: B-09-04-01. SOURCE: Ontario-Only. CODE REFERENCE: Division B / 9.4., 9.23., 9.27.5.1. Issued by Ontario Ministry of Municipal Affairs and Housing.

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Municipal programs

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