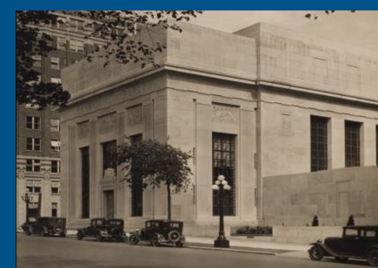
BUILDING RESILIENCE:

PRACTICAL GUIDELINES FOR THE SUSTAINABLE REHABILITATION OF BUILDINGS IN CANADA

2016



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CONTENTS

1.1. INTRODUCTION

Building Resilience: Practical Guidelines for the Retrofit and Rehabilitation of Buildings in Canada serves as a “sustainable building toolkit” that will enhance understanding of the environmental benefits of heritage conservation and of the strong interrelationship between natural and built *heritage conservation*. Intended as a useful set of best practices, the guidelines in *Building Resilience* can be applied to existing and traditionally constructed buildings as well as formally recognized heritage places.

These guidelines are primarily aimed at assisting designers, owners, and builders in providing existing buildings with increased levels of *sustainability* while protecting *character-defining elements* and, thus, their *heritage value*. The guidelines are also intended for a broader audience of architects, building developers, owners, custodians and managers, contractors, crafts and trades people, energy advisers and *sustainability* specialists, engineers, heritage professionals, and officials responsible for built heritage and the existing built environment at all jurisdictional levels.

Building Resilience is not meant to provide case-specific advice. It is intended to provide guidance with some measure of flexibility, acknowledging the difficulty of evaluating the impact of every scenario and the realities of projects where buildings may contain inherently *sustainable* elements but limited or no *heritage value*. All interventions must be evaluated based on their unique context, on a case-by-case basis, by experts equipped with the necessary knowledge and experience to ensure a balanced consideration of *heritage value* and *sustainable rehabilitation* measures.

Building Resilience can be read as a stand-alone document, but it may also further illustrate and build on the *sustainability* considerations in the *Standards and Guidelines for the Conservation of Historic Places in Canada* (Federal Provincial Territorial Historic Places Collaboration (FPTHPC), Second Edition, 2010). Refer to Section 1.4 below.

GUIDELINES AT A GLANCE

PART ONE provides background and context around issues related to the *sustainable retrofit* and *rehabilitation* of buildings. It defines the terms and helps us understand why *sustainable retrofit* and *rehabilitation* is useful and important, how it relates to the wider world, who should be involved in *building conservation*, and how *Building Resilience* can be used as a companion to the *Standards and Guidelines for the Conservation of Historic Places in Canada.*

PART TWO delves more deeply into issues surrounding *sustainable retrofit* and r*ehabilitation***,** placing emphasis on the fundamental need to properly and thoroughly understand the existing building prior to undertaking *retrofit* or *rehabilitation* work, particularly the building’s history, cultural heritage value, fabric, changes of form, and use over time. Part Two also provides information on some broader related issues such as the building site’s wider context and the *retrofit* or *rehabilitation* of buildings from the Modern period.

PART THREE provides practical tested guidance, broken out by building components to simplify the approach to building *retrofit* and *rehabilitation*. It also looks at building materials and maintenance as they relate to *sustainable retrofit* and *rehabilitation*. Use Part Three for direct assistance in planning, designing, and executing a *retrofit* or *rehabilitation* project.

PART FOUR offers further information, including a bibliography and resource list, information on web-based design tools, a glossary, and Appendices, including case studies.

CASE STUDIES in Appendix C provide illustrative examples of building *retrofits* and *rehabilitations* across Canada where sustainable principles are effectively incorporated to help significantly improve the building's overall *sustainability* while protecting *heritage value*.

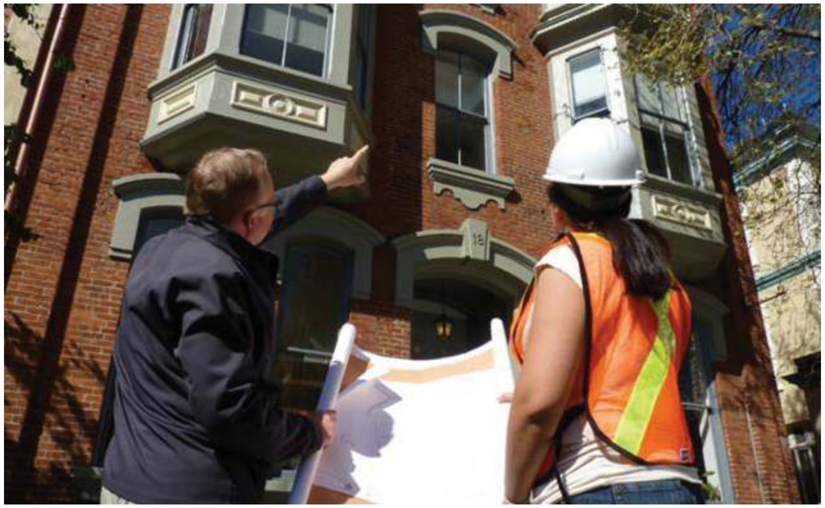

Figure 1 Reviewing *sustainability* upgrade opportunities and inherently sustainable elements on site. Source: Judith Cook

2.2. MAINTAINING HERITAGE VALUE AND CHARACTER-DEFINING ELEMENTS

There are far too many past examples in Canada where *character-defining elements* were replaced in the name of energy efficiency or environmental requirements without adequate evaluation of potential impacts on heritage value. These replacements did not improve energy performance and were a poor return on investment. It's important to avoid replicating these mistakes by ensuring that a *heritage value* and *character-defining elements* have been identified and that its environmental characteristics and performance have been properly understood before beginning planning measures that will improve energy efficiency and overall *sustainability*.

Once *heritage value* and *character-defining elements* have been established, sustainability goals can be balanced with the broader project objectives. In order to determine the most appropriate solutions to meet energy efficiency requirements with the least impact on *character-defining elements*, the project team should work with specialists at this point.

The next step is to create a project-wide design and conservation approach to the *rehabilitation* intentions. Minimal intervention and reversibility are always foundational principles when rehabilitating heritage properties; the remaining elements of the approach establish criteria for making design decisions, and they help provide a definitive rationale for the interventions.

Usually, drafting a matrix of desired interventions, such as improvements that are sustainable, their prioritization, and their anticipated heritage character impact, will help the designer establish a systematic decision–making process that applies the rigour needed to most successfully execute the design and conservation approach.

Enlisting one of the on-line decision making tools, as listed at the end of the Resources Section of Part Four, can also help the designer work through challenging and often conflicting objectives.

Figure 8 Operable windows in a heritage building that currently functions well for contemporary use and demands. (Ontario Heritage Trust, 10 Adelaide Street, Toronto)

CONSIDERING HERITAGE AND NON-HERITAGE BUILDINGS

Building Resilience is intended to provide guidance for considering *sustainability* modifications to all sizes and types of buildings regardless of *heritage value*. All buildings contain inherent characteristics that should be respected to minimize material expended and unnecessary waste of usable materials.

Yet, as *heritage value* must be considered when deciding on the nature and degree of appropriate intervention, these guidelines also give specific direction for minimizing impacts on *character-defining elements* and intervening sensitively into non-*character-defining elements* in buildings with *heritage value* when considering upgrades that support sustainability.

In addition, completing the original design intent is not always a reasonable approach from a heritage conservation perspective and is rarely supported by the Standards and Guidelines for the Conservation of Historic Places in Canada. However, completion may be justified in the name of environmental goals to reduce urban sprawl or enhance the use and sustainability of an existing building.

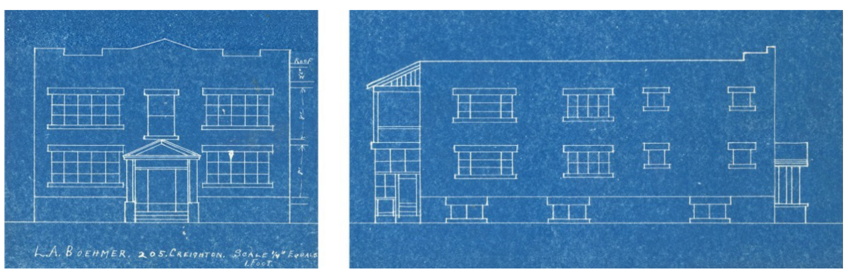

Figure 9 Plans depicting what was originally intended as a post-war duplex on an urban site in the New Edinburgh neighborhood, Ottawa, ON, 1945. Source: L.A. Boehmer

Figure 10 Actual building constructed after money to build second storey ran out, 2013 view. The surrounding neighbourhood of workers' housing and commercial structures, predominantly consisting of 2-storey, street-oriented design, became a designated Heritage Conservation District in 2002. This district, New Edinburgh, was originally a mill village at the Rideau River Falls and is adjacent to Rideau Hall, the Governor General's estate. The "suburban" look on this prominent corner does not harmonize with the neighbourhood. Source: VERTdesign.inc

Figure 11 Proposed "green" heritage-sensitive redevelopment of the property targeting LEED Platinum and Passivhaus certification. The original design intention is completed and includes an enlarged rear addition and many sustainable features. Source: VERTdesign.inc

2.5. UNDERSTANDING INHERENT SUSTAINABILITY

Project teams should find solutions that take advantage of durability, adaptability, and other passive *features that support sustainability* and that are often in existing buildings. Traditionally designed and constructed buildings, in addition to frequently using higher amounts of local and natural materials, typically take advantage of non-mechanical strategies adapted to the local climatic context to promote daylighting and thermal comfort throughout the year.[11]

The Online Sustainable Conservation Assistance Resource (OSCAR) tool outlines why using features that support sustainability is key:

> Buildings traditionally had sustainable/energy-efficient features out of necessity. Basic principles resulted in a wide diversity of responses, many of which became character-defining features of specific buildings and/or local building traditions. In the preservation of heritage buildings, it is important to recognize these features, not only as character-defining features, but also for their climatological significance. In doing so we can:
>
> 1. recognize the inherent energy-harnessing features and systems and how they function, to best work with, rather than against the historic intent
> 2. effectively prioritize work, including the reconstruction of non-extant original features to best meet the sustainability goals
> 3. learn from techniques from similar climates elsewhere in the world, foster awareness and stay attuned to opportunities to use such strategies where appropriate.[12]

Understanding the building as a holistic system should include evaluating the contribution of the inherent sustainability of the building and its site. Inherently sustainable characteristics, listed below, should be maintained and incorporated where possible into the *retrofit* or *rehabilitation* design:

- Building orientation;
- Building layout;
- Passive heating and cooling systems;
- *Embodied energy*;
- *Embodied carbon*;
- Materials: indigenous, durable, recyclable, natural;
- Long life and loose fit;
- Assemblies: breathable, repairable, compatible.

BUILDING ORIENTATION

Intentional building orientation takes into account form, siting, and landscape features that respond to sun and wind exposure. Examples include:

- A building entrance designed to protect from wind or rain and the region's uncomfortable weather;

11 Masonry and stone used for cladding of institutional buildings including limestones, sandstones, granites, and marbles may or may not be local. Nevertheless, they can provide thermal mass, depending on the thickness and density, and durable finishes.

12 http://oscar-apti.org/isf-tree/ (accessed 16 March 2015).

- Buildings that minimize exposure to the prevailing wind or cold north face by narrowing elevation or by including less door and window openings;
- Buildings set into slopes to take advantage of the greater temperature stability offered;
- Buildings built close to the ground, avoiding the need for their structures and envelopes to address extremes of weather.

BUILDING LAYOUT

Sustainable building layout occurs when plans take advantage of the group effects provided by shared heat and wind sheltering. Examples include:

- Plan forms that create enclosed areas with a cooler/warmer micro-climate for passive air conditioning systems;
- Plan forms designed with light wells or shallow depths from the exterior, reducing the need for artificial lighting;
- Spaces appropriately and efficiently sized that are applied against the building program requirements to minimize waste;
- Rooms grouped around a central chimney heat source, thereby sharing the heat;
- Zoned HVAC, such as bedrooms, that remain unheated during the day and are allowed to benefit from the downstairs heat rising at night;
- Larders with evaporative cooling systems on the roof or connected to the outside air and use convection to keep a building cooler.

PASSIVE HEATING AND COOLING SYSTEMS

Retrofit or *rehabilitation* projects should consider maintaining or heightening the building's passive heating and cooling systems through these measures:

- Maintaining or installing operable windows, skylights, and vents to provide natural ventilation and daylighting;
- Maintaining or installing storm windows, awnings, and shutters to provide seasonal or daily passive thermal controls;
- Installing two sets of storm windows in buildings in cold climates;
- Installing windows specifically sized to suit a space's function.

EMBODIED ENERGY

It is known that "even the most energy-efficient new building cannot offset its embodied energy for many years. The United Nations Energy Programme estimates that the embodied energy of a building is 20% [of the total building-life energy expenditure] if a building is operational for 100 years... the shorter the service life, the greater the ratio of embodied energy to operating energy is".[13] Existing buildings that reuse the energy expenditure of their original construction through *retrofit* and adaptation can lower the "environmental debt" that all new buildings acquire through the manufacturing and construction process.

EMBODIED CARBON

Carbon emitted through building construction, including the entire process of extraction, fabrication, transportation,

13 Carroon, Jean. 2010. Sustainable Preservation: Greening Existing Buildings.New Jersey: John Wiley & Sons Inc.: 7.

and assembly is called *embodied carbon*. When an existing building is demolished and a new building is erected, the carbon footprint is much larger than that of a *retrofitted* or *rehabilitated* building, in which its life-cycle carbon is largely already spent.

MATERIALS: INDIGENOUS, DURABLE AND RECYCLABLE

Vernacular buildings often used locally available materials – wood in forested regions, stone near local quarries, etc. Locally available materials reduce the transport footprint and encourage the longer life of a building through easy material replacement.

Natural, durable and recyclable materials also bring benefit to *retrofit* or *rehabilitation* work:

- Natural materials are non-toxic and provide variances for tolerances in replacements;
- Durable materials contribute to a building's long life and ease of *retrofit* or *rehabilitation*;
- Recyclable materials, when being switched during *retrofit* or *rehabilitation*, reduce the footprint of that action;
- Because lime-plaster is a carbon sequester, it uses much less energy than its modern equivalents.

LONG LIFE AND LOOSE FIT

- Allows for changing uses over time through design of layouts, structural spans, access to natural light, etc. This is why existing buildings built for a specific purpose can often be adapted and retrofitted for a variety of new uses

ASSEMBLIES: BREATHABLE, REPAIRABLE, COMPATIBLE

Traditional building assemblies often offer many sustainable features and characteristics such as those listed below:

- Traditional buildings respire, ensuring passive air changes ("breathability"). *Retrofits* and *rehabilitations* must respect and allow for this through envelope design and ventilation approach;
- Older buildings were constructed from repairable materials and assembled in ways that can often be repaired by local craftsmen or professionals or even occupants;
- Shingle-hanging provides the ultimate rainscreen with three levels of redundancy built-in.
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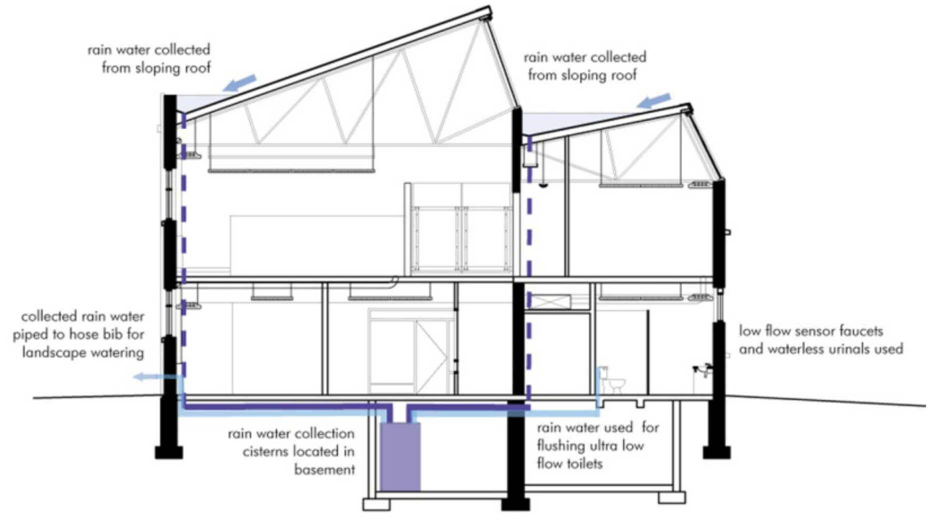

Figure 15 Integrating existing roof slopes into drainage and greywater retention system. Triffo Hall, University of Alberta. Edmonton, AB. Source: SAB Magazine