Scaling-up circularity in new home construction

with CRD wood

This case study was developed to showcase applied circular principles and business/organizational practices and is intended only for education and/or informational purposes.

Circular Economy Unit, Waste Reduction and Management Division,
Environmental Protection Branch/Environment and Climate Change Canada

1. Introduction

The reuse of salvaged lumber in new residential construction is being tried and tested by Meredith Moore, founder of Ouroboros Deconstruction. With project partner Royston D'Souza, Ouroboros is challenging the established "take-make-waste" construction model practiced across Canada. Their approach to a recent laneway house project in Toronto, Ontario demonstrates how thousands of board feet (in this case, over 4,400 FBM) can be diverted from landfill to become a valuable resource instead.

Deconstruction is the systematic disassembly of a building or its parts to recover the maximum economic and environmental value of materials through reuse and recycling.

This case study examines the challenges, solutions, and outcomes of their process, and highlights the potential to expand secondary markets for salvaged lumber through its regrading and reuse in new homes. This is an opportune time to introduce greater circularity of building materials in Canada's construction, renovation, and demolition (CRD) sector. There is an urgent need for new housing, and at least 3.5 million units are required across the country to restore affordability by 2030.[1] At the same time, many homeowners are undertaking renovations and deep retrofits of their properties in a bid to upgrade and improve energy efficiency.

As a pilot project, the laneway house offers lessons and pinpoints potential opportunities to scale-up circularity in a sector that accounts for 40% of the waste in Canada's landfills, about 30% of which is lumber.[2] While the traditional CRD model – demolition and disposal of building materials – is familiar, inexpensive, easy, and fast, this project introduces a countermodel with potential applications across the country.

Demolition and disposal are inexpensive, and they shouldn't be.
– Meredith Moore, Ouroboros

About the Project Partners

Ouroboros Deconstruction specializes in harvesting, processing, and selling salvaged lumber and other materials from homes being renovated or replaced through deconstruction. Ouroboros' goal is to ensure that materials remain within the supply chain and out of landfill.

For this project, Ouroboros provided the salvaged lumber from a deconstructed residential home, warehousing of the lumber prior to its use, and oversight of the process. Royston D'Souza oversaw the construction, managed the tradespeople, and drove the progression of the regrading process.

[1] Canada Mortgage and Housing Corporation (June 23, 2023). *Housing Shortages in Canada: Updating How Much Housing We Need by 2030*.
[2] Canadian Standards Association (March 2024). *The Circular Built Environment in Canada: A Review of the Current State, Gaps and Opportunities*.

2. Project Challenges and Solutions

Integrating salvaged lumber for the structural components of the laneway house required the project partners to continually innovate. While each has their own processes, procedures, and workflows, there was no established "playbook" for a partnership of this type, as the market is still being created. For Moore, the project presented a unique opportunity to test the use of reclaimed wood in a structural capacity; for D'Souza, it was also a chance to work with a high-quality wood product in a new way.

Adept problem-solving, flexibility, and coordination was required throughout the process. The project partners shared the following challenges and their solutions:

Key Facts

Location: Toronto, Ontario

Footprint: Approx. 25' x 20'; two stories
- Ground floor garage (10' x 20'), storage (15' x 20')
- Second floor living area (27' x 26' achieved with cantilevering)

Use of reclaimed lumber:
Construction of entire floor and flat-roof system, including lintels (beams):
- 4,421 FBM (board feet) of SPF#2 (structural grade):
  - 64 FBM of 2x8s
  - 2,493 FBM of 2x10s
  - 1,864 FBM of 2x10s

Standards, inspections, and permits: The Ontario Building Code requires that salvaged wood be regraded before it can be reused. However, it does not prescribe how regrading is to be achieved. Lacking formal guidance (e.g. an operations manual), the onus was on the partners to navigate a "difficult and opaque" process that added time and complexity to the process.

The project partners described the steps they took to secure approval for use of the salvaged lumber in a structural capacity, as follows:

- Ouroboros pre-sorted the salvaged lumber to help streamline the anticipated inspection process, a process that took about one day.
- They invited a grader from the Canadian Softwood Inspection (CSI) Agency to inspect the salvaged lumber at the Ouroboros warehouse. The grader completed this work by hand, inspecting and signing off on each piece that met a #2 SPF standard (for structural use) and rejecting those that did not. The grader then provided a letter itemizing the number of pieces and grade of each for the project partners to submit to the municipal building official.
- They also searched for a qualified professional engineer (P.Eng.) to review the grader's findings, which proved to be more difficult than anticipated. A select few have the technical knowledge and experience of working with salvaged wood, and are willing to take on the risk of liability. Once hired, the engineer reviewed the regraded lumber and provided a letter of approval, also to be submitted to the municipal building official.

- The project partners were then responsible for submitting both letters to the municipality's building official.

D'Souza's engineering background and extensive technical knowledge enabled him to collaborate with the municipality, the grader, and the engineer to establish an approval process that worked for everyone. The project partners also found a range in officials' familiarity with salvaged wood, and in attitudes toward it, which they suggest could be addressed through training and education. In addition, they propose a review of the permitting process may be needed to smooth the path for others who seek to build with salvaged lumber or establish a similar partnership.

Design changes: The project manager needed to modify the laneway house design after the lumber package was issued, requiring some pieces to be further cut down. In this case, Ouroboros ensured that the rough-cut and modern lumber were not mixed. (While modern salvaged lumber can be substituted with modern virgin lumber, because dimensionally it is the same, it is not interchangeable with old growth or rough-cut lumber.) Project partners also suggest inviting framers to review the regraded lumber prior to purchase.

Hardware compatibility: The project partners encourage others to be mindful of the compatibility between modern hardware and that which is needed for salvaged true dimensional lumber. In this case, as the joist hangers were designed for modern lumber, the framers used shims to fill gaps and secure the salvaged pieces. They recommend that careful advance planning be done to ensure all attachment hardware is on site when framing begins; true dimensional salvaged lumber could also be used for non-hardware-dependent applications, such as stud walls or rafters.

Additional fixed costs: While the cost of the regraded lumber was comparable to that of new lumber, the project partners note several additional fixed costs:

- **Transportation:** The project manager needed to transport the lumber from the Ouroboros warehouse to the project site (as it had been sourced from a deconstructed house on a different site). The project partners suggest that early project planning and coordination could eliminate the need for warehousing off-site. The lumber could be moved directly from the site of deconstruction to that of the new build, or be used on the same site, to simplify the logistics and reduce costs.
- **Storage:** Lumber needs to be protected from precipitation to maintain its moisture content at optimal levels. On site, D'Souza placed a layer of poly on the ground, followed by pallets to elevate the lumber about 6" above grade. The lumber was covered with a tarp and tapered to the edges to allow any precipitation to drain.
- **Preparing lumber for framing:** Ouroboros prepared the lumber for the laneway house project; an otherwise additional cost.
- **Cost of engineering review:** The engineer's review and certification of the lumber was an additional cost.

Operating procedures: The project partners recommend that builders establish a sequence of operations for how the lumber will be prepared on site for installation. For example,

1. Deliver lumber to site (in stages).
2. Sort lumber into varying thicknesses and lengths.
3. Cut/trim lumber to the required sizes.
4. Protect lumber from precipitation.
5. Install lumber.

3. Outcomes, Benefits, and Opportunities

The laneway house project demonstrates the immense potential to increase circularity of reclaimed lumber and challenge the standard take-make-waste linear model of construction. The salvaged lumber was reused, after regrading, to construct the entire floor and flat-roof system, including lintels:

- 4,421 FBM (board feet) of (#2 structural grade):
- 64 FBM of 2 x 8s
- 2,493 FBM of 2 x 10s
- 1,864 FBM of 2 x 10s

In total, almost 100% of the structural lumber used in the floor and roof system was salvaged lumber, about 40% of the full build. It was also used for some non-structural components (blocking, temporary staircase, framing for ducts), while modern lumber was used for walls, posts, and sheathing.

Benefits emphasized by the project partners

Environment: Lower embodied carbon; landfill diversion; lower carbon footprint.

Quality: Lumber from deconstructed sites is often higher quality than modern lumber. In addition to its visual appeal, framers commented on its exceptional quality and ease of use.

Value: Homeowners often appreciate the integration of old and new: experiencing a connection to their original home and the knowledge that they have had a positive environmental impact. In this case, the cost was comparable to that of new lumber, making it viable from a financial and environmental standpoint.

A truly sustainable way to build.
– Royston D'Souza

Opportunities to expand the secondary market

Work together to:

- Establish a replicable, streamlined process for the regrading of salvaged wood.
- Consider financial incentives to reuse – and disincentives to demolition and disposal (e.g. higher tipping fees for CRD materials).
- Expand training and education on the value and application of salvaged lumber for everyone involved (graders, engineers, building officials), and those considering building with salvaged lumber in the future (homeowners, members of the public).
- Consider new certification programs, through wood product certification bodies (e.g. Forest Stewardship Council, Sustainable Forestry Initiative).
- Support building material exchanges to help suppliers of recovered wood connect with buyers.
- Encourage partnerships that build knowledge and capacity through collaboration.

4. Conclusion

Strategies for CRD waste reduction are essential for Canada to move to a circular economy model in that sector. Business-as-usual will not only continue to contribute to the take-make-waste approach that strains our solid waste management system; it represents a loss of economic value from the businesses, jobs, and revenues that could be created and scaled-up by keeping CRD wood materials in circulation.

The laneway house project provides lessons for builders, all orders of government, investors, and homeowners. It demonstrates that reuse of salvaged wood in new construction can be successful, and with some strategic interventions, can be further tested in markets across Canada. For example, by streamlining the regrading process and minimizing reprocessing to encourage the sale of reclaimed lumber, it could become as easy to access as new lumber is today. Innovators like Meredith Moore and Royston D'Souza are already advancing circularity in Canada's CRD sector and demonstrating the as-of-yet untapped potential to scale-up the secondary market for salvaged lumber.

Recommended Resources

Build Reuse. *Empowering communities to turn construction and demolition waste into local resources:* buildreuse.wildapricot.org

> *Build Reuse Knowledge Directory, "Salvaged Structural Wood in Building Codes":* allanswered.com/kb/build-reuse/doc/ommlgm/salvaged-structural-wood-in-buildingcodes

International Society of Wood Science and Technology. *Assuring high standards for professional performance of wood scientists and technologies:* swst.org/wp and swst.org/wp/wp-content/uploads/2019/10/wfs2879.pdf

ReuseWood. *North America's Wood Reuse and Recycling Directory:* reusewood.org

Project Partners

Meredith Moore, Ouroboros Deconstruction
Role: Supplier of salvaged lumber; provided warehousing and oversight of the regrading process; ensured material was correctly processed and ready for grading. Collaborated directly with CSI grader and builder, facilitated transportation, and sought feedback to improve future processes.
Website: ouroborosdecon.com
LinkedIn: in/meredith-moore-322766a

Royston D'Souza
Role: Builder and designer; project manager; oversaw trades and regrading process.
LinkedIn: in/desouzar

David April, Canadian Softwood Inspection Agency
Role: Inspector/grader; conducted grading process.
Website: canadiansoftwood.com

Saaz Mariani, First Principles Engineering
Role: P.Eng; reviewed regraded lumber for structural use.
Website: fpeng.ca

Haven Builds and ***The Carpentry Group***
Role: Framers.
Website: havenbuilds.ca

Photo credit: Cover page: Royston D'Souza (2024).

About this series: The Waste Reduction and Management Division profiles opportunities to recover and reintegrate construction, renovation, and demolition (CRD) materials to develop the circular economy of Canada's CRD sector. This series focuses on the diversion of wood from landfills through improved secondary markets, boosting recovery of materials, and connecting supply and demand.