



Construction in Reverse

Lessons from a Residential Renovation Pilot

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What is Deconstruction?

Deconstruction is the selective disassembly of buildings into their components for re-use and recycling, as opposed to demolition where a site is cleared of its structures by the most expedient means. "Deconstruction has also been defined as 'construction in reverse'."¹

Benefits of Deconstruction

Approximately sixty-three percent of demolition, land clearing and construction (DLC) waste sent to landfill is wood. As it decomposes in landfills, wood waste releases methane, a greenhouse gas that has a global warming potential 20 times greater than carbon dioxide over a 100 year period.² The amount of methane generated in Canadian landfills in 2005 was equal to the emissions of 4.7 million passenger vehicles.³ In addition, many municipalities have limited landfill space. A University of Victoria study conducted in 1995 found that 41% of Canadian landfills would run out of space by the end of this decade.⁴

Deconstruction not only diverts wood from landfill but also reduces the demand for virgin resources on new construction projects. The deconstruction of a typical 2,000-square-foot (190 m²) wood frame home

can yield 6,000 board feet of reusable lumber.⁵ This technique provides a source of quality, low-cost building materials to the local community, allowing for more affordable construction.

Deconstruction also provides other benefits to the local economy. Because it takes more time and skill, deconstruction typically employs five workers for every one in a demolition job.⁶ Deconstructing a building is a good way to learn how to construct a building, and therefore is well suited to provide on-the-job training to prepare unskilled or low-skilled workers for a career in the construction industry.

Case Study

Description

As part of its goal to maximize reuse, recycling and material recovery, Metro Vancouver has targeted an eighty percent diversion rate for all DLC waste in the region by 2015.⁷ To achieve this, Metro Vancouver is mandating recycling on construction, demolition and renovation projects across the region through the municipal building and demolition permit process. Light House worked with Metro Vancouver to create an innovative, small-scale program⁸ for recycling and hauling services to reduce waste and maximize

¹ Wikipedia, "Deconstruction (building)", http://en.wikipedia.org/wiki/Deconstruction_%28building%29

² United States Environmental Protection Agency, "Overview of Greenhouse Gases", <http://epa.gov/climatechange/ghgemissions/gases/ch4.html>

³ Don't Waste Wood, "Regulators & Municipalities", <http://dontwastewood.com/regulators-municipalities>

⁴ Don't Waste Wood, "Regulators & Municipalities", <http://dontwastewood.com/regulators-municipalities>

⁵ Wikipedia, "Deconstruction (building)", http://en.wikipedia.org/wiki/Deconstruction_%28building%29

⁶ Second Chance, "Benefits of Deconstruction", http://www.secondchanceinc.org/index.aspx?u=Benefits_of_Deconstruction

⁷ Metro Vancouver Integrated Solid Waste and Resource Management Plan (ISWRMP).

⁸ Findings from preliminary research as well as the results of a survey conducted in May 2009 regarding recycling and waste reduction practices on home renovation sites, were used to inform the project design.

salvage and recycling on construction and renovation projects. The program was then tested on an actual renovation project to determine its feasibility and to inform the development of a sample recycling bylaw as well as supporting tools and resources for municipalities.

For the pilot, the team selected a single-family home renovation undertaken by reVISION Custom Home Renovations (www.revisionrenovations.com). The \$250,000 renovation included removal of the existing roof and the addition of a third storey, as well as renovation of approximately 50 percent of the main floor and 60 percent of the basement.

A deconstruction consulting firm was hired to conduct a walk-through of the project with the team prior to any demolition work to:

- 1) Assess the relative value of the various materials versus the amount of labour required to remove them intact,
- 2) Provide training on efficient removal of materials with the goal of preserving them for salvage or separating them for recycling, and
- 3) Demonstrate the use of some key tools for deconstruction.

A construction waste management plan was created for the project detailing all anticipated waste materials, their salvage and recycling potential, and the receiving facility for each material. Anticipated waste materials included drywall, tile, flooring, trusses, roofing, gutters, bricks, lumber, plumbing fixtures, and a hot water tank. Materials with potential for salvage included the doors and hardware as well as the hardwood flooring in the living room and bedrooms.

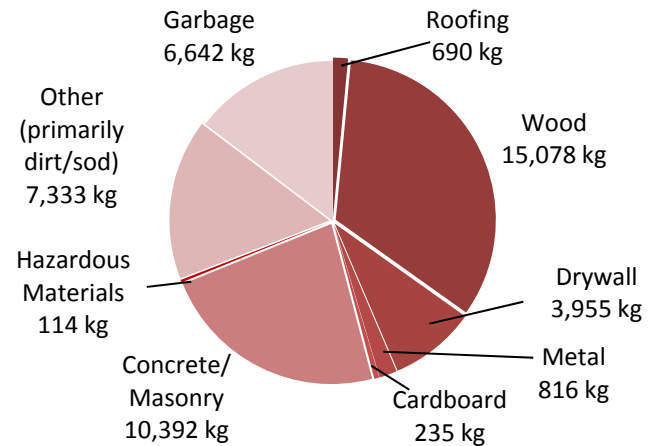
To minimize the time spent by trades sorting materials, Benefits Waste Management (benefitswaste.com), a hauler that provides on-site sorting services without the use of large roll-off bins, was selected for the project. As a result, deconstruction activities had only a minor impact on the project schedule, although some additional time was spent by the contractor's crew on the roof removal and separation of lathe and plaster.

To address site constraints the hauler accommodated pick-ups on an as-needed basis. In addition, the hauler had an established method of reporting material diversion in client invoices. To encourage the contractor to source-separate materials when practical, small bins were provided for the following materials: wood, gypsum, plastic, metal and garbage. The bins were labeled with detailed information regarding the types of materials to be placed in each bin.

Results

Overall, of the 45,255 kilograms of waste generated by the project, 85 percent was diverted from landfill. Of the 6,756 kilograms of waste not recycled, at least 1,622 kilograms consisted of insulation as well as at least 1,100 kilograms of asphalt shingles. The remainder consisted primarily of new construction building materials such as plastic bags/sheets, PVC, polystyrene, plastic drainage matting, and ceramic tile.

Waste Generation



The majority of material separation and waste removal for the project was conducted by the hauler, using small bins to separate smaller items on site and transporting larger materials to the area directly in front of the truck bed where they were sorted by type and loaded efficiently into the bed of the truck in sequence of drop-off location. For all materials landfilled or recycled, the hauler provided copies of waybills collected at receiving facilities. In cases where the load contained materials from more than one site, the hauler worked out a visual estimate of the amount of materials corresponding to each site, and marked this directly on the waybill at the time of drop-off.

Waste removal costs charged by the hauler (including sorting, hauling and recycling/tipping fees) were compared to the cost of renting a roll-off bin from SuperSave (including hauling and tipping fees, and sending all the materials to landfill, except concrete and drywall). The results demonstrated that using roll-off bins is more cost-effective with mixed waste, while the sort and haul service model is more cost-effective when a greater proportion of the waste consists of concrete and drywall.

The total cost of tipping fees for the project was \$1,508.57. By comparison, if all materials for the project were taken un-separated (with the exception of

drywall) to the closest transfer station, Wastech in North Vancouver, the cost of tipping fees would be \$4,599.31.

Challenges with Deconstruction

Key challenges encountered through this pilot included:

1. Timelines

- Deconstruction requires more time than conventional demolition.
- Construction schedules are tight and sometimes uncertain, allowing little additional time for deconstruction and materials separation.
- Employees of general contractors are motivated by timelines and are not focused on diversion efforts.
- Tracking construction waste involves additional administrative time to collect documentation and conduct calculations. Typically, documentation is not provided for salvaged items.

2. Education/Resources

- Lack of staff/trades support and commitment for onsite materials separation.
- Lack of education and training on how to develop and implement a construction site waste reduction and recycling program.
- Insufficient market demand for some used/recycled building materials.
- Poor infrastructure for notifying consumers about available used building materials.
- Industry perception that virgin materials are superior to reused materials.

3. Materials

- Insufficient volumes of certain materials to merit diversion.
- Bins small enough to carry around the site are too small to accommodate the majority of materials generated.
- Current building code requirements for higher performance materials prevent the use of some salvaged materials.
- Some construction methods do not allow for deconstruction.
- The condition of materials in older homes can be too poor for reuse.

4. Facilities

- Relatively low landfill tipping fees make it difficult to recover the costs associated with separation and sorting of materials through the sale of materials and avoided tipping fees.
- Lack of conveniently located facilities in the region, and lack of capacity of existing facilities for accepting certain materials.

Recommendations

Based on the findings from the project, the following five recommendations for governments, industry associations and educational institutions were identified as key to increasing diversion on residential renovation projects.

1. Update permitting processes to incorporate the following:

- Expedite deconstruction permits so that they are received in advance of demolition permits to allow for additional time required for material separation. Based on the results of this pilot, an advance of one to two weeks is recommended for projects of similar scope. Deconstruction permits should require a minimum percentage of waste diversion.⁹
- Require a construction waste management plan in order to obtain a building permit.
- Mandate diversion targets and collect a recycling deposit along with permitting fees. A percentage of the deposit will be returned based on the amount of waste diverted from landfill, up to a maximum for the targeted diversion rate. To facilitate compliance, the amount of the deposit must be significantly greater than the additional cost of achieving that diversion rate. Furthermore, waybills should be required as proof of diversion.
- Relax municipal regulations around bin placement on streets during home renovations (eg. maximum storage time on street), and simplify the application process. In addition, consider reducing fees associated with permits, as well as those for insurance and lost parking metre revenues.

Regulations should be implemented gradually with plenty of notice to allow the industry time to adjust.

2. Develop education programs that address topics such as development of a construction site waste reduction and recycling program, decision-making to determine when diversion makes sense, innovative ways to reuse materials on site, and construction methods that allow for future deconstruction.

Programs should be promoted through industry associations and trade schools and delivered as part of the curriculum for new trades, as well as continuing education for those currently working in the industry.

⁹ The City of Vancouver recently introduced a deconstruction permit option, providing these permits in advance of building/development permits, along with discounted tipping fees.

Consider offering an incentive (e.g., financial, recognition from industry associations) to encourage participation from established contractors and trades.

3. **Create a database to provide tools and resources** such as simple construction waste management plan and waste tracking templates, a database of haulers that have established tracking systems and address space and schedule issues by picking up materials right away, a database and map of recycling facilities in the region with a listing of accepted materials and tipping fees, and information on the most efficient deconstruction practices for various building components.

These tools and resources should be delivered to the industry through industry associations via website and email. In addition, municipalities could provide information at the time of granting a demolition permit. DLC waste tracking software can also be used to provide many of these tools to the industry (see box).



Many municipalities are turning to specialized waste tracking software to help support effective DLC waste diversion. Programs, such as Green Halo, facilitate the handling of deconstruction deposits and allow contractors and haulers to create online waste management plans, identify waste facilities by material type, track waste receipt information, and provide real-time reporting on whether a project or city is meeting its diversion targets.

For more information about waste tracking software, contact Light House at 604. 677.3619.

4. **Facilitate use of recycling facilities** in the region through the following:

- Eliminate volume discounts at landfills and increase tipping fees for mixed waste.¹⁰
- Enforce hazardous waste and banned materials regulations for small demolition projects and expand landfill bans on recyclable materials to create a level playing field for deconstruction.
- Investigate options to encourage smaller-scale private waste recycling facilities in more central and accessible locations (e.g., via favourable zoning regulations or development incentives for particular types of uses).

5. **Develop the market for recycled and salvaged materials** through the following:

- Provide grants for research into development of innovative recycling technologies for materials that are currently not recyclable, or additional applications for recycled materials with a limited market. Manufacturers may have an interest in this once the Packaging and Printed Paper amendment to the BC Product Stewardship Plan is implemented in May 2014.
- Increase the profile of salvaged and recycled materials in design and construction by incorporating them into public building and infrastructure projects. Educational tools should be developed to raise awareness of the use of these materials and the associated benefits.



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¹⁰ According to calculations from the pilot, public transfer station fees for mixed waste would need to increase by 80 to 150 percent, depending on the composition of waste, in order to bring costs associated with diversion of materials on par with standard disposal using roll-off bins. As this level of increase is likely not feasible, this measure should be used in conjunction with others.