Barriers for Deconstruction and Reuse/Recycling of Construction Materials in Canada

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INTRODUCTION / BACKGROUND

Canada is located on the northern portion of the North American continent. It is the second largest country in the world by land mass covering 8,965,121.42 square km (Statistics Canada, 2012), and spanning from the Atlantic ocean in the east, the Pacific ocean in the west to the Arctic ocean to the north. The county shares the world longest land border with the United States of America along its south and parts of the western border. Statistics Canada 2011 census data lists a population of 33,476,688 people meaning a population density of 3.7 per square km (Statistics Canada, 2012). Although vast in size and sparsely populated, 90% of Canadians reside within 160 km of the southern border (Central Intelligence Agency, 2012). There are ten provinces and three territories all with their own governments and legislatures. These are further divided into municipalities which have their own by-laws and regulations depending on local circumstances. This complex multi-tiered political environment leads to great variation in policies and regulations from region to region.

Canada has one of the highest levels of solid waste per capita in the world. As of 2007 Canada produced 894 kg of municipal solid waste per capita, last out of 17 OECD nations (Conference Board of Canada, 2012). Waste management expenditures for all local governments was $2.6 billion for 2008 (Statistics Canada, 2010). Collection and transportation comprise $1.1 billion of the cost, followed by operation of disposal facilities, and tipping fees (Statistics Canada, 2010). According to the 2008 Waste management industry survey waste management expenditures accounted for $79 per capita on average for Canada with great variation in the expenditures and methods of processing this waste from province to province (Statistics Canada, 2010).

Canada's construction industry employs 6% of the workforce making it the third largest employment sector behind services, and manufacturing (Statistics Canada, 2006). The construction, renovation, and demolition wastes contribute an estimated 25% of all solid waste by volume (Recycling Council of Ontario, 2006). Buildings are a major contributor to waste, greenhouse gas emissions, and resource consumption in Canada. The Commission for Environmental Cooperation 2008 report *Green Building in North America* provides statistics on the various impacts of the built environment in Canada some of which are listed below:

- 33 percent of all energy used;
- 50 percent of natural resources consumed;
- 12 percent of non-industrial water used;
- 25 percent of landfill waste generated;
- 10 percent of airborne particulates produced; and
- 35 percent of greenhouse gases emitted.

1. BARRIERS TO DECONSTRUCTION IN CANADA

This section discussed the barriers to deconstruction for 3 major structural materials used in Canada: steel frame used in commercial and industrial buildings, wood frame which predominates in low rise residential buildings and concrete which is used in office and high rise residential buildings amongst others.

1.1. Steel Framed Construction

1.1.1. Commonly Used Methods To Remove Steel Framed Buildings

Structural steel buildings are most often removed by mechanical demolition. In order to have the demolition project proceed quickly and efficiently, heavy machinery does all the major work and building components are often damaged in the process of their destruction. Valuable components may be source separated if a known revenue stream exists for the waste products. Structural steel is one such product and Gorgolewski, Straka, Edmonds, & Sergio (2006) indicate that:

> "… approximately 90% of steel arising from demolition goes back to the steel mills for recycling, about 10% goes to some form of component reuse, and only a minimal amount, perhaps less than 1% goes to landfill as it is difficult to extract from the waste stream." (p. 4)

The level of steel recycling should be commended, however the deconstruction process and structural steel re-used in 'as is' condition will save energy, money and resources. Steel only forms the structural core of the building and as with all building types the finish materials, cladding, glazing, or doors may be demolished in the same manner or by selective deconstruction, where the most valuable and easily accessible components are removed before the structure comes down. If the waste from demolition of this building type becomes mixed the steel can be easily separated by magnets (Falk, 2002) and so steel is not generally contaminated by being mixed with other wastes.

1.1.2. Barriers for Deconstruction of Steel Frame Construction

Complications of reusing building components in 'as is' condition.

Engineers will not always approve the reuse of structural steel components as they have not been tested in accordance with current standards and the specifications are not immediately known, unlike with new structural steel components. Liability becomes the main concern (Gorgolewski et al. 2006). The costs to test reclaimed steel components for structural integrity are relatively high and may result in prices that are similar to new structural steel components for reused components to be viewed as cost effective

Lack of awareness of reused structural steel components within construction industry

A general lack of awareness of potential for reuse of materials 'as is' makes demolition crews more likely to work recklessly and simply remove components as quickly as possible (Gorgolewski et al. 2006).

Reliability of supply of building components/lack of markets for deconstructed building materials

Building components are often not available when needed for a new construction project and so more planning has to be undertaken and components acquired when they are available. This may result in building components needing to be stored and results in higher than normal storage costs for new construction projects. There may also not be enough of a single component type to meet the demands of a new construction project. Designs would then need to be adaptable in order for major steel building components to be accepted and integrated into a project.

Unnecessary damage being done to building components as they are removed.

The use of welded joints instead of mechanical joints on structural steel components can make the deconstruction of building components more difficult. In these cases care needs to be taken to remove the components undamaged through grinding and cutting of welded joints (Canadian Standards Association, 2012).

High price of scrap steel makes reusing steel components less worthwhile.

The steel recycling industry is very well established in Canada and much of the reclaimed steel is already sent to steel recycling facilities instead of reused in as is condition. This is quicker and easier solution for contractors because they already have established networks for this process. The immediate recycling of steel building components decreases any storage costs and results in immediate income for the projects (Gorgolewski et al. 2006).

1.1.3. Strategies to Overcome Barriers to Deconstruction of Steel Framed Buildings

Improve the deconstruction process by taking more care in dismantling of components

Building components can often be damaged in the process of their removal which decreases their value as reusable building components. By improving the removal practices of building components, for example through careful cutting and grinding of welds, more material could be reclaimed (Canadian Standards Association, 2012).

Improve and streamline the process of re-grading structural steel components

In the search of literature there was no specific Canadian research regarding the improvement of the steel re-grading process. If steel products could be proven to be structurally sound for future construction projects it would be more likely that used building components would be adopted.

1.2. Wood Framed Construction

1.2.1. Commonly Used Methods To Remove Wood Frame Buildings

The most common method of removing wood framed buildings in Canada is through demolition with the majority of wastes sent to landfill. Demolition is completed as quickly as possible with mixed wastes being disposed of in common waste bins. This results in very little care be paid to the valuable components that could be source separated. In some cases there is selective deconstruction of easily accessible and easily sold building materials. There are scattered companies across Canada that specialize in building deconstruction with most demolition companies performing mainly mechanical demolitions with heavy equipment.

1.2.2. Barriers Specific To Wood Framed Buildings Deconstruction

Deconstruction of wood building is difficult

Wood frame buildings can be difficult and time consuming to dismantle. The wood components need to have a large number of fasteners removed from them to be reused. This can add a great deal of labour costs to a deconstruction project. Framing members such as stick framing or trusses for roofs can be awkward and dangerous to remove and may require special equipment or bracing during the deconstruction process (Canada Wood Council, No date).

Use of new generation of products can make deconstruction more difficult.

Falk (2002) indicates that the use of new products such as oriented strand board, plywood and construction adhesives make deconstruction process more difficult. Products are less likely to come out intact as compared with older buildings which may have used simple mechanical fasteners and solid boards.

Wood waste is often mixed with other materials and contaminated by other substances

Standard demolition techniques create mixing of building products to make recovery of materials cost effective. Deconstruction by selective dismantling is a cost effective solution to increase the rate of material recovery (Canada Wood Council, No date).

Low cost and abundant availability of new building materials

Scrap wood is difficult to separate from all of the other building components and is extremely cheap to buy new and clean so there is very little value in recycling or reclaiming the material from disposal bins. Canada is a world leader is sustainable and well managed forests (Canada Wood Council, no date), and considered a renewable resource under such circumstances.

Lack of regulations demanding waste management plans for this building type.

Typical wood framed construction in Canada consists of individual residential houses and therefore is not big enough to fall under the regulations that do exist. Therefore no waste management plan is necessary and any waste that is removed from demolition sites is most often sent to landfill. Unless selective deconstruction is demanded or the value of building components is understood by the building owner/contractor then the building will most likely be removed as quickly as possible which is most often by mechanical demolition.

1.2.3. Strategies To Overcome Barriers In Wood Framed Buildings Deconstruction

Design for deconstruction

This process considers the entire lifecycle of the building and helps builders and designers to make decisions regarding design, materials choices, all in an effort to mitigate waste created at the end of life of individual building components, and the entire structure. Falk (2002) states that highly engineered materials might not be the best choices for wood framed buildings given the difficulty in removing and reusing these components in an ‘as is’ condition.

Encourage greater adaptive reuse

This is a common strategy amongst older buildings within Canada. They are often well suited for making major changes to layout and which can result in extending the life of a building instead of its demolition. Adaptive reuse is when there are specific components of the building that are removed, redesigned and/or adapted in order to change the functionality of an existing building. Wood framed buildings are particularly well suited to this type of renovation given the ease with which wood framing can be adapted and moved.

1.3. Concrete/Masonry Construction

1.3.1. Commonly Used Methods to Remove Concrete/Masonry Construction

This building type is most often demolished with traditional mechanical demolition. Concrete structure is brought to the ground in pieces and crushed to remove any reinforcing steel. As with other building types interior finishes may be removed by other means but they too are removed as mixed wastes and sent indiscriminately to landfill. Demolition of this building type can be dangerous and time consuming if manual removal of concrete components is undertaken.

1.3.2. Barriers to Deconstruction of Concrete/Masonry Buildings

Source Separation of materials is difficult

Concrete is particularly difficult to deal with because it is generally not reusable in the 'as is'state on new construction projects. It is often mixed with other wastes such as reinforcing steel and gets easily damaged in the demolition/dismantling process. It cannot often be reused as is and instead can be crushed and down cycled as aggregates for future projects. (Canadian Standards Association, 2012; Hurley, Goodier, Garrod, Grantham, Lennon, & Waterman, 2002)

It is not cost effective deconstruct and reuse concrete

Most concrete construction is cast in place and this means it is specific to the building in which it was constructed. This leads to problems of dimensions, and the high costs of transporting concrete components makes it unfeasible to reuse compared to new concrete (Hurley et al., 2002).

1.3.3. Strategies to Overcome Barriers in Concrete/Masonry Construction

Better planning of projects from the design stage through to end of service life

If planning for end of service life was done from the earliest stages of a concrete construction project then when that time arrives for the building the likelihood of major portions of the building being salvaged is greatly improved (Canadian Standards Association, 2006). This could include designing with precast concrete that can be used in other applications instead of purely cast in place concrete.

2. BARRIERS FOR REUSE AND RECYCLE

In this section the barriers to reuse and recycling in Canada are discussed for 3 construction materials: wood, drywall and concrete.

2.1. Wood

Wood constitutes 30-34% of the waste stream from construction, renovation, and demolition activities (NRCan, 2006).

2.1.1. Diverted rate (reuse and recycle): 5.4%

This figure only accounts for waste diverted by the waste management industry. Any waste reclaimed directly from the waste generator is unaccounted for (CCA, 2001).

2.1.2. Products produced from wood waste

Reuse: In Canada, high quality architectural pieces such as beams, posts, trusses, and millwork are the most often salvaged and reused wood products (Cooper, 1999). Another common activity is salvaging wood from barns to be repurposed as flooring.

Recycle: Wood is most often recycled in Canada as feedstock for landfill or as mulch used in the landscape cover (Cooper, 1999). Although other recycled wood products include composite wood materials, paper pulp, animal bedding, soil amendment, and compost (Cooper, 1999). Wood can be recycled into building materials such as singles or roof felt (Cooper, 1999).

2.1.3. Barrier to wood reuse and recycle

On-site sorting

One of the main challenges with diverting wood is sorting wood on-site for proper management. This problem is particularly true for the case of preserved wood products. (Cooper, 1999)

Research in treatment options

In Canada, not enough is understood of the treatment options to facilitate recycling or reuse of preserved wood. Some research indicates that building composite products such as wood and plastic or wood and cement may be viable in the future, but more research needs to be done. Currently, the market for treated wood composite materials is not strong in Canada. (Cooper, 1999)

Easy access to landfill

Infrastructure needed to collect, transport, store, and prepare preserved or untreated wood is widely unavailable. Infrastructure would be expensive to design, implement, and enforce. At the same time, there is no deterrent to landfilling. For example, preserved wood is still accepted as nonhazardous waste in most provinces and can be disposed of in unlined landfills. (Cooper, 1999)

2.1.4. Strategies to overcome barriers for wood reuse and recycle

Industry promotion through education

The Forest Products Association of Canada (FPAC) has set a carbon neutrality goal for 2015. As part of their initiatives to promote carbon neutrality, they have developed the 'Don't Waste Wood' campaign. The program highlights the role of the construction and demolition industry to make significant reductions in wood waste disposal. The campaign stresses the importance of diverting wood from landfill and uses the globally accepted waste hierarchy (reduce-reuse-recycle-then, landfill) to discuss the appropriate options for wood waste treatment. Reuse is particularly promoted through case studies and additional resources that offer further information and links to deconstruction and reuse professionals. However, most of the links provided by campaign are to businesses and groups in the United States. (Forest Products Association of Canada, 2012)

Increased aesthetic value

Architectural salvage is a small but growing industry in Canada. Older, rare, and weathered wood in particular is sought after for its aesthetic value. Interest is growing as the inventories of old grow woods and certain species of wood are becoming increasingly more difficult to acquire. As mentioned about high quality architectural items such as posts, beams, and trusses are popular reuse items.

2.2. Drywall

Drywall constitutes 11-13% of the waste stream from construction, renovation, and demolition activities (NRCan, 2006)

2.2.1. Diverted rate (recycle): 33%.

This figure only accounts for waste diverted by the waste management industry. Any waste reclaimed directly from the waste generator is unaccounted for.

2.2.2. Products produced from gypsum waste:

Drywall is rarely reused. Most often in Canada, gypsum is recovered from drywall and recycled as a soil amendment or incorporated again into the gypsum component of drywall. In Canada, manufacturers of recycled drywall products typically include 25% secondary gypsum. (Saotome, 2007)

2.2.3. Barrier to drywall reuse and recycle

Inaccessibility to gypsum recycling facilities

There are very few facilities that recycle gypsum in Canada and the majority are located on the west coast. With minimal options, most gypsum waste is produced at far distances from recycling facilities. With no financial incentive to spend additional resources coordinating transportation to long distance facilities, it is often deemed as more practical to dispose of drywall at near-by landfill sites. (Saotome, 2007)

On-site separation

Drywall is difficult to separate on-site because demolition contractors are typically unaware that gypsum can be recycled. Furthermore, demolition sites are often too small to include a separate bin for drywall. (Saotome, 2007)

2.2.4. Strategies to overcome barriers for drywall reuse and recycle

Municipal bans of gypsum from landfills across Canada

When disposed of in landfill, gypsum biological and chemical reacts with organic waste to produce hydrogen sulphide gas (Saotome, 2007). The hydrogen sulphide gas is harmful to human health and creates an unpleasant odour (Gratton, n.d.).

In some major municipalities across Canada, such as Vancouver and Ottawa, gypsum is banned from landfill. In the case of Vancouver, the ban of gypsum facilitated a market for recycling gypsum and, as such, facilities sprung up in the area. (Canada Green Building Council, 2009; Saotome, 2007)

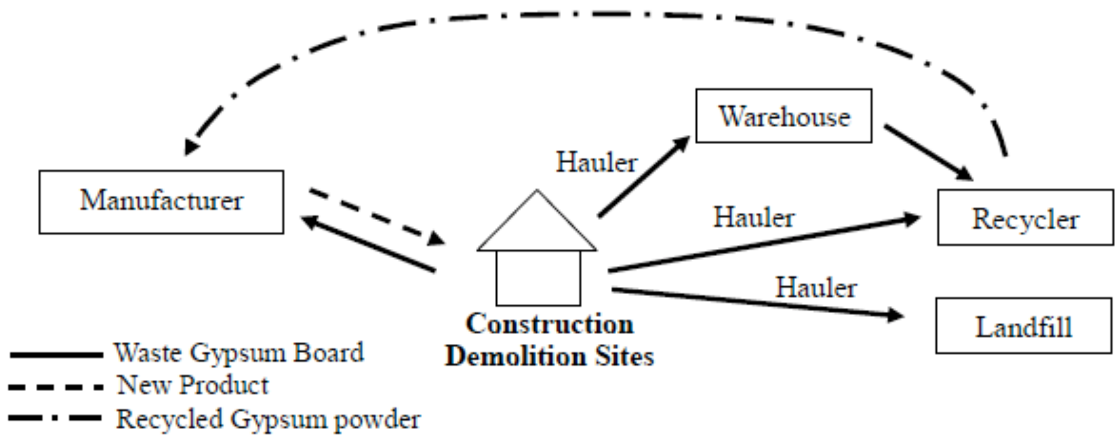

Figure 1: Typical recycling flow of gypsum (Saotome, 2007).

2.3. Concrete

Concrete constitutes 10-16% of the waste stream from construction, renovation, and demolition activities (NRCan, 2006).

2.3.1. Diverted rate (recycle): 72.4%.

This figure only accounts for waste diverted by the waste management industry. Any waste reclaimed directly from the waste generator is unaccounted for (CCA, 2001). As well, this figure includes concrete associated with civil engineering projects such as roads and bridges (NRCan, 2006).

2.3.2. Products produced from concrete waste:

In Canada, concrete is mainly recycled into aggregate. Recycled aggregate can be used to produce more concrete, but is most often used as a road base. In 2007, 13 million tonnes of recycled concrete aggregate was used in the construction of buildings, roads, sewers, and water mains. In Ontario, Canada recycled aggregate accounts for 7.2% of the aggregate market (Canadian Urban Institute, 2011).

2.3.3. Barrier to concrete reuse and recycle

Cost of recycled aggregate does not reflect product quality

Recycled aggregate often contains contaminant residuals from the previous life of the concrete. The contaminants reduce the compressive strength of the aggregate by about 25%. Because the quality of recycled aggregate is lower than the virgin aggregate materials, many Canadian industry members believe that the price should also be lower. However, the cleaning, processing, inspection, storage, and sale of recycled aggregate can result in costs comparable or higher than virgin aggregate. (Nisbet et al, n.d.)

Production costs vary depending on the use of the recycled aggregate. On-site production is the least expensive option, generating the least quality aggregate, which is used primarily as fill in road construction (Nisbet et al, n.d.).

2.3.4. Strategies to overcome barriers for concrete reuse and recycle

Recognition of recycled concrete in federal and provincial construction standards

Recycled aggregate has been incorporated into the Canadian Standard Association's (CSA) Standard A23.1-00. The standard acknowledges:

> "Concrete is a 100% reusable resource. Common practice is to recycle returned product and all materials both on and off site. Concrete can be crushed and aggregates reused in new concrete or reclaimed and used as road base, reducing the requirement for new aggregate." (Construction Standards Association, 2009)

At the same time, the CSA standard considers recycled aggregate a synthetic material and suggests that more attention to its durability characteristics, deleterious materials, potential alkali-aggregate reactivity, chloride contamination, and workability characteristics should be observed than with its virgin counterparts. (Construction Standards Association, 2009)

In 1993, recycled concrete was incorporated into the Ontario Provincial Standard Specification (OPSS) 1010, material specification for aggregates - base, subbase, select subgrade, and backfill material (Cement Association of Canada, 2003). The OPSS 1010 standard accepts up to 100% recycled aggregate for dense graded aggregates and one type of well-graded aggregates. The code mandates that recycled aggregates (either blended or homogenous) require additional testing by a contractor to ensure that quality standards are met before use. (Ontario Provincial Standard Specification, 2003)

The incorporation of recycled aggregate into the OPSS 1010 standard has pushed Ontario's industry to provide education and resources of the manufacturing and handling processes for recycled aggregate. For example, The Ontario Stone, Sand, and Gravel Association is the only provincial aggregate industry association in Canada to provide resources about recycled aggregate and these resources directly apply with the OPSS 1010 standard (Ontario Stone, Sand, and Gravel Association, 2006).

3. GENERAL ISSUES OF DECONSTRUCTION, REUSE AND RECYCLE IN CANADA

3.1. Barriers To Deconstruction, Reuse, and Recycle Common To All Major Construction Types and Material

Lack of knowledge about the value of material reuse or about materials being reused

There is very little specific private or academic research done on the deconstruction process in Canada. Although there are various resources available and scattered retailers and deconstruction practitioners around the country regular citizens seem unaware of the possibilities of reuse and the value of the existing materials. Surveys of industry professionals indicate a general lack of awareness of materials being reused in an as is condition (Gorgolewski et al., 2006), and so with no knowledge of a market and value of products little attention will be paid to maintaining quality of products as a building is demolished.

Many of the strategies discussed in Canada draw on examples from other parts of the world. For example, in establishing a waste diversion strategy for Alberta in 2001 Portland, Oregon's waste management framework was used as a model (Sonnevera International Corporation, 2006). Since Canada and the United States are very close geographically, in architecture style, and some could argue, in policy, many statistics used in Canadian literature is derived from research in the United States. Although these statistics may be perceived as accurate 'enough', research on the subject of deconstruction, reuse, and recycling must be further investigated in the scope of Canada.

Assumption of higher costs of deconstruction

It is assumed by many industry professionals that deconstruction process would result in higher overall costs for a project than traditional demolition and landfilling. (Falk, 2002; Gorgolewski et al., 2006)

Short timeframes for projects

If demolition contractors are busy they will often not carefully deconstruct building components and instead will choose the quickest method to remove the building (Gorgolewski et al., 2006). Falk (2002) points out the irony that a building may have sat derelict for years but as soon as a new project is determined for the site there is very little time to carefully deconstruct the building. Time is an easy and common excuse for fast irresponsible demolition of buildings.

Poor planning of waste management on jobsite

This can include limited space for extra waste bins required for source separation (RCO, 2006), and a lack of record keeping regarding waste removed from the site (Canadian Standards Association, 2012)

Lack of cooperation of all parties

This can include owners, contractors, subcontractors, waste haulers, architects and designers. If any of the interested parties do not fully grasp the project of deconstruction it can hinder the entire process. A thorough understanding of projects goals and a developed plan is often not shared with all parties nor monitored. (RCO, 2006)

General lack of developed market for reclaimed building materials

While a thriving market exists for architectural salvaged materials in Canada the main structural building components are often not salvaged at all. Only quick sale items are collected by selective deconstruction and sold on a large scale. This problem is one of both supply and demand, retailers will not carry products that are not in demand and consumers will not buy products they do not know are available. This issue is closely related issue to awareness of the value of reclaimed building components

3.2. Strategies To Overcome Barriers For Deconstruction Of All Major Construction Types

Market development for reused building components

The primary barrier to recycling and reuse in Canada is the balance between landfilling fees and costs to divert waste (Nisbet et al, n.d.; Saotome, 2007). For example, it is estimated that the cost of landfilling materials is about 40% lower than recycling them (Nisbet et al, n.d.). Low landfilling costs create disincentives for diverting waste.

Existing Regulations within Canada

Certain major cities and municipalities have taken steps to lead the country in producing green buildings within their jurisdictions. Metro Vancouver has a Zero waste initiative (Metro Vancouver, 2011) which includes the construction and demolition wastes, and the City of Toronto has their own green building standard which demands more stringent environmental compliance for new buildings (City of Toronto, 2012).

Another example is the City of Calgary. The city has implemented a goal to reduce all construction and demolition waste going to landfill to 20% of the amount sent in 2007. To achieve the goal, the city is utilizing an approach that includes economic, regulatory policy, and voluntary measures. (The City of Calgary, 2011)

Regulations vary vastly throughout the country, changing from province-to-province. In 1994, Ontario developed the 3R's Regulation under the Environmental Protection Act, consisting for four regulations that intended to reduce waste going to landfill by 50% in 2000. In particular two of these regulations applied to the construction industry: Waste Audits and Waste Reduction Work Plans (Regulation 102/94) and Industrial and Commercial and Institutional (IC&I) Source Separation Programs (Regulation 103/94). (Environment Canada, 2003)

However regulation 102/94 does not require waste audit plans to be submitted to the Ontario Ministry of the Environment (Environment Canada, 2003). A survey of in 2006 revealed that 90% of waste generators from the institutional, commercial, and industrial (IC&I) group were out of compliance with the regulations as a result minimal enforcement/authorization. The regulation put responsibility of waste management to the project owner, who is often removed from the contractors actually doing the construction/renovation/demolition (Nisbet et al, n.d.; Saotome, 2007). As well, the regulation only pertains to projects greater than 2000 square feet, excluding waste management to the majority of residential buildings in Ontario (Saotome, 2007). The waste management goal for 2000 was never reached and overall, the regulation continues to be viewed as not successful (Saotome, 2007).

Canadian Standards Associations (CSA) guides

There are currently two guides produced by the Canadian Standards Association that deal with buildings demolition, deconstruction and adaptive reuse. These standards are written with guidance from steering committees comprised of various construction industry professionals, academics, and parties representing various materials associations within Canada. *The Guideline For Design For Disassembly And Adaptability Of Buildings* is a 2006 publication and was written with the intention of providing a framework for reducing the amount of construction waste produced, thus improving a buildings economic, societal, and environmental impacts by designing buildings that are adaptable and easily disassembled at the end of their service life (Canadian Standards Association, 2006). The guideline provides strategies for designers, materials manufacturers, and contractors on how to make buildings that meet these requirements.

Deconstruction of Buildings and There Related Parts was published in 2012 and is intended to provide standard methodologies for building deconstruction for all interested parties (Canadian Standards Association, 2012). The guide provides general information about the business of deconstruction, procedures for deconstructing buildings, and how to appropriately keep track of materials removed from a project (Canadian Standards Association, 2012). These are excellent resources for understanding the process, products and outcomes of the deconstruction process within Canada, and demonstrate a growing interest in the appropriate manner of conducting such work.

Proper planning of the demolition/dismantling project

The CSA guide *Deconstruction of Buildings and There Related Parts* (2012) discusses the necessity of planning for how a deconstruction project will be undertaken. This includes a site plan for where on the jobsite products will be processed, keeping records of building components removed from the project, the development of material recovery targets, and a work plan for how certain materials will be dealt with once removed.

Extended producer responsibility

The Canadian council of ministers of the environment approved in principle a Canada wide plan in October 2009 recommending Extended producer responsibility(EPR) as the main avenue to decrease waste created and set for disposal (Moyes, 2010). Responsibility for the disposal and management of waste becomes that of the producer of the product and no longer simply the final user. Theoretically this takes the pressure off of consumers of products, local governments who manage the waste and landfills through the use of take-back programs and better design for end of life by product manufacturers (Canadian Home Builders Association, 2010).

Zero waste initiatives

There are various initiatives underway in Canada that strive to achieve zero waste in the construction industry. This includes not for profit organizations, associations of municipalities, and specific regions that are seeking to diminish the amount of waste that they have to deal with on a regular basis.

Specifically the Construction Resource Initiative (CRI) Council was established in coincidence of the City of Ottawa’s ban on landfilling gypsum. The CRI council intention is to utilize education, advocacy, and industry support to eliminate construction, renovation, and demolition waste to landfill by 2030. Reuse, recycle, and deconstruction are all highlighted by the CRI Council as tools essential to reaching zero waste. (Construction Resource Initiative Council, 2012)

Along with zero waste, initiatives supported by industry associations include:

Recycling exchange programs (http://www.recyclexchange.com/),

Recycling Council of Alberta (http://www.recycle.ab.ca/drywall-processing),

Recycling Council of Ontario (https://www.rco.on.ca/),

Recycling Council of British Columbia (http://rcbc.bc.ca/),

The Saskatchewan Waste Reduction Council http://www.saskwastereduction.ca/.

Integrated design process

The integrated design process (IDP) involves greater communication and increased roles in the construction of a building by all interested parties, including owners, architects, engineers, and contractors. An IDP project would have an independent party in charge of managing the process and keeping all invested parties engaged throughout (Zimmerman, no date). IDP projects allow all members of the construction team to be in on the decision making processes from the very beginning of a project which leads to greater understanding of project goals and 'green' objectives (Zimmerman). This process would help improve deconstructability, recycling and reuse of building materials because of its inclusive approach and the awareness of the important issues throughout the project.

Building Rating systems

There are a wide number of building rating systems that are currently used within Canada. Many of them demand that certain amounts of materials be reused or reclaimed or have recycled content in order to achieve specified numbers of points within the rating system. Generally they encourage greater awareness of sustainable building policies and practices and specifically they demand better waste management practices in order to achieve certifications.

For example, one of the most widely used building rating systems for new construction is the Canadian Green Building Council's Leadership in Energy and Environmental Design (LEED). The Government of Canada has included LEED standards in their federal sustainable development strategy for Canada. The standard requires that all new federal government buildings meet LEED gold standards (Environment Canada, 2010). Although it should be noted that using LEED does not guarantee that buildings will incorporate reused or recycled material and does not directly promote deconstruction practices, the standard does bring awareness these waste diversion tools to the construction industry (Cement Association of Canada, 2003; Sonnevera International Corporation, 2006).

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