CONSTRUCTION, RENOVATION, AND DEMOLITION WASTE TRACKING AND BENCHMARKING

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CONSTRUCTION, RENOVATION, AND DEMOLITION WASTE TRACKING AND BENCHMARKING*

A CASE STUDY OF THE UNIVERSITY OF BRITISH COLUMBIA

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* A shorter version of this report will be published in a paper format. The paper is entitled: "Construction and demolition waste practices in medium-size renovation projects at the University of British Columbia"

Abstract

This report describes the measures which are taken to improve construction, demolition, and renovation waste (CDR waste) management practices of "special" (medium size) renovation projects on UBC campus. Currently there is minimal information available about these projects, because these projects are conducted by private companies and they are not required to gain any environmental certification. Three measures have been currently taken based on the findings of a data collection from a number of contractors and waste subcontractors working on UBC campus. Actions taken are:

- Developing electronic and hardcopy waste management forms which are intended to reduce the amount of time and effort required for waste tracking
- Providing concise educational documents to promote waste tracking
- Creating a waste generation and diversion benchmark to compare performance of different projects, and to assist in estimation of expected waste quantities based on other project parameters.

The reports finishes with some suggestions for future actions which include: measures to facilitate and improve on-site waste separation; motivational measures for contractors and subcontractors; taking more control over CDR waste management by directly managing CDR waste of the special projects or assigning a limited number of waste managers for multiple projects on-campus; using online waste tracking software tools; and some further research opportunities.

Glossary

Special projects: Renovation projects that fall between large and small projects. By contrast to the large projects, these projects are not required to gain Leadership in Energy and Environmental Design (LEED) or Residential Environmental Assessment Program (REAP) certification (University of British Columbia, 2013, 2014). Waste for these projects is not managed by UBC Building Operations, like small projects. The waste is rather managed by private contractors.

CDR waste: Construction, Demolition, and Renovation waste

1 Introduction

Tracking waste generation and diversion in construction projects is important as it motivates the stakeholders to increase waste diversion and also provides the authorities with more accurate information about the current conditions of CDR waste management. It will also help them to identify technical and social challenges and opportunities of waste diversion.

At UBC, large projects (e.g., construction of a new building) generally have good waste tracking systems, since they are mandated to adhere to the waste management requirements of LEED or REAP green building rating systems. Moreover, UBC demands a minimum waste diversion rate of 85% from LEED projects[1] and 75% from REAP projects (University of British Columbia, 2013, 2014). Waste from some small projects (less than $50,000 construction value) is also

[1] In LEED system, projects will gain 1-3 points for developing and implementing a construction waste management (CWM) plan in which 50, 75, or 95% (Exemplary Performance (EP) point) of nonhazardous construction and demolition debris is recycled and/or salvaged (by weight or volume, but must be consistent). Excavated soil and land-clearing debris do not contribute to this credit (U.S. Green Building Council, 2013a, 2013b).

tracked because it is managed by UBC Building Operations. However, waste generation and diversion is not tracked in special projects, which are renovation projects that fall between large and small projects. It is because by contrast to the large projects, these projects are not typically required to gain a LEED or REAP certification and the waste is not managed by UBC Building Operations like small projects. They are rather managed by private contractors. It is estimated that UBC manages about 30-60 "special" projects per year.

This case study consists of two phases. In the first phase, the current situation of waste generation and diversion in the special projects and its challenges were investigated by interviewing a number of general contractors and waste manager subcontractors who work on the on-campus projects. In the second phase, the findings of the first phase were used to develop measures to promote, require, and facilitate waste tracking in the special projects. These measures include:

- Developing electronic waste management forms which are intended to reduce the amount of time and effort required for waste tracking
- Providing concise educational documents to promote waste tracking
- Creating a waste generation and diversion benchmark to compare performance of different projects, and to assist in estimation of expected waste quantities based on other project parameters.

2 Phase one: Interview with contractors and waste manager subcontractors

In the first phase general contractors and demolition/waste management subcontractors working on-campus were interviewed regarding their waste management and tracking practices. We also

requested them to fill a waste tracking form in which waste generation and diversion of each material stream were required (Hosseini, 2013).

The key findings in this study were as follow:

- General contractors are not very aware or concerned about demolition waste management as they assign a demolition/waste manager sub-contractor to take care of demolition waste. For the construction waste they typically rent bin(s) from waste managers. The bins will be hauled to transfer stations/recycling facilities/landfills, either by the general contractor or a hauler subcontractor.
- There was a general agreement among the respondents that tracking waste is a relatively easy task and can be done by analyzing the weight receipts from landfills, transfer stations, recycling facilities, or reused material stores. Yet contractors do not consider waste tracking a necessity in medium or small size projects.
- Respondents stated that there is usually not enough space on-site to set up separate bins, but waste can be categorized in different piles, cans, or plastic bags. However, in small projects, waste is usually collected in mixed bins and they will pay an extra cost to transfer stations/landfills to separate mixed CDR waste. Another option is to transfer the mixed loads to their own yard and separate it there before taking it to the facilities.
- Reusing materials is not common. The respondents indicated the following reasons: customers prefer new materials; salvage materials might not meet required quality or quantity; in some cases, it is against construction codes; there is usually a lack of storage area; market unavailability; and time constraints.

- The materials which are usually not diverted on most projects are: small quantities of mixed waste, plastic, bonded systems, and food waste.

According to the interview findings, the following goals were set for the next phase of the study:

- Provide standard and easy waste management forms in both electronic and hardcopy formats.
- Mandate waste tracking and a minimum waste diversion rate in project specifications and/or contracts.
- Develop educational materials for contractors and workers about the benefits and ease of waste tracking, and the feasible methods for waste reduction and diversion.
- Develop a benchmark against which the performance of projects can assessed.

3 Phase Two: Developing waste tracking measures

3.1 Waste management forms

A set of waste management forms were developed with the main purpose of simplifying the waste tracking practices to minimize the effort of contractors/subcontractors (see Appendix A: Waste Management Forms for the hard copy version[2]). There are three forms in the set which are described in the following sections.

[2] Electronic version can be accessed at: http://www.technicalguidelines.ubc.ca/technical/sustainability html

In order to make sure that contractors will be responsible for filling the waste management forms, the forms are included in the general contract. There will also be a minimum diversion goal in the contract for non-LEED and REAP projects (this minimum is currently 75%).

3.1.1 A. Waste Management Plan

The 'Waste Management Plan' (Figure 9) is to be used prior to project start-up to estimate the types and amount of waste that the project will generate and how it will be managed, i.e. reused, recycled, and diverted, and where it will be taken[3]. This form helps contractors/subcontractors to identify the potential opportunities for maximizing waste diversion at the beginning of the project. Currently this form is only required for the projects with construction value of $200,000 or higher, recognizing that contractors in smaller projects are less willing or able to add to the time and complexity of their projects.

3.1.2 B. Waste Tracking Form

'Waste Tracking Form' (Figure 10) is the most important form in the set and it is mandatory for all the projects on campus[4]. This form is designed to quantify the actual amount of waste that is generated and how it is managed, including the types of waste material, where the materials are taken, and the amounts diverted. The contractors/subcontractors are expected to use the weight receipts from recycling facilities/transfer station/used material stores/landfills or estimate the

[3] Developing a similar waste management plan is a prerequisite in LEED v4 (U.S. Green Building Council, 2014).

[4] LEED and REAP projects are allowed to submit the forms that they have submitted to the certification system and instead of the 'Waste Tracking Form'

weight of the reused and salvaged materials. They are expected to keep the weight receipts for 2 years after finishing the project as a proof for their claim.

This form simplifies the process and reduces the contractors/subcontractors' work load, compared to our previous form used in phase one of the research (see section 2). The form used in the interviews were more similar to **Error! Reference source not found.**, in which the total quantities of each material type are required, rather than the quantities of each load.

The users can choose their input metrics for the project gross area (Sqft and Sqm) and materials weight (kg or tonne). They are also able to input the diversion quantities either in percentage (%) or weight. A Unit Converter is attached to the forms, to help users transfer materials volume or area to weight. Providing these options not only facilitates the use of the forms, but also reduces some of the common errors resulting from inconsistent metrics.

3.1.3 C. Waste Diversion Report

The 'Waste Diversion Report' (see Figure 11) calculates the total amount of waste generated and diverted in the projects using the data from 'Waste Tracking Form' (see section 3.1.2). This form is optional for all projects in the hard copy version and will be automatically calculated in the electronic version. The form provides waste generation and diversion quantities by diversion type (i.e. reuse or recycle), and also by type of waste material. This form will also provide charts which compare the waste generation and diversion rates of the project with the benchmarks (see section 3.3.2) and goals. These visualizations (see Figure 1) will help contractors/subcontractors

to assess their performance at the end of the project and hopefully help motivate them to improve their performance in their future projects.

Analyzing the aggregate data from Waste Diversion Reports of all the projects studied provided us with insight into current construction waste management practices, particularly in special projects (from which minimal information is currently available). Further investigation of this data will also help to identify the areas that need further improvement. The analysis of this data is discussed in section 3.3.

3.2 Educational documents[5]

The contractors/subcontractors are provided with two brief educational documents. The first document presents some simple strategies they can incorporate in their project to maximize their waste diversion (See Figure 12). The second document intends to motivate the contractors/subcontractors by illustrating the economic savings of recycling compared to mixed loads delivery (see Figure 13).

3.3 Data analysis

An early data analysis was undertaken, using the data from 3 new construction projects and 6 renovation projects conducted in 2013-2014. This information was used to calculate the factors which are described in the following sections.

3.3.1 Total waste generation and diversion quantities

The collected data was used to calculate total waste generated, diverted, and landfilled by type of materials and type of project. This data shows that there is a considerable difference between the total diversion rate of the renovation and new construction projects studied (68% and 93% respectively). This implies a gap between the waste management performance in new construction and renovation projects, which suggests a need for further attention to CDR waste management in special projects. In section 3.3.2 benchmarks are developed to compare the two types of projects more accurately.

[5] Can be accessed at: http://www.technicalguidelines.ubc.ca/technical/sustainability html

Major waste material streams generated in the studied sample projects are concrete (52%), wood (16%), mixed waste (16%), and Metals (7%). However, a majority of the generated waste is diverted (88.6%). Mixed waste constitutes the largest proportion of the waste sent to the landfill (97%). According to the interviewees, this stream consists of small pieces of mixed materials, plastic, bonded systems, and food waste (see in section 2). However, there is a need for further investigation to identify the material types in the mixed waste stream and if there is a potential for further separation and diversion on-site or in transfer stations.

In a comparison of waste streams in new construction and renovation projects (Figure 2 and Figure 3), it is noticeable that new construction projects have better performance in separating waste streams, while in renovation projects a considerably larger proportion of mixed waste is generated. According to the interviews in section 2, in many cases this mixed waste is contaminated with unrecyclable garbage (such as food waste) and consequently cannot be recycled in transfer stations.

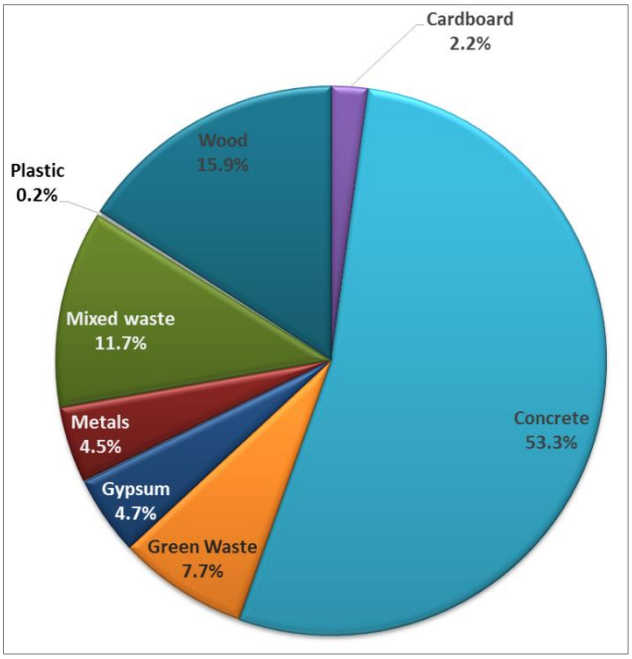

Figure 3 UBC case study new construction projects CDR waste generation by material type

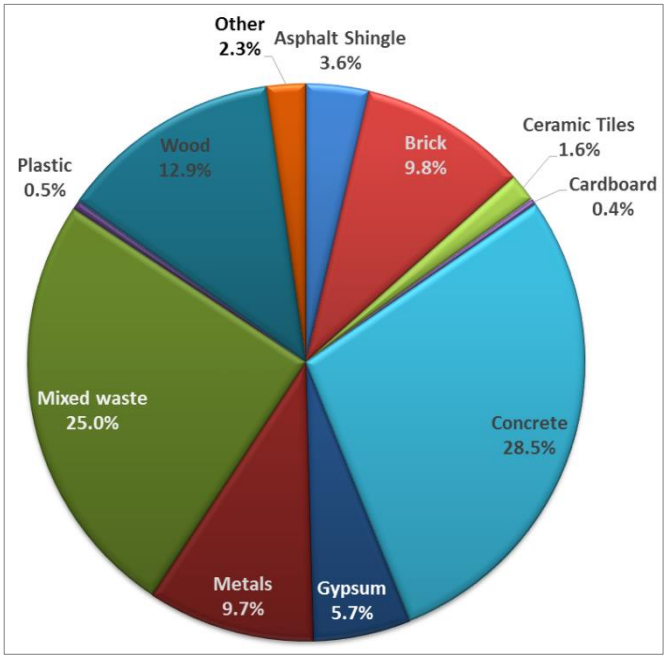

Figure 2 UBC case study renovation projects CDR waste generation by material type

3.3.2 Initial waste generation benchmarking

Using the available information from 3 new construction projects and 6 special projects, we calculated the average waste generation per square metre and per $1000 of construction cost for both new construction and renovation projects (see **Error! Reference source not found.** and Figure 5). It is noticeable that the average waste generation quantities are considerably larger in renovation projects compared to new construction. It was also mentioned in section 3.3.1 that diversion rate is significantly lower in renovation projects (68% vs. 93%).

None of the projects used in this benchmarking calculation included demolition, except for one of the new construction projects which covered foundation demolition. The demolition waste in this project considerably increased waste generation quantities and since demolition and construction phases were not separated in the report, it significantly raised the benchmark for

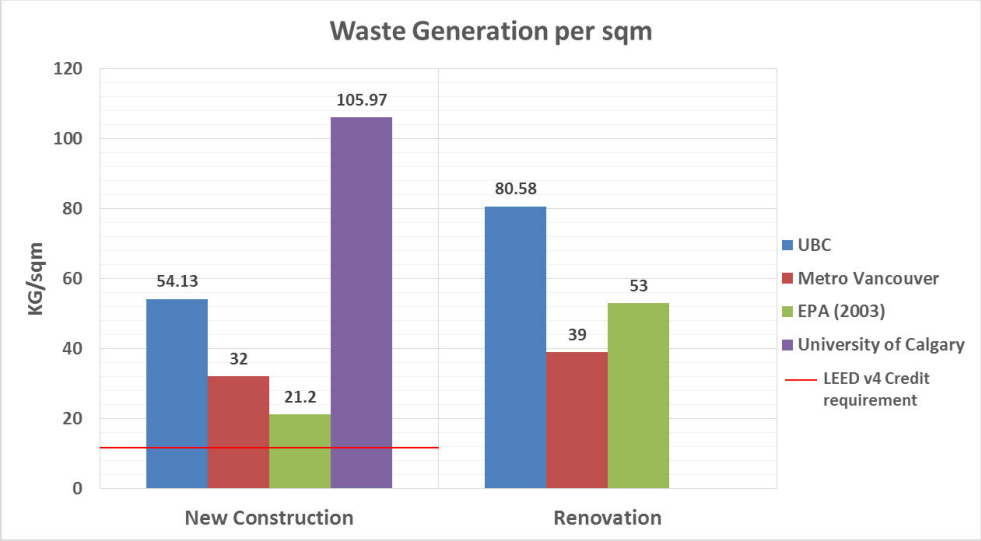

Figure 4 The comparison of average CDR waste generation per square meter of the UBC case study projects with similar studies (Baldick & Stoker, 2014; Greater Vancouver Regional District, 2008; US Environmenal Protection Agency (USEPA), 2009)

new projects. As more data is collected from new projects, the benchmarks will become more accurate.

The average waste generation per square metre was compared with the existing information in the literature. The waste generation average presented in the guideline provided by Greater Vancouver Regional District (2008) (12.3 kg/m^2) is for low-rise commercial projects and extracted from studies in the North America. The figures presented by US Environmenal Protection Agency (EPA) (2003) are based on a number of non-residential projects in different parts of North America. Baldick & Stoker, (2014) have presented average waste generation in a number of new construction projects on the campus of the University of Calgary. The red line in **Error! Reference source not found.** indicates the waste generation limits in LEED v4 for new construction projects to achieve 2 points credit for waste management (U.S. Green Building Council, 2014). It is noticeable that even in new construction on the UBC campus, which have a

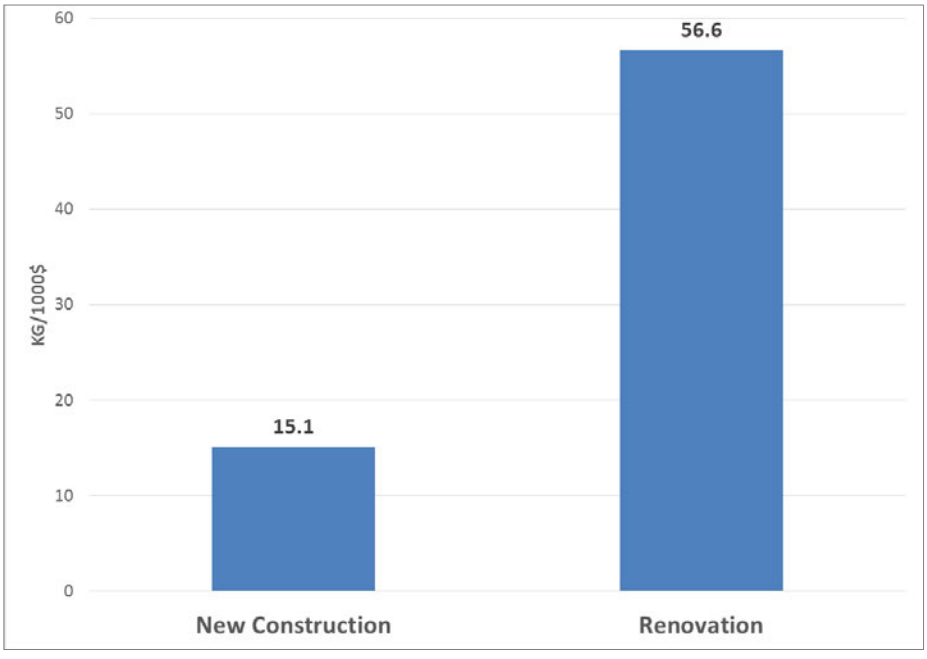

Figure 5 UBC case study average C&D waste generation per $1000 Construction Cost

minimum LEED Gold certification, waste generation rate in considerably higher than the requirement in the new version of LEED assessment system.

The average quantities were used in the the electronic version of 'Waste Diversion Report' (see 1section 3.1) as a benchmark against which waste generation performance of a project can be compared. In the electronic version of the Waste Diversion Report (see 3.1.3), the information used in the benchmarking charts (see Figure 1) is automatically adjusted to the selected type of projects and the preferred metric units.

At this stage, the benchmarking is limited to special projects, since the number of new construction projects was not enough to test the correlation. Moreover, this benchmarking information is based on a limited number of projects (six) from which waste tracking reports were available at the time of this study. The benchmarking should be updated periodically as more data is collected from UBC on-campus projects using the waste management forms presented in section 3.1.

In the next step, we tested the correlation between waste generation quantities and construction cost and project gross area using Statistical Package for the Social Sciences (SPSS) software (see **Error! Reference source not found.** and Table 2). The Pearson correlation coefficient test results[6] indicate that there is a significant correlation between construction cost and waste

[6] Pearson correlation coefficient is a measure for the strength of the relationship between two continuous variables. It can take a real value between -1 and 1. A negative value indicates an inverse relationship (Field, 2013).

generation quantity (r=.92, p<.008) in renovation projects. Also construction cost and project gross area of these projects have a significant correlation (r=.99, p<.012).

Table 1 Pearson Test: Waste generation and construction cost correlation in UBC case study special projects

		Generation	Cost
Generation	Pearson Correlation	1	.925**
	Sig. (2-tailed)		.008
	N	6	6
Cost	Pearson Correlation	.925**	1
	Sig. (2-tailed)	.008	
	N	6	6

** Correlation is significant at the 0.01 level (2-tailed).

Table 2 Pearson Test: Project area and construction cost correlation in UBC Renovation projects

		Cost	Area
Cost	Pearson Correlation	1	.921*
	Sig. (2-tailed)		.026
	N	5	5
Area	Pearson Correlation	.921*	1
	Sig. (2-tailed)	.026	
	N	5	6

* Correlation is significant at the 0.05 level (2-tailed).

School authorities can use the correlation between waste generation and construction cost to estimate waste generation quantities of the projects, when they do not have access to project waste tracking information (see Figure 6). Project gross floor area can be used to estimate project construction cost, when project construction cost is not available (see **Error! Reference source not found.**). Construction cost is suggested as the primary unit because during the data collection of this study, it was found out that it is easier to get access to the construction cost than gross

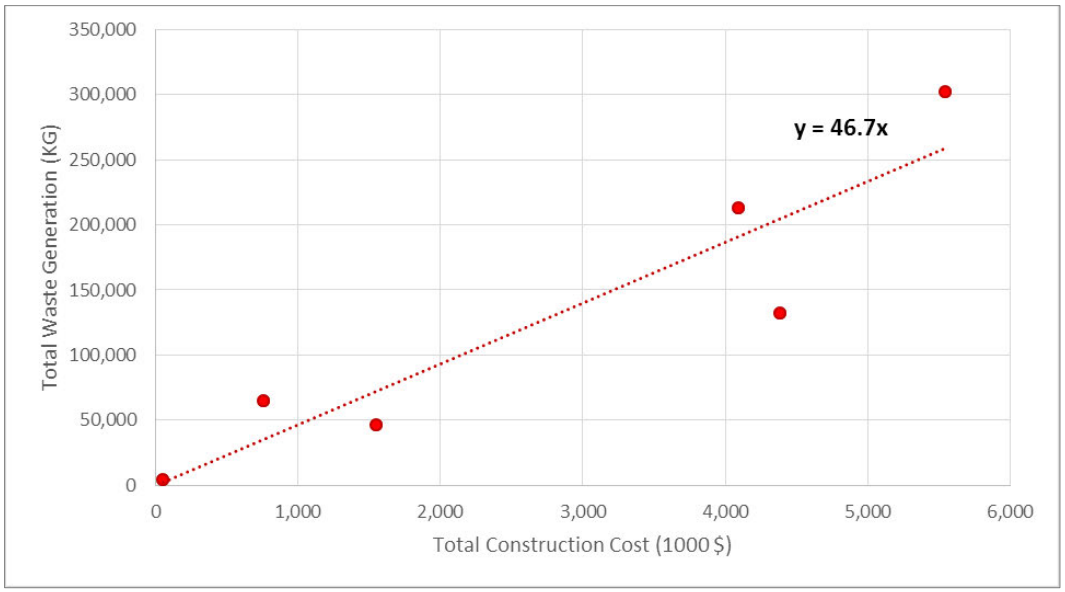

Figure 7 Waste generation and construction cost correlation in UBC case study special projects

floor area. Moreover, in some façade renovation projects there is no gross floor area assigned to the projects.

Using the project costs and the equation in Figure 6, waste generation quantity of the special projects that have been conducted in 2013-14 fiscal year was estimated (see Table 3). This is only an approximate estimation, because the correlation equation itself is based on a small

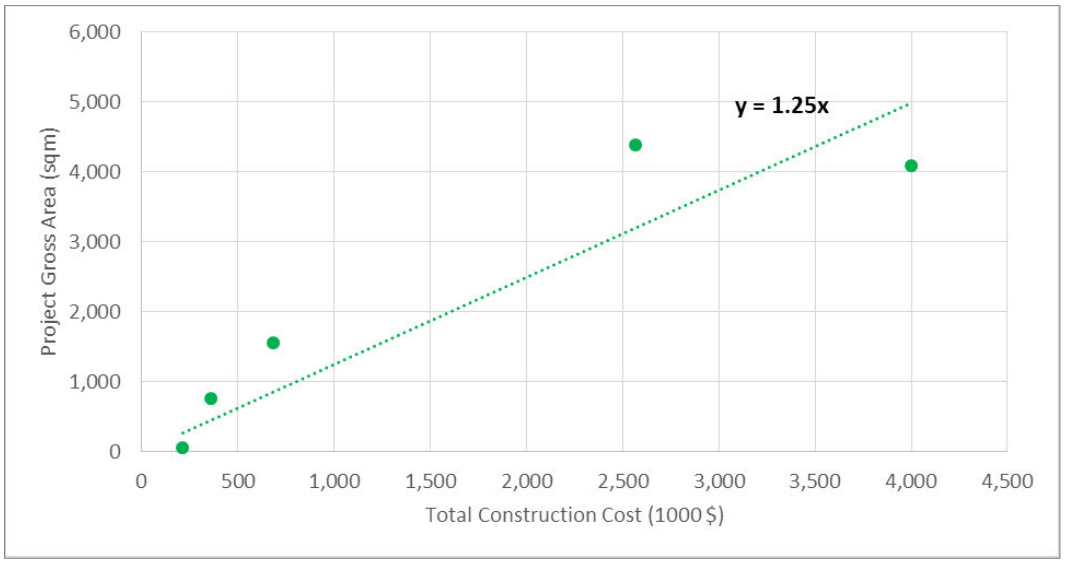

Figure 6 Waste generation and project gross area correlation in UBC case study special projects

number of projects. However, this estimation is valuable, as it gives the UBC authority a general understanding of the amount of waste generated in special projects. Figure 8 compares the estimated quantity of waste generated in special projects with new construction projects at UBC in 2013-2014 fiscal year.

Table 3 Waste Generation estimation of special projects in 2013-14 fiscal year

Project Type	Count	Construction cost ($)	Estimated waste generation (Kg)
Mechanical	4	1,277,619	-
Deconstruction & Construction	31	7,357,640	343,602
Construction	1	214,000	9,994
Total C&D projects	**32**	**7,571,640**	**353,596**
Total	**36**	**8,849,259**	-

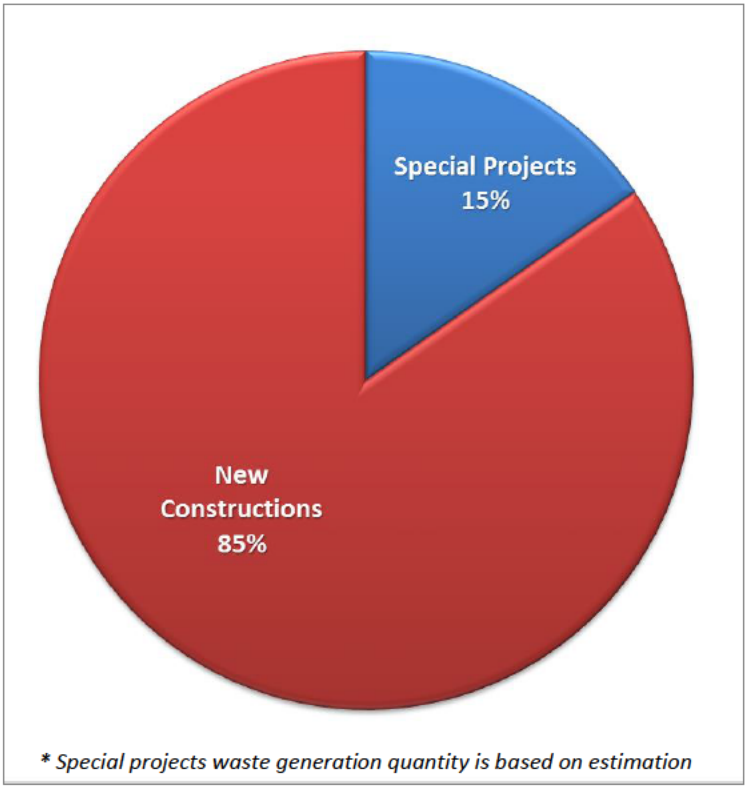

Figure 8 Comparison of total waste generated in new construction projects at UBC in in 2013-14 fiscal year with estimated waste generated in special projects in the same period of time

4 Future opportunities

There are further steps that can be taken by UBC in order to improve waste management within special projects, which are medium size renovation projects. Some of the following suggestions require more direct involvement of UBC departments. It is crucial to conduct a detailed cost benefit analysis of the below strategies to confirm their feasibility.

4.1 Facilitating on-site waste separation

UBC can help private contractors and waste manager subcontractors to separate waste on-site by:

- Providing small size bins, with clear signage indicating the type of waste that goes into each of them. These small bins are easy to fit in small sites and will help the contractor/subcontractor to haul small amounts of waste separately.

- Providing large construction sites with UBC recycling stations or bins which have a separate compost stream. This helps to prevent wet waste to be introduced into the mixed CDR waste bins.

4.2 Motivational measures

UBC can recognize the contractors' efforts to improve their waste management practices through measures such as announcing the best practice projects on the UBC website or issuing the contractors/subcontractors an appreciation certificate.

4.3 Assigning one waste manager to multiple projects on-campus

In the first phase of the study, waste management subcontractors stated that a challenge for small loads of separated waste is that if they carry them by one truck or pick-up, they have to unload the materials one by one and weigh the truck each time. This process can be time consuming and – in some transfer stations – costly. In this case delivering waste as a mixed load and paying the extra money to the transfer stations to separate the mixed waste might be a more reasonable option.

A solution is that UBC directly hire a limited number of waste manager/hauler companies for multiple projects on-campus. These contractors will be responsible for providing small bins to

the projects, collecting separated waste in a location on or off-campus, and hauling waste from various sites to the recycling facilities when the bins reach an acceptable quantity. Such a method will:

- Make separation of small waste quantities more viable
- Reduce dump fees by reducing cost for larger quantities and also for separated loads
- Require less space on campus for setting up large bins
- Promote on-site waste separation and consequently increase the diversion rate
- Make the process of waste tracking easier and more accurate

Another option is that UBC expand its current operational waste management service and cover CDR waste from special projects, by taking the responsibility of providing bins and hauling waste from these projects. This way waste management costs would be no longer included in bids. Instead UBC project managers would assign a waste management cost to each project, based on the size and its other characteristics. This cost would be paid to the UBC waste management service provider rather than being paid to contractors.

4.4 Mandating the use of on-campus transfer stations

UBC could expand the existing transfer station on-campus to accommodate larger quantities of CDR waste from special projects or establish a transfer station close to the campus and mandate projects to only use the UBC transfer station. This transfer station could maximize waste separation before taking it to the recycling facilities or provide waste recycling services. It could also be used as a lab for investigating new opportunities for waste diversion.

4.5 Using online waste tracking software

To make the process of waste tracking and reporting more accurate and easier, UBC plans to shift to a web based waste management software solution in future. These types of software are user-friendly and intuitive tools which provide data, charts, graphs and reports of CDR waste in real time. Metro Vancouver is promoting regional municipalities to adopt a region-wide software solution for the same purpose. Therefore, as UBC prefers to use the same software as the rest of the region, this initiative will remain on-hold until municipalities move forward with it.

4.6 Further research areas

Interviewees in the first phase of the study have stated that a challenge for them is finding a proper recycling facility. UBC can provide contractors with an updated list of recycling facilities and used material stores with high diversion rates, competitive fees, and a reasonable distances from UBC. This list could be provided as part of online software tools in the future.

UBC Sustainability & Engineering can also conduct further studies on the waste diversion potentials for the materials that are not currently being recycled, such as plastic, bonded systems, materials which are difficult to separate (for instance because of adhesives or nails), and specially mixed waste.

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Appendix A: Waste Management Forms

A. Waste Management Plan *(OPTIONAL for projects with total construction of less than $200,000)*

To be completed prior to project start-up

▶ *Forms can be accessed at:* http://www.technicalguidelines.ubc.ca/technical/sustainability.html

Project Name: **Project Type:** ☐ New Construction ☐ Renovation ☐ Demolition

Project Gross Area: ☐ Sqm ☐ Sqft Area: **Project Estimated Construction Value ($):**

Contractor's Name: **Contact person:** **Date Submitted:**

Waste Estimation

● *If needed, use the Unit Converter sheet to transfer material quantities from volume or area to weight.*

	A	B	C	D	E	F	G	H
	Type of Material	**Recycle / Disposal Facility** *to be used*	**Total Waste** *to be Generated*	**Percentage** *to be Diverted* **Reuse**	**Recycle**	**Total**	**Total Waste** *to be Diverted*	***For Information*** *Suggested*
						D + E	F * C /100	
		(Name)	☐ *KG* ☐ *Metric Ton*	*(%)*	*(%)*	*(%)*	☐ *KG* ☐ *Metric Ton*	*Diversion Process*
1	**Bricks**							Reuse or recycle
2	**Cardboard**							Recycle
3	**Carpeting & Underlay**							Reuse or recycle
4	**Ceramic (e.g. tiles)**							Reuse or recycle
5	**Clean fill & Soil**							Recycle
6	**Concrete**							Recycle
7	**Glass**							May be recycled
8	**Gypsum (Drywall)**							All must Recycle
9	**Insulation (e.g. foam, fibers)**							Reuse or recycle
10	**Metal**							Recycle
11	**Mixed Waste**							
12	**Paper**							Recycle
13	**Plastic**							Recycle
14	**Roofing (shingles, asphalt)**							Recycle
15	**Wood**							Recycle
16								
17								
18								
19			**Generate**	**Reuse**	**Recycle**		**Divert**	**Landfill**
20	**Total**	**Weight** (☐ KG ☐ Metric Ton)	**Sum** (Column C)	Sum(Di*Ci)/100	Sum(Ei*Ci)/100		D20 + E20	C20 - G20
21		**Percentage** *(%)* *(From total waste to be generated)*		D20/C20 *100	E20/ C20 *100		G20 /C20 * 100	H20 /C20 * 100

Figure 10 Form A: Waste Management Plan

Figure 11 Form B: Waste Tracking Form

B. Waste Tracking Form

To be completed during the project

Date Submitted:

▶ *Forms can be accessed at:* http://www.technicalguidelines.ubc.ca/technical/sustainability.html

Project Name: **Contractor's Name:** **Contact person:**

Project Type: ☐ New Construction ☐ Renovation ☐ Demolition **Project Gross Area:** ☐ Sqm ☐ Sqft **Project Construction Value ($):**

Demolition/Waste Subcontractor's Name: **Contact person:** **Phone:**

Waste Tracking

• *If needed, use the Unit Converter sheet to transfer material quantities from volume or area to weight.*

	Weight receipt number	Date Load Hauled			Recycle/Disposal Facility	Type of Materials	Total Waste Generated	Percentage of Waste Diverted			Total Waste Diverted
								Reuse	Recycle	Total	
	A	B			C	D	E	F	G	H	I
										F + G	H * E /100
	(from recycling/disposal facility)	*DD*	*MM*	*YYYY*	*(Name)*	*(See Form A)*	☐ *KG* ☐ *Metric Ton*	*(%)*	*(%)*	*(%)*	☐ *KG* ☐ *Metric Ton*
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											

Figure 12 Form C: Waste Diversion Report

University of British Columbia

Demolition and Construction Waste Management

C. Waste Diversion Report

To be completed at the end of the project

(In the electronic version, this form will be automatically filled using your inputs in Form B.)

▶ *Calculate the total amount of waste generated and diverted.*

▶ *Electronic (Excel) and hard copy (PDF) format of the forms can be accessed at:* http://www.technicalguidelines.ubc.ca/technical/sustainability.html

C.1. Project General Information

C.1.1. Project Information

Prepared By:		**Date Submitted (DD | MM | YYYY)**	
Project Name:		**Project Number:**	

C.1.2. Contractor Information

Contractor's Name:		**Email:**		**Phone :**	
Address: Street		City			

C.2. Waste Tracking Calculations *(The formulas may refer to **Section B.3** in Sheets B or the following section (**Section C.2**), in this form.*

	A	B	C	D
	C.2.1. Waste Generated and Diverted	**Total Waste Generated** *(Tonnes)*	**Total Waste Diverted** *(Tonnes)*	**Percentage of Waste Diverted** *(%)*
1	**Demolition Waste**	B.3 (Demolition Sheets): Sum (Column F)	B.3 (Demolition Sheets): Sum (K)	C.2: C1/B1*100
2	**Construction Waste**	B.3 (Construction Sheets): Sum (F)	B.3 (Construction Sheets): Sum (K)	C.2: C2/B2*100
3	**All Waste**	C.2: B1 + B2	C.2: C1 + C2	C.2: C3/B3*100

Appendix B: CDR waste educational documents for the stakeholders

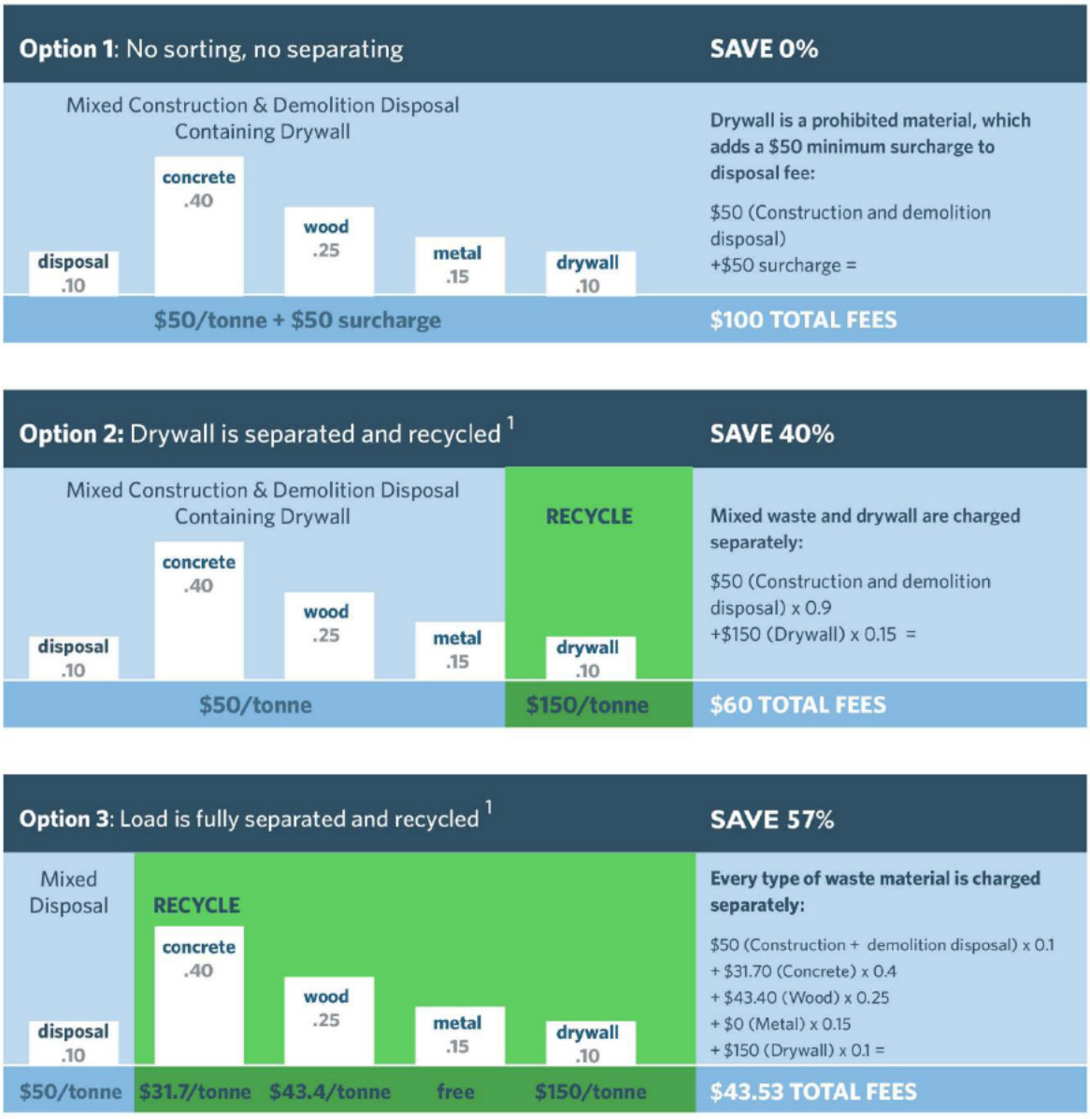
Simple Steps for Demolition and Construction Waste Diversion

		STRATEGIES	TOOLS[2]
1. ESTIMATE	Consult the salvage and demolition contractor early in the planning stage to: • Estimate amounts and types of wastes generated through each stage of a project. • Identify diversion opportunities on-site or off-site.	• A team consisting of the owner, architect, general contractor, and salvage/recycling specialists[1] should audit the building early in the planning stage to identify the salvageable and recyclable materials • Ensure that the salvage/demolition contractor is experienced in salvaging, professionally qualified, bonded and/or insured	C&D Waste Form A Waste Management Plan
2. SET TARGETS	Based on your estimates: • Establish the highest % waste diversion targets possible for each type of waste. (Target: minimum 75%)	• Check UBC's current policies for the overall diversion target for your project type[2] • Set clear and specific reducing, reusing/salvaging, and recycling targets for each type of waste material in your project	
3. PLAN	For each stage of the project, plan for: • Minimizing waste generation and maximizing recycling. • Best locations for recycling stations, and types of waste materials that will be collected separately.	• Work with suppliers that take back offcuts, and provide reusable or practicably recyclable packaging • Consider standardization and/or prefabrication to reduce offcut waste • Order the amount that is required to avoid surplus materials and avoid over packaged or easily damaged materials • Consider using bins with lids or added security (fencing/locks), particularly those near the public driveways, to avoid contamination or scavenging	
4. ENGAGE	Designate a party responsible to ensure that: • Recycling stations are well situated and signposted • All staff and subcontractors are briefed on the project waste diversion targets and strategies. • The staff and subcontractors ideas and feedback are appreciated.	• Locate recycling bins to where materials are generated, place recycling bins and garbage bins next to each other, and designate a specific eating area onsite • Signpost recycling stations, bins and piles using large, removeable, weatherproof signs, which clearly show what belongs in each bin/pile • Include waste reduction and recycling targets in subcontracts • Use meetings with subcontractors to reinforce commitments to waste diversion, a list of acceptable/unacceptable materials for recycling/reuse, and show them the recycling areas	
5. TRACK	Designate an on-site party responsible to: • Monitor and document waste management performance. • Inform all the site workers about waste management progress through talks and posters.	• Use the tracking forms to record all waste removed from the site • Review performance on a regular basis and plan for further actions if the targets and plans are not being achieved • Inspect bins on a regular basis to identify contamination problems • Keep a record of salvaging, recycling, and disposal receipts • Report waste management progress updates to on-site workers and subcontractors	C&D Waste Form B Waste Tracking
6. EVALUATE	• Compare your performance with your targets. • Get feedback from all the contributing stakeholders to identify the opportunities for future improvements.	• Investigate where you could do better and the reason why • Make sure that others in the project team contribute to the review and related learning points are disseminated to them • Please share your feedback and the lessons that you have learnt for your future projects with us. Let us know how we can help to facilitate your efforts.	C&D Waste Form C Diversion Report

Figure 13 Educational document: Simple strategies to maximize CDR waste diversion

Recycling C&D Waste: Reduce Your Tipping Fees

In this example, sorting and recycling a 1,000kg load can save up to 57% in fees compared to delivering a load of mixed waste to the waste facility. The example load contains 40kg of drywall, 150kg of metal, 250kg of wood, 400kg of concrete, and 100kg of non-recyclable refuse.



1. If separated loads are delivered using one vehicle, the vehicle will be rescaled each time one type of waste material is unloaded. Another option is to store each type of material in a yard and when it reaches the required quantity, deliver it with a separate vehicle.
2. In option 3, since the wood is fully separated, it can access a lower tipping fee at recycling facilities like Harvest Power and Barstan Fuels.

Figure 14 Educational document: potential economic savings by waste diversion rather than delivering mixed loads of waste to the landfills