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Construction Waste on Campus



Figure 1. Construction and demolition waste.

As concerns for climate change continue to gain attention, institutions are inclined to look into sustainable design. The creation of the Leadership in Energy and Environmental Design or LEED rating system for buildings and its growing popularity is a testament to this assertion. Consequently, many people have gained a better understanding of the features of sustainable design; however, a few of these ideas remain hidden from the limelight of “green” building. The recycling and reuse of construction and demolition waste (C&D waste) is one of these less popular attributes. Version 2.2 of *LEED® for New Construction & Major Renovations* has a section titled *Materials & Resources* that focuses for the most part on reducing waste that is

produced on-site and hauled to landfills during building projects. The primary requirement for the Materials and Resources section is to “provide an easily accessible area that serves the entire building and is dedicated to the collection and storage of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics and metals”¹. To gain one point toward LEED certification, this section requires that a construction project must “recycle and/or salvage at least 50% of non-hazardous construction and demolition debris” as well as developing and implementing “a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled”².



Figure 2. Logo of Waste Management Recycle America, the facility that collects recyclable commodities from surrounding areas, including the College’s C&D debris, then ships these materials in bulk to appropriate recycling facilities.

If project managers are feeling particularly ambitious, they can recycle 25% more (75% overall) of the afore mentioned debris for an additional point in the rating system³. Since it is possible to recycle up to 90% of C&D waste, this is not impossible. This goal becomes more complicated, however, once labor and energy cost efficiency are taken into consideration. Transporting waste large distances to recycling facilities can produce more pollution than transporting the waste to a landfill depending on the distance and the mode of transport. Fortunately, this is usually not the case, and the transport of waste to and disposal of waste in landfills often require more energy than does recycling waste. This is also true when comparing the energy required in using raw construction materials versus recycled ones. Using

¹ U.S. Green Building Council, *LEED® for New Construction & Major Renovations*, Version 2.2, 43, <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220>

² Ibid., 47.

³ Ibid., 48.

recycled materials often demands less energy than purchasing new supplies. These facts coupled with reports stating that construction waste alone—excluding demolition debris—accounts for 8% of the College’s total waste⁴ and nearly 20% of the total municipal solid waste produced by the United States make waste management on the construction site imperative for environmental sustainability⁵.

Although Williams College has yet to complete a LEED certified building on campus, it has been practicing C&D waste management on a gradually increasing scale for some time now. It is not known when the College first began to manage and recycle waste from building projects, but it likely began in earnest with the parking garage in Greylock quad since that is the first building that Barr and Barr, a construction management firm, built for the college. Barr and Barr has committed to a level of environmental sustainability on Williams campus constructions, spurred by pressure from the College. Unfortunately, Barr and Barr did not begin documenting C&D waste until the demolition of Baxter Hall and the construction of Paresky Center --due to a change in mandates from Hopkins Hall and Facilities. Recently Barr and Barr has begun the North and South Academic building project which is to be LEED certified, ensuring that the C&D waste will be well taken care of and recorded by both the firm and the College (Figure 3). Since there is little demolition taking place in the North and South Academic building project (disregarding the Stetson Sawyer part of the project), this paper will focus on recycling and reuse of construction waste.

⁴ White, 3.

⁵ Ibid., 1.



Figure 3. Rolloff dumpster for mixed C&D waste on the construction site of the North and South Academic Buildings. This is one example of how Barr and Barr has committed to managing its construction waste.

Before analyzing what happens to the waste that leaves the North and South Academic building, it is crucial to understand its composition. On the whole, construction waste typically comes from scrap material and packaging. By scrap materials, I mean any left over pieces of material used to construct the building. To cover exactly what types of scraps come out of a construction site effectively, a level-by-level analysis of a building is ideal.⁶

Beginning with the basement or the below-grade levels, the primary wall and floor components are concrete, steel rebar, and steel mesh. Steel rebar and steel mesh are reinforcement elements for the concrete. On the exterior of these basement walls tar and foam boards are applied for waterproofing and insulation respectively. The basement typically holds the mechanics of a building such as the furnace, hot water heater, fuse box, and so on. Although none of these appliances themselves produce construction waste, their attachments do. By attachments I mean piping and wiring. Piping is generally made of either metal or plastic. Copper, steel, and galvanized steel (steel covered with a zinc coat to prevent rust) make up the

⁶ See Table 1.

bulk of the piping market but plastic piping made of PVC is widely used as well. Wiring is somewhat diverse in terms of materials since it may vary given the conditions under which it is required to operate. By and large however, wire is usually composed of the metals aluminum and copper with some sort of plastic or rubber sheathing. These are the most elemental basics of the sublevel floors.



Figure 4. Photograph of the digging of the foundation for the South Academic Building. Possible materials that could be diverted from disposal in this photograph include concrete, wood beams, metal piping, copper wire, and plastic packaging. See Table 1 for a more comprehensive list of construction and demolition debris.

Table 1. Breakdown of Construction and Demolition Waste for Williams College’s North & South Academic Building Project: Scrap Materials and Packaging.

Purpose of Scrap Materials	Scrap Materials Used
<i>Roofing</i>	Metal, wood, slate, asphalt
<i>Interior</i>	Plasterboards—gypsum, paper
	Flooring tiles—wood, plastic, rubber, slate
	Wiring—metal, rubber, plastic
	Piping—plastic, ceramic
<i>Exterior</i>	Brick, stone, lumber, vinyl
<i>Structural</i>	Studs—wood, metal
	Supports and Beams—wood, steel
Purpose of Packaging Materials	Packaging Materials Used
<i>Wrappings</i>	Plastic
<i>Packing Fill</i>	Styrofoam, Plastic
<i>Pallets</i>	Wood
<i>Containers</i>	Wood, Cardboard, Plastic

Some sublevels are used for other purposes other than housing the mechanics of the building; for instance, Paresky Center uses part of its sublevel area for a bar, recreation area, theater, and deli. If this is the case, then much of the material used to create these interior spaces are the same as those of the above ground interior spaces. Support for these upper levels usually comes from wood, steel I-beams, or reinforced concrete. Steel decking or plywood is then laid down over these supporting elements. Flooring is highly varied and can be made of anything from stone to synthetic polymers. More specifically flooring includes stone slates, hardwoods, ceramic tiles, carpeting, laminates, vinyl, and linoleum. The synthetic nature of vinyl flooring comes from its chlorinated petrochemical base, thus rendering it as very unfriendly to the environment⁷. Contrary to belief however, linoleum flooring is not the same case. Since it is made of renewable all-natural ingredients, this flooring type is considered to be more environmentally friendly than both laminates and vinyl and in some cases hardwoods (depending

⁷ Cynthia Sanz, “Linoleum Lives On,” *This Old House*, 1, <http://www.thisoldhouse.com/toh/article/0,,202857,00.html>

on whether the hardwoods are treated with some sort of chemical)⁸. Moving from the floor to the interior walls, we encounter quite a different assortment of materials. Evenly spaced vertical posts that are called studs typically support these interior walls. These studs are either metal (aluminum or steel) or wood. To cover this framing, materials such as gypsum wallboard, wood, or some type of vinyl wallboard is used. This is very much the same for the ceiling as well. In addition, the interiors of both the wall and ceiling likely have wire and piping running through them. The construction of built-in furniture, counters, storage space, and so on are likely to produce scrap lumber in most cases. The exterior walls often produce scrap material in masonry, stone, brick, concrete, lumber, some types of metal, and in minimal cases vinyl siding. Insulation is another factor to be considered in exterior walling. While insulation is made of a variety of different materials, most of it is synthetic like fiberglass and polystyrene.

The roof of a structure begins with steel or wooden supports that hold up either steel decking or plywood. Some sort of waterproofing material is then laid on top. This material is often tarpaper. It is often determined by whether the roof is flat or pitched as to what goes on top of the tarpaper. Flat roofs are generally covered in tar and gravel or some kind of synthetic rubber membrane. Pitched roofs however, have a much wider range of options. Metals such as copper and aluminum are popular as well as asphalt shingles, ceramic tiles, or wooden shakes.

⁸ Ibid, 1.



Figure 5. Additional examples of both scrap materials and packaging waste from the North and South Academic Buildings construction site.

Although I certainly haven't covered everything that might produce scrap material on a construction site, this is a fairly thorough overview. To sum it up in a more succinct manner, these materials include metals such as steel, galvanized steel, copper, aluminum or stone that may come in the form of slate flooring, slate roofing, countertops, bench tops, and so on. Other material scraps consist of lumber, ceramic tiles, laminates, linoleum, carpeting, vinyl wallboard, gypsum wallboard, insulation, rubber, plastic, synthetic membranes, asphalt shingles, and tar. Contrary to what facts may imply, leftover brick, masonry, concrete, and gravel do not make of the bulk of construction scraps or leftovers. Waste management currently measures C&D waste by weight and since masonry, concrete, etc. are heavy materials they may achieve high weight measurements with much less volume than, for instance, wood. It is true however the demolition waste can produce large quantities of concrete rubble and whatnot. Aside from construction scraps, building projects produce a surprising amount of packaging material waste.

Packaging material used to protect glass windows, furniture, appliances, and utilities usually consist of cardboard, wood, or plastic. Some of this packaging can be returned to the appropriate company for reuse. For instance, some quarries will take back the wooden pallets on which they transport stack stones for further use. For the most part, the plastic and the cardboard are recycled.



Figure 6. Allied Waste Services hauls the sorted waste from the North-South Academic Building construction.

The collection of construction waste is a relatively simple enterprise. The difficulty comes in figuring out where to ship this waste and how to ship it efficiently. For the North and South academic building project, Barr and Barr has signed an agreement with Allied Waste Services concerning the collection and shipping of the waste. Allied Waste Services is a waste management company that specializes in the collection and transportation of solid waste. The collection system employed by the company is a fairly simple process that involves a series of dumpsters provided by Allied Waste. Each of the dumpsters is designated for a certain type of construction waste including plastic, clean metal, cardboard, and commingled construction and demolition debris (mixed C&D).



Figure 7. Example of on-site sorting of recyclable C&D waste. Allied Waste designates dumpsters for different types of waste.

Collecting scraps and packaging waste is both a less intensive and cleaner process than sorting demolition debris. When the rolloff dumpsters are full, Allied Waste Services picks them up to be taken to recycling centers such as the WM Recycle America facility in Springfield, MA. These recycling centers provide further collection and distribution allowing for the efficient transportation of waste. For example, the recycle centers ensure that a constant stream of fully loaded transportation containers is sent to facilities that reprocess or reuse the waste. This system of collection and distribution firms ensure that C&D waste is handled in an efficient and reasonable manner.

As of March 2008, Allied Waste Services has collected 448.04 tons of construction waste from the North and South Academic building project⁹. This figure does not include the 369 tons of brick and concrete waste produced by J.H. Maxymillian, Inc.'s site work of road and sidewalk

⁹ Douglas Schlaefter from Barr and Barr, interview by author, Williamstown, MA, April, 2008.

removal, all of which were recycled¹⁰. Of the 448.04 tons of waste managed by Allied Waste Services, 251.01 tons came from commingled C&D (miscellaneous category of construction material), 126 tons from concrete and brick, 7.88 tons from plastic, 44.01 tons from steel, and 19.14 tons from cardboard¹¹. All of these, with the exception of commingled C&D waste, were recycled 100%¹². Only 25% of the commingled C&D waste was recycled since it probably contains materials such as synthetic membranes that are hard to recycle or hazardous materials¹³. Barr and Barr categorizes and reports C&D recycling to the College on a monthly basis (Table 2).

Table 2. Recycled materials from the construction of the Williams College North & South Academic Buildings (courtesy of Allied Waste Industries, Inc.).

Type of Waste	Tons	% Recycled	Tons Recycled
Commingled C&D Totals	251.01	25.00%	62.75
Recycled Concrete/ Brick Totals	126.00	100.00%	126.00
Recycled Plastic Totals	7.88	100.00%	7.88
Recycled Steel Totals	44.01	100.00%	44.01
Recycled Cardboard (OCC) Totals	19.14	100.00%	19.14
PROJECT TOTALS	448.04	57.09%	259.78

With 57.98 percent of the C&D waste recycled, the project is on track to receive at least one point toward its LEED Certification. According to Barr and Barr the project is doing well since it was originally projected to recycle only 50% of its C&D waste.

In addition to recycling and reusing C&D waste from the North and South Academic buildings, Barr and Barr has made efforts to reduce potential waste from even reaching the

¹⁰ Ibid.

¹¹ Ibid.

¹² Ibid.

¹³ Ibid.

construction site. For instance, carpets are pre-ordered in the dimensions of the rooms that they will be used in, reducing the amount of scraps produced by cutting down carpets to fit certain rooms. Ordering materials as accurately as possible is crucial to reducing unnecessary waste from materials—especially those that are difficult to recycle, such as paint, tar, lumber, etc. If planned carefully, reducing waste at the source is both practical and efficient and is the first logical step toward overall minimization of waste.



Figure 8. Gypsum recycling center.

As well as recycling C&D waste and feeding the supply market, the College is strengthening the demand as well by using recycled content material in the construction of the North and South Academic buildings. Recycled content material is typically material that is composed or partially composed of recycled material. Currently the college is using recycled content metal studs, rebar, lean concrete, bricks, bar steel, steel decks, copper roofing, fire proofing, wood doors, gypsum, and carpets¹⁴. The use of these materials is critical in perpetuating recycling. Fortunately, Barr and Barr has no complaints concerning these materials. Hopefully this will remain the case in the future.

The C&D waste stream coming out of the North and South Academic buildings is well documented by Barr and Barr and a fair amount of the debris is recycled. There is some ambiguity as to what comprises the commingled waste category, but it is likely that better measures could be taken toward recycling it. Aside from this, the project has a decent record in

¹⁴ Ibid.

C&D waste management. With this in mind, it seems that the smaller projects on campus are the ones that need more attention in waste management. It is difficult to reduce land filled waste from small projects for several reasons. The lack of large firms to manage specialized areas leaves no one to focus solely on managing the waste from the project. Other problems include the lack of efficiency and feasibility in transporting small quantities of certain waste materials to distant and diverse locations. Although these loads may seem small individually, they build up significantly over time. To combat this problem, the College might hire an individual as a specialist of solid waste management on campus. This person could initiate a reduction in land filled construction waste coming from the college. One initiative could be closer monitoring of College dumpster bins. While rolloff dumpsters do exist at the campus Agway for different waste streams--including construction and demolition debris--, these bins often end up in landfills, because they are contaminated with non-recyclable materials due to poor labeling and supervision. On the whole Williams College does not fare badly when it comes to managing its construction waste; however, we could improve significantly if we give it greater priority. And the considerable volume and cost related to hauling and disposing and/or recycling of construction waste strongly suggests that we do so.

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