Construction Waste Reduction and Recycling

A demonstration of how construction waste can be recycled in a downtown location with space constraints.

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An overall demolition recycling rate of 55 percent was achieved over 21 months beginning in June 2001 at a major downtown construction project in Madison, WI, easily eclipsing the 35 percent goal. The Wisconsin Department of Natural Resources grant period is now complete, but recycling operations will continue through the end of Phase II construction due for completion in 2006.

Construction of the 385,000 sq ft Overture Center—which will provide a venue for Madison's local arts organizations—began in June 2001. The general contractor, J. H. Findorff & Son, Inc., hired WasteCap Wisconsin to manage the construction waste recycling efforts and WasteCap Wisconsin hired Madison Environmental Group as the on-site recycling manager. WasteCap Wisconsin (www.wastecapwi.org) is a nonprofit organization which provides waste reduction and recycling assistance for businesses.

The scope of the work for the waste reduction and recycling demonstration grant included the following: locate and label containers, instruct and educate employees and subcontractors, monitor trash and recycling bins for compliance, summarize waste results, evaluate the construction waste management results, evaluate the project economically, and share the results. Local markets for various recyclable materials were also investigated.

Over the course of the project, Findorff has recycled concrete (including brick and block), wood, drywall, metal, cardboard, white paper, newspaper, and comingled cans and bottles. Large-volume materials (concrete, wood, metal, drywall, and trash) were collected in dumpsters ranging from 10 to 30 cu yd. Cardboard was collected in smaller 2-cu yd as well as 6-cu yd containers with lids to keep the cardboard dry.

Until summer 2003, there was no recycling signage at these containers and recyclables were always deposited properly. In May and June 2003, when nearby Mifflin Street was reopened to traffic, three containers (wood, trash, and metal) were moved and workers on-site decided to label them at their new locations to avoid confusion about where recyclables should go.

One of the ways ongoing results of the project were shared with the public was through the use of onsite signage showing materials recycled and goals.

Smaller volume materials (white paper, newspaper, and cans and bottles) were collected in smaller containers. White paper (mostly drafting plans) was collected in two 90-gal plastic containers with wheels at the on-site office and at the Overture office across the street from the construction site. Newspaper was collected in clearly labeled plastic bins and in cardboard boxes in lunch and break areas. Cans and bottles were collected at recycling stations in lunch and break areas and at several high-traffic locations around the work site. Each of these stations had a pair of 30-gal plastic containers clearly labeled for recycling and for trash located next to each other.

In addition, up to 14 "break room" recycling stations were established for newspaper, cans and bottles, and trash. These stations were periodically moved as construction activities changed.

Since recycling began in 2002, new recycling markets were identified for shredded paper, Styrofoam beadboard, "rebond" polyurethane foam, and drywall, and a new market was developed for recycled wood when the previous hauler and processor went out of business.

Drywall was collected at the Overture site for about six weeks in May and June as part of the pilot drywall recycling project. We worked with Royster Clark (a retail and wholesale distributor of mixed fertilizer, fertilizer materials, seed, crop protection products, and agronomic services to farmers) to produce an agricultural-grade gypsum product from scrap drywall, which the company used on a trial basis as an alternative to com-

mercially purchased agricultural gypsum in its manufacturing operations. Type X, or "Firecode C" drywall—the type of drywall used most extensively in commercial construction—was separated, ground, screened, and used to manufacture fertilizer. Other types of drywall, such as green board, blue board, and Dens Glass, contain paraffin or more than one percent fiberglass. The effect of these materials on fertilizer production was unknown so they were not separated for recycling.

For the pilot project, WasteCap coordinated drywall collection from Overture and Don Simon Homes. Pellitteri Waste Systems hauled the drywall to Royster Clark's manufacturing facility on the east side of Madison. Sixty-two tons of drywall were collected for the pilot. Tests were conducted in both May and June 2003 that evaluated different grinding and screening equipment. The pilot test was successful and Royster Clark successfully manufactured SulfaCal, one of their fertilizer products, using the ground and screened drywall. Altogether, less than 15 tons of drywall were recycled from Overture due to the capacity limitations of the pilot project.

Instruct and Educate

In April 2002, an Earth Day event was held to share recycling information and introduce the recycling program to employees. At that time, the program was presented at one of Findorff's weekly "tool box" meetings for all site workers and at a weekly foremen's meeting. Subcontractors' workers were also educated about the recycling program.

On November 15, 2002, America Recycles Day, an appreciation luncheon was held for construction workers on the job site. At that lunch current recycling rates were posted and employees were congratulated for their success. Rates were periodically updated so workers could see the recycling increase over time.

Regular site visits two to four times a month offered many opportunities to communicate with workers about recycling and to answer questions about specific materials. Many workers were interested in learning what happened to the recycled materials after they left the site. Workers on-site were pleased with their successful recycling operations and a high level of support for recycling among construction workers was observed. Workers were also interested in knowing what other construction jobs in the community were recycling.

Throughout the recycling project, the on-site recycling managers met with the foremen about once a month to get their feedback and answer questions. The Findorff superintendent and foremen also updated the on-site recycling managers on the construction activities and notified them about changes in materials to be generated on the site. These updates were important so that we could identify markets for new materials that could be recyclable.

As construction work evolved on-site, new Findorff crews and subcontractor crews periodically arrived, all of which had to be kept current on the recycling operations. Regular site visits by on-site managers helped maintain recycling operations. During a high turnover period in the summer 2003, new workers were introduced to the recycling program. They were updated as to which materials were being recycled and where to get their recycling questions answered.

Before Mifflin Street was reopened, the drywall container was located at the corner of Mifflin and Henry streets, adjacent to a fence. Some contamination with waste materials occurred when waste materials were thrown over the fence into the container (Contamination was defined as any material placed in the wrong container for disposal.) After the large containers were moved to Mifflin Street, minor contamination occurred again, most likely due to confusion among workers who mistook them for trash containers. On-site personnel responded to this situation by creating spray-painted plywood signs for all large containers. Also, on-site personal communication with workers was increased so they were fully updated on the recycling operations.

In general, Findorff's operations minimized contamination by collecting recyclable waste materials in 1-yd carts throughout the work site and transferring material from those carts into large 20- or 30-yd containers. Using small containers for intermediate collection provided an opportunity for workers to identify any contamination and remove it before transferring material to the large dumpsters.

In lunch and break areas, contamination problems were minimized by eliminating isolated trash containers and ensuring that trash and recycling bins were always placed adjacent to one another.

Records from haulers and processors were collected to document the weight of trash and recyclable materials from the work site. Newspapers and cans and bottles recycled curbside were weighed before being placed on the curb. A small amount of material was occasionally taken off-site for recycling or reuse as opposed to being placed in the containers. Monthly summaries were created from these records to report the quantity of each material recycled and reused. The recycling process was also documented through photographs.

Off-site reuse and recycling was by far the most difficult category of material to track and document. These materials were removed by many different parties and in small quantities that were not often measured. Sometimes the general contractor removed reusable material to take to another job site, and sometimes subcontractors returned reusable or recyclable materials to their own shops. Examples include plastic buckets, scrap metal, or wooden spools used for electrical wire. These activities were revealed through discussions with workers and foremen on the job site.

In February 2003 we developed a Reuse Tracking Form that allowed workers or foremen to record materials being removed from the job site for reuse or recycling. Foremen did occasionally report off-site reuse or recycling, but it is likely that other reuse and recycling occurred that was not discovered. Not everyone on the job was aware of the Reuse Tracking Form, and there were numerous subcontractors who did not know about the tracking efforts who might have taken materials back to their own shops for reuse or recycling. Weekly site visits to the project were not

enough to learn about all these materials. As a result, off-site reuse and recycling estimates are conservative.

From April 2002 to December 2003, concrete accounted for the highest proportion of recycled materials by weight. As aforementioned, the 55 percent recycling rate for the 21-month project period from April 2002 to December 2003 was 55 percent, which exceeded the project goal of 35 percent. This recycling rate include the disposal of material from the deconstruction of the Yost Facade on State Street. The reinforced concrete from the facade was not recyclable and was disposed of in an approved fill site.

Overall, participants were pleased with the methods developed to collect, transfer, and haul materials from the site. Recycling proceeded smoothly in spite of the challenges of limited space and uncertain markets. In October 2002, three signs were posted on the fence surrounding the construction site to publicize the recycling program and show the results month by month. Also, the initial collection system for the on-site lunchroom was improved by placing each trash container adjacent to a recycling container and by replacing a recycling station that took up too much space with a smaller one on wheels.

Results of the project were shared through a combination of television news coverage, tours, radio interviews, newspaper articles, project site signage, conference presentations, e-mail bulletins, and web updates at www.findorff.com.

Economic Evaluation

Data were collected from haulers and processors regarding their hauling and disposal fees for trash and recyclable materials, as well as rebates for materials where applicable. (See Table 1.) For comparison, Table 2 shows projected costs for disposal if no recycling program was in place and if all waste was sent to a landfill. The volume and weight used to calculate hauling costs is based on disposal records during the 21-month period from April 2002 to December 2003. Based on the projected costs in Table 2 and the actual costs in Table 1, savings due to recycling is calculated as $28,633 ($108,758 estimated disposal costs without recycling minus $80,125 actual disposal costs with recycling.) This amounts to 26 percent savings in disposal costs over the 21-month period from April 2002 to December 2003. GE

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Table 1. Summary of Disposal Costs

Material	Amount (tons)	Disposal Fees ($)	Cost/Ton ($)
Concrete and Brick	1,234.96	8,400.00	6.80
Wood	422.74	24,070.00	83.26
Metal[1]	255.66	(248).00	(0.97)
Drywall	14.34	620.00	43.24
White Paper[2]	14.12	102.00	7.27
Cardboard[2]	23.02	165.00	7.17
Newspaper	1.30	0.00	0.00
Cans and Bottles	1.79	0.00	0.00
Shredded Paper	0.11	0.00	0.00
Styrofoam	0.02	0.00	0.00
Polyurethane Foam	2.04	0.00	0.00
Total Recycling	**1,970.10**	**33,109.00**	**16.81**
Trash	884.11	40,216.00	45.49
Fill Waste[3]	712.59	3,529.00	4.95
Total Landfilled (Trash + Fill Waste)	**1,596.70**	**43,745.00**	**27.39**
Other Fees		3,271.00	
Totals at 55 Percent Recycling	**3,566.80**	**80,125.00**	

[1] Hauling fees totaled $5,550 but rebate for scrap metal is $25/ton or $5,798 resulting in a net gain of $248.

[2] After the original cardboard hauler was purchased, the new cardboard hauler instituted a hauling charge for paper and cardboard. Until July 2003, there was no charge for paper or cardboard hauling.

[3] This figure includes 518.32 tons of reinforced concrete from deconstruction of the Yost Facade and 194.32 tons of other concrete not recyclable.

Table 2. Estimated Waste Disposal Costs Without Recycling

Disposal Data	Estimated Disposal Quantities and Costs Without Recycling (April 2002-December 2003)
Total tons of waste (excluding fill[1])	2,854
Total volume of waste (cu yd)	10,822
Number of hauls (Total cu yd @ 30 cu yd/haul)	361
Hauling fees[2] ($72 per 30 cu yd haul)	$25,992
Tipping fees[3] ($29/ton)	$82,766
Total disposal costs if 0 percent recycling (hauling plus tipping)	**$108,758**

[1] The deconstruction waste (712.59) tons that was disposed of in an aproved fill site is excluded from this estimate because it is unlikely that a large amount of this material would ever be disposed of in a municipal landfill. We therefore did not include the $29/ton tipping fee for this material in our estimated disposal costs.

[2] Hauling fees are based on current rates from our trash hauler.

[3] Tipping fees are based on tipping rates paid for trash disposal from this job site.