# Construction and Demolition

## Best Practices and Case Studies

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</tbody>
</table>

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1. Require a waste management plan from the contractor
   Include language in RFP
   Require that subcontractors separate waste (set up labeled bins)
   Or: Seek a waste hauler that obtains recyclables from co-mingled waste

2. Use modular or prefab construction materials

3. Replace cement in concrete with flyash

4. Use reusable forms for concrete

5. Make sure the entire project team is up-to-speed with the high performance/sustainable objectives
   Require LEED training for all trades on-site

6. All HVAC ductwork should be externally insulated to prevent the growth of bacteria and mold
   Ductwork should be sealed & covered prior to & during installation to prevent contamination from construction dirt & debris

7. Construction and demolition materials that can be recycled or reused
   *Local Vendor list is provided in this section*
   - Asphalt
   - Beverage Containers
   - Brick
   - Cardboard
   - Carpet
   - Ceiling Tiles
   - Concrete
   - Foam Insulation
   - Glass - windows
   - Gypsum Board/Wall Board
   - Land-clearing Debris
   - Metal - plumbing fixtures, wires
   - Wood - doors, beams
Materials and Resources

**Best Practice #1: Require a waste management plan from the contractor**

**Credit 2. Construction Waste Management**

I. **RFP Language - General**

The language used in RFPs should reflect the overall objectives of the building process. Potential subcontractors should be made aware of the subtleties of the RSB building that may vary from other projects. In addition, the language should 1) explicitly identify quantifiable minimums (including LEED objectives), 2) encourage innovation and cost-effectiveness, and 3) provide real examples of past successes if possible.

*Example 1:*

"UofM RSB has a goal to be an environmentally-sensitive company. In your proposal, please explain your policy and approach toward assisting UofM RSB meet its corporate goal on this specific project."

*Example 2:*

“For the new RSB building, we are dedicated to achieving at least 75% recycling of demolished materials, and expect this minimum from any contractor employed. Our goal is to achieve as high a recycling rate as possible, and encourage contractors to be creative in providing cost-effective and innovative methods to exceed expectations. Other construction projects stand as successful examples, having shown exceptional accomplishments in this area. These include Middlebury College’s new library that recycled over 97% of deconstructed materials."

II. **RFP Language - Tracking Waste**

In order to comply with LEED, subcontractors need to capture additional waste data. It is best if this is completed while performing the construction and demolition.

Information should be collected regularly (e.g. monthly) from subcontractors. The detailed breakdown for each material disposed should indicate if it was:

a. Recycled
b. Salvaged, including reused on site
c. Sent for hazardous waste disposal
d. Sent to a landfill

It should also include information about:

a. Hauling Cost
b. Weight
c. Origin location
d. End location

*Example:* A subcontractor’s RFP response and sample tracking form can be found on the next page.
**Construction Waste Management**

**Credit (3) points; Recycle % (90 or higher)**

XX Construction with coordination of each Subcontractor shall provide labeled recycle containers for all recyclable debris. The containers shall be located within close proximity to the area that the debris is generated. XX Construction as well as each Subcontractor shall track all material leaving the jobsite (i.e., reused material, landfill material, and hazardous waste material) by means of a material tracking system.

XX Construction shall provide all containers for the use of general trash collection.

XX Construction / Subcontractors shall recycle, salvage, reuse, and/or donate a minimum of ninety percent (90%), by volume of the total construction and demolition waste, less hazardous waste material, generated during

All Subcontractors shall provide to XX Construction the following submittals on the submittal dates identified:

a. Construction Waste Management Plan prior to any construction site activities
b. Construction Waste Monthly Reports
   1. Subcontractor cost’s of disposing of construction waste materials.
   2. A detailed breakdown by weight of each material type disposed of as follows:
   3. Recycling
   4. Salvage, including reuse on site
   5. Hazardous waste disposal
   6. Landfill

This information shall be provided to XX Construction as necessary according to XX Construction.

XX Construction shall track above-mentioned information by means of electronic spreadsheet.

**Sample Recycle Debris Tracking form:**

<table>
<thead>
<tr>
<th>Date:</th>
<th>Container Size</th>
<th>Material Weight (lbs)</th>
<th>Company</th>
<th>Card Board</th>
<th>Metal</th>
<th>Wood / Landscape</th>
<th>Plastic</th>
<th>Aluminum</th>
<th>Mix Paper</th>
<th>General Trash</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/23/2000</td>
<td>3yrd</td>
<td>350</td>
<td>xyz</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6/1/2000</td>
<td>40 yrd</td>
<td>500</td>
<td>abc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>N/A</td>
<td>850</td>
<td>N/A</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td><strong>TOTALS:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

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**Materials and Resources**

| Best Practice #1: Require a waste management plan from the contractor |
| Best Practice #5: Make sure the entire project team is up-to-speed with the high performance/sustainable objectives |

| Credit 2 | **Construction Waste Management** |
| Thoreau Center for Sustainability |

| Location: San Francisco, CA |
| Building type(s): Commercial office |
| Renovation of a historic 1899 building, last renovated in 1933 |
| 73,000 sq. feet (6,780 sq. meters) |
| Urban setting |
| Rating: Green Building Challenge |

At the Thoreau Center, Plant Construction Company organized and managed a waste prevention program throughout the course of demolition and construction. The company has a long-term commitment to recycling of building materials. At the end of each year, Plant donates the money received from material recycling to local charities.

The contractor provided separate debris bins designated for scrap metal, brick and concrete, wood, and general debris. Wood removed from the project during demolition was used for new infill framing wherever possible. The general contractor trained all personnel on the job site to separate and use the designated debris bins. Golden Gate Disposal, the local refuse company, accepted pre-sorted materials from the job site for recycling. They also monitored the quantities of materials delivered during the course of construction.

At the Thoreau Center for Sustainability, over 73% of all debris was recycled. The typical recovery rate for recycled construction material at Golden Gate Disposal is 40 to 50%. The increase in the amount of recycled material is due to the commitment of the general contractor and crew.

- *19.2 tons (17.4 tonnes) of scrap metal were sent to Circosta Metals to be recycled.*
- *380 tons (345 tonnes) of inert fill (including concrete, bricks, soil, and terra cotta) were sent to Ryan Engineering or Brisbane Recycling, where it was either dumped for fill or screened for topsoil and sand. Bricks were cleaned and reused.*
- *137 tons (124 tonnes) of wood were recycled.*
- *Various contaminants prevented the recycling or reuse of 199 tons (180 tonnes) of general debris.*
- *In total, 73% (536.2 of 735.2 tons, or 486.4 of 666.9 tonnes) of all material was recycled.*

**Ideas and Questions to ask the Project Team**

- GC ? Reuse existing structure
- GC ? Identify items to be reused from existing structure
- GC ? Identify items to be salvaged from existing structure
- GC ? Recycle materials to be discarded from existing structure
- GC ? Designate a recycling coordinator
- GC ? Require weekly job-site recycling training
- GC ? Set up labeled bins to keep recyclable materials separate
Materials and Resources

Best Practice #1: Require a waste management plan from the contractor

Best Practice #5: Make sure the entire project team is up-to-speed with the high performance/sustainable objectives

Credit 2

Construction Waste Management

Thoreau Center for Sustainability

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Flack & Kurtz Consulting Engineers
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GL&A
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Materials and Resources

Best Practice #1: Require a waste management plan from the contractor

Credit 2

Construction Waste Management

20 River Terrace – The Solaire

Location: New York, NY
Building type(s): Multi-unit residential
New construction
357,000 sq. feet (33,100 sq. meters)
Project scope: 27-story building
Urban setting
Rating: U.S. Green Building Council LEED-NC, v2 Level: Gold (41 points)
Rating: Green Building Challenge Level: 2.0

All sub-contractors were required to submit a plan noting the anticipated weight of all on-site construction waste they would produce. This allowed the contractor to plan for the volume of waste that would have to be disposed of. All site-generated construction waste was brought to a transfer station, where it was sorted by category to be sold for re-use. 93% (by weight) of the construction waste for 20 River Terrace was recycled.

Ideas and Questions to ask the Project Team

GC ? Investigate local infrastructure for recycling
Materials and Resources

Best Practice #1: Require a waste management plan from the contractor

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Materials and Resources

Best Practice #1: Require a waste management plan from the contractor

Credit 2

**Construction Waste Management**

20 River Terrace – The Solaire
Elizabeth, New Jersey

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**Michael Gubbins**
The Albanese Organization, Inc.
Resident manager
### Materials and Resources

**Best Practice #1:** Require a waste management plan from the contractor  
**Best Practice #2:** Use modular or prefab construction materials

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<tr>
<td></td>
<td>1400 Fifth Avenue Residential Building</td>
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<tr>
<td>Location: New York, NY</td>
<td></td>
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<tr>
<td>Building type(s): Commercial office, Restaurant, Retail, Multi-unit residential, Assembly</td>
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<tr>
<td>New construction</td>
<td></td>
</tr>
<tr>
<td>225,000 sq. feet (20,900 sq. meters)</td>
<td></td>
</tr>
<tr>
<td>Project scope: 8-story building</td>
<td></td>
</tr>
<tr>
<td>Urban setting</td>
<td></td>
</tr>
</tbody>
</table>

http://www.buildinggreen.com/hpb/overview.cfm?ProjectID=441

Onsite construction waste was reduced to some degree by the use of pre-assembled, panelized wall systems, complete with windows and cladding. The general contractor presorted the onsite construction wastes to a limited degree, and full recycling responsibility was delegated to the city-based waste management company.

**Ideas and Questions to ask the Project Team**

- GC ? Require a waste management plan from the contractor
- GC ? Use modular or prefab construction materials
Materials and Resources

Best Practice #1: Require a waste management plan from the contractor
Best Practice #2: Use modular or prefab construction materials

Credit 2

Construction Waste Management

1400 Fifth Avenue Residential Building

Contact Info

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William Q. Brothers Architect
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Carlton Brown
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Joseph Higgins
Aramark Corporation
### Materials and Resources

**Best Practice #1:** Require a waste management plan from the contractor

**Best Practice #2:** Use modular or prefab construction materials

<table>
<thead>
<tr>
<th>Credit 2</th>
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<tr>
<td></td>
<td><strong>1400 Fifth Avenue Residential Building</strong></td>
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<tr>
<td></td>
<td>Commissioning agent</td>
</tr>
<tr>
<td></td>
<td>Philadelphia, PA</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.aramark.com">http://www.aramark.com</a></td>
</tr>
<tr>
<td></td>
<td><strong>Sergio Smiriglio</strong></td>
</tr>
<tr>
<td></td>
<td>SSEC, Inc.</td>
</tr>
<tr>
<td></td>
<td>Geothermal consultant (Hydrologist)</td>
</tr>
<tr>
<td></td>
<td>Cornwall, NY</td>
</tr>
</tbody>
</table>
Best Practice #2: Use modular or prefab construction materials

Credit 2  Construction Waste Management  
Green Village Company

All units are assembled from prefabricated sections that were constructed at Epoch Homes’ factory in Pembroke, New Hampshire. The Green Village Company had already been working with Epoch on the Building America program, so they were comfortable with the quality and energy-efficiency of the manufactured units. They also note that factory construction creates relatively little waste, and what there is can be collected for recycling more easily than on a construction site.

Best Practice #4: Use reusable forms for concrete

**Concentration Waste Management**

**Bachelor Enlisted Quarters Building 1044**

- Location: Bremerton, WA
- Building type(s): Multi-unit residential
- New construction
- 99,800 sq. feet (9,270 sq. meters)
- Project scope: 8-story building
- Suburban setting

Challenges included undocumented underground utility systems, asbestos abatement, and an environmentally sensitive site.

The room design created during the charrette process was tested by building a full-scale mock-up of a sample unit on the construction site. This mock-up helped the owners understand the unit layout much better. As the owners walked through the three-dimensional space, they identified problems and adjusted the design. For example, the bathroom seemed excessively small, and the mock-up helped them determine that it was possible to enlarge it slightly by rotating the studs, creating a thinner partition wall.

The commissioning agent was also involved in the mock-up process, and as he examined the air system he noticed a fan location that would make filter changes difficult. His suggestion to move the fan 1-1/2 inches made the filters easy to access.

The mock-up served as a room "template," too. The mechanical and plumbing systems were tested on the mock-up until all of the participants were satisfied. Then, the ducts and piping systems were fabricated in a shop, brought to the site, and put in place. Waste from the fabrication never came to the site and the uniform pieces were fabricated more efficiently because pipe sections could be reused right away in the shop. Overall, the mock-ups contributed considerably to the effectiveness of the just-in-time delivery, reduced waste, and increased the project's efficiency.

The project diverted 5,500 tons of waste from the landfill, a 93% diversion. Much of the diverted material was recycled, but almost three and a half tons of steel doors, frames, equipment, lights, and poles were reused.

The combination of shotcrete concrete walls and a regular, symmetrical building reduced concrete formwork since forms could be flipped and mirrored instead of being reconstructed for each floor.

**Ideas and Questions to ask the Project Team**

- GC: Use reusable forms for concrete
- GC: Use mockups to test concepts
Materials and Resources

Best Practice #4: Use reusable forms for concrete

Credit 2

Construction Waste Management

Bachelor Enlisted Quarters Building 1044

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Dave Steuart
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Greg Varney, PE, SE
Materials and Resources

Best Practice #4: Use reusable forms for concrete

Credit 2

Construction Waste Management

Bachelor Enlisted Quarters Building 1044
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- Structural engineer
- Seattle, WA
  - [http://www.kpff.com](http://www.kpff.com)

Robin Wille
- Robin Wille
- Interior designer
- Seattle, WA
  - [http://www.willeinc.com](http://www.willeinc.com)

Jack Johnson
- Site Workshop, LLC
- Landscape architect (Project manager)
- Seattle, WA
  - [http://www.siteworkshop.net](http://www.siteworkshop.net)

Jane Simmons, PE, LEED AP
- O'Brien & Company, Inc.
- Sustainability consultant
- Bainbridge Island, WA
  - [http://www.obrienandco.com](http://www.obrienandco.com)

Tom Gurlowski, PE
- Shannon & Wilson
- Geo/hazard testing
- Seattle, WA
  - [http://www.shanwil.com/indexflash.html](http://www.shanwil.com/indexflash.html)

Bob Pielow
- Pielow Fair Associates
- Code analysis
- Seattle, WA

Keithly Welsh Associates
- Commissioning agent
- Burien, WA
  - [http://www.keithlybarber.com](http://www.keithlybarber.com)
Best Practice #5: Make sure the entire project team is up-to-speed with the high performance/sustainable objectives

Construction Waste Management

BigHorn Home Improvement Center

Location: Silverthorne, CO
Building type(s): Commercial office, Industrial, Retail
New construction
44,400 sq. feet (4,130 sq. meters)
Project scope: a single building
Suburban setting

The Center was constructed in three distinct phases. This description focuses only on the third phase.
Rating: Green Building Challenge Level: 2.6 in GB Tool 1.76

http://www.buildinggreen.com/hpb/overview.cfm?ProjectID=54

The construction team was aware of the goal of creating a sustainable building. They willingly participated in a program to recycle and reuse construction waste.

The design and construction team were highly integrated throughout all aspects of construction. Weekly meetings with all team members, including architects, trade contractors, general contractor, and mechanical and electrical engineers, helped resolve issues on an ongoing basis.

Ideas and Questions to ask the Project Team

Make sure the entire project team is up-to-speed with the high performance/sustainable objectives
Materials and Resources

Best Practice #5: Make sure the entire project team is up-to-speed with the high performance/sustainable objectives

Credit 2

Construction Waste Management

BigHorn Home Improvement Center

Contact Info

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Mechanical contractor
Vail, CO

Dave Yoder
M-E Engineers, Inc.
Mechanical engineer
Avon, CO

Jerry Dokken, AIA
Marketplace Architects
Architect
Dillon, CO

Michael Shult, AIA
Marketplace Architects
Architect
Dillon, CO

Paul Torcellini
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Energy consultant
Golden, CO

Dave Clement
Range West
Civil engineer
Frisco, CO

John Reese
Reese Engineering
Electrical engineer
Denver, CO

Charlie Cole
Summit Northstar Partners
Owner/developer
Silverthorne, CO

Don & Betsy Sather
Summit Northstar Partners
Owner/developer
Silverthorne, CO

Kieth Pitts
TCD
Contractor
Breckenridge, CO

Tom Kingdom
**Materials and Resources**

**Best Practice #5:** Make sure the entire project team is up-to-speed with the high performance/sustainable objectives

**Credit 2**

<table>
<thead>
<tr>
<th>Construction Waste Management</th>
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<tbody>
<tr>
<td><strong>BigHorn Home Improvement Center</strong></td>
</tr>
<tr>
<td>Thomas A. Kingdom, P.E.</td>
</tr>
<tr>
<td>Structural engineer</td>
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<tr>
<td>Littleton, CO</td>
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<tr>
<td><strong>Gary Probst</strong></td>
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<td>Triangle Electric</td>
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<tr>
<td>Frisco, CO</td>
</tr>
<tr>
<td>Stedila Design, Inc.</td>
</tr>
<tr>
<td>Interior designer</td>
</tr>
<tr>
<td>New York, NY</td>
</tr>
<tr>
<td><strong>Edward Clerico</strong></td>
</tr>
<tr>
<td>Applied Water Management</td>
</tr>
<tr>
<td>Water reuse consultant</td>
</tr>
<tr>
<td>Belle Mead, NJ</td>
</tr>
<tr>
<td><strong>Michael English</strong></td>
</tr>
<tr>
<td>Horizon Engineering</td>
</tr>
<tr>
<td>Commissioning agent</td>
</tr>
<tr>
<td>New York, NY</td>
</tr>
<tr>
<td><strong>Charlie Avolio</strong></td>
</tr>
<tr>
<td>Turner Construction Company</td>
</tr>
<tr>
<td>Construction manager</td>
</tr>
<tr>
<td>New York, NY</td>
</tr>
<tr>
<td><strong>Michael Gubbins</strong></td>
</tr>
<tr>
<td>The Albanese Organization, Inc.</td>
</tr>
<tr>
<td>Resident manager</td>
</tr>
</tbody>
</table>
Management Building at Georgia Tech
http://www.buildinggreen.com/hpb/process.cfm?ProjectID=227

The consultant and the contractor communicated closely on indoor air quality (IAQ) management, construction waste management, and the preparation of submittals related to LEED, including monthly up-to-date and projected calculations, vendors’ back-up statements, product data sheets, and photographs. The consultant reviewed and stamp-approved all contractor submittals related to LEED, including data on the white, heat-reflecting membrane roofing. The close communication paid off in outstanding performance in recycling construction waste and using

Carl T. Curtis - National Park Service
http://www.buildinggreen.com/hpb/process.cfm?ProjectID=418

The general contractor for this project took the LEED approach to heart throughout the project. The general contractor's onsite project manager and some of his office staff became LEED accredited professionals in order to better understand the intent of the project.
By the first onsite construction meeting a recycling effort was well underway. Subcontractors’ pay was withheld if they did not participate daily in the recycling program. The general contractor also purchased products that were

Brewery Block 4

A sustainability and LEED consultant was engaged after the design process to structure a LEED program for the developer. LEED was used as a framework to inform the design, but a consultant was necessary to properly execute the process. Project Consultant Scott Lewis notes that "The project team has pressing time demands and if nobody has the responsibility of tracking the project it all falls off of the table. It's not a priority for them; it's an added duty."
The project successfully recycled 96% of construction waste because an aggressive commingling recycling program and tracking system was established prior to construction. Cady notes that putting the plan into practice required that the information trickle down to the subcontractors. "You have to inform them and pull them along,

U. of Wisconsin-Green Bay

The team set a goal of reducing construction waste by 90% as compared to standard practices.
Working with the state waste reduction office—one of the building occupants—the team prepared a detailed construction waste specification. A list of local firms that accept various construction materials for recycling was provided to each construction firm bidding on the project. Before construction began, the team worked with the

U.S. EPA Research Triangle Park Campus

As part of the safety training for its new laboratory facility, EPA expanded the scope to include environmental training. Environmental concerns were stressed during a significant portion of worker orientation, including about half of the 12-minute training video and instruction on separating construction waste for reuse or recycling, maximizing indoor air quality, and protecting site ecology. Upon completion of the mandatory training program, workers were issued stickers reading: "I've been trained." Workers were required to display the stickers on their hard hats to indicate that they had completed the training and to remind workers that both safety and environmental protection are always a concern.
Louisiana-Pacific (LP)


LP required each contractor and supplier to submit information on the environmental aspects of its operations. As a result, the company’s new offices reflect an environmental commitment and vision for sustainability. Green

• Recycled wood flooring, used in the reception areas and elevator landings, manufactured from trim pieces of laminated veneer lumber from LP’s Hines, Oregon, facility.
• High-performance, bio-composite tile, placed in the employee lunchroom, manufactured using an energy-efficient process that is free of volatile organic compounds.
• Cabinets, located in the copy and coffee rooms, made from medium-density fiberboard, a product manufactured from sawdust and fines.
• Office furniture containing recycled-content steel, sustainably harvested wood, and non-hazardous materials.
• Energy-efficient timing devices that shut off office lights after 30 minutes of inactivity.

Hugh Donnelly, LP’s corporate facilities manager, noted that “it wasn’t hard to find suppliers who were eager to talk about the green aspects of their business. What’s more, LP’s move to the Fox Tower was completed on time and under budget.”
General Demolition Contractors with LEED Experience
Brandenburg Industrial Services (http://www.brandenburg.info/salvage/index.html)
Bierlein Demolition (http://www.bierlein.com/)
King Wrecking (Cincinnati, OH)
Dale N. Scrace and Sarah Cicero at White/Olson LLC
  St. Clair Shores
  586.771.9330
Tom Whitmore from Christman Company
  734.761-2673

Specific Materials

Concrete
American Recycling – Waterford, MI (248-363-6060)
M&M Contracting – Romulus, MI (734-479-3366)
Modern Industries – Flint, MI (810-767-7610)

Metals (Including Wiring, Ferrous & Non-ferrous)
American Recycling – Waterford, MI (248-363-6060)
Metal Recycling Unlimited – Dexter, MI
Jackson Metals – Jackson, MI
Haggerty Metals – Plymouth, MI

Wood
Uof M Plant Operations
http://www.plantops.umich.edu/grounds/recycle/materials/scrapwood.html

Carpet
Manufacturer take back program

Drywall/Gypsum
Taylor Recycling – Montgomery, NY (845-457-4021) & Des Moines, IA (515-246-0600)

Glass (Including Window Glass, Fluorescent Light Bulbs)
Recycle Ann Arbor – Ann Arbor, MI (734-662-6288)

Plastics
Recycle Ann Arbor – Ann Arbor, MI (734-662-6288)

Misc. Salvage
Materials Unlimited – 2 West Michigan Ave, Ypsilanti, MI (734-483 6980)
Architectural Salvage Warehouse – Detroit, MI (313-885-1136)
Senate Resale – Detroit, MI (313-963-5252)

Ceiling Tiles
Armstrong take back program
Best Practice #7: Construction and demolition materials that can be recycled or reused

Construction Waste Management

Douglas School

Project: 137,000 sf new construction plus 6,800 sf renovation and addition
Public owner

Project Description: Consigli Construction Inc. was the lead contractor for the Douglas School project. The brick structure is located on a wooded hillside in a rural area. Most of the project consisted of construction of a new high school; a two-story building designed for 700 students, grades 7-12.


Total Waste Reduction: 57% (444 tons recycled, 338 tons disposed)
Cost Savings Attributed to Recycling: $31,812, or 66%

<table>
<thead>
<tr>
<th>Material</th>
<th>Tons</th>
<th>Recycling Cost</th>
<th>Avoided Disposal Cost*</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>285</td>
<td>$8,265</td>
<td>$31,065</td>
<td>$22,800</td>
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<tr>
<td>Metal</td>
<td>69</td>
<td>$1,380</td>
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<td>Wallboard</td>
<td>49</td>
<td>$2,559</td>
<td>$5,450</td>
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<tr>
<td>Cardboard</td>
<td>0.67</td>
<td>$67</td>
<td>$70</td>
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<td>Wood</td>
<td>40</td>
<td>$4,381</td>
<td>$4,358</td>
<td>($23)</td>
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<tr>
<td>TOTALS</td>
<td>443.67</td>
<td>$16,652</td>
<td>$48,464</td>
<td>$31,812</td>
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</table>

Reuse and recycling of materials can reduce project costs in two ways:
• through recovery of the salvage value of various building materials and components
• through cost avoidance resulting from diversion of solid waste from the municipal landfill.
CBF Merrill Environmental Center

Existing structures on the site were deconstructed rather than demolished and all materials were auctioned, salvaged, or recycled. The existing foundations were chipped and used as road base. Seven loads of chipped concrete were hauled off-site to be reused. With regard to construction waste, all cardboard, metals, concrete,

Genzyme Center

One of the most critical pieces of the sustainability puzzle, in construction terms, was the decision to use a new kind of concrete-slab construction, rarely used in office buildings, called a “Filigree Wideslab,” which has many green benefits. It is a composite system of 2-1/2” thick pre-stressed, precast planks that initially act as formwork before their composite behaviors kick in. Depending on the structural requirements, varying depths of traditional reinforced cast-in-place concrete are then joined together by welded wire trusses embedded inside. Polystyrene void formers eliminate unnecessary zones of concrete, making the slab much lighter. The environmental benefits

Genzyme Center is framed with filigree slab concrete, an unusual and challenging application for this material, in a building with irregular, non-standard floor plans. The concrete structure substantially increased the thermal efficiency of the finished building. But the inherent strength of the filigree slabs also reduces the need for reinforcing steel. By using foam fillers in the panels, the overall structural weight was reduced, thus requiring fewer concrete piles and reducing the foundation elements. In total, the contractor used 386 fewer tons of steel

Specifying a customized 12” upturned edge on the filigree also allowed for the incorporation of precast filigree slabs, saving more than 2,600 sheets of plywood forms and construction time. In addition, since a conventional cast-in-place building of this size would typically require 357 gallons of release agent for stripping the wood forms, the use of the filigree significantly reduced the release of VOCs into the environment at the factory and on-site.

Several features and programs were incorporated to preserve natural resources. More than 500 ft2 of area within the building is devoted to the storage of recyclables collected as part of the building’s recycling program.

SPNHF- French Wing
http://www.buildinggreen.com/hpb/materials.cfm?ProjectID=17

The decision to relocate rather than demolish the existing Rathbun house diverted an estimated 120 tons (110 tonnes) of construction and demolition waste from disposal. Additionally, numerous other reuse and recycling opportunities were identified. Engineered wood was chipped for biomass fuel, dimensional lumber was sorted for reuse or chipped for fuel, other wood scrap was given away as kindling, and land-clearing products were milled on-site as lumber or used as firewood or mulch. Cardboard and beverage containers were transported to the Concord transfer station. Metals were sold as scrap. Concrete from the Rathbun foundation was cut into paver tiles or ground up as road base. Brick from the Rathbun chimneys and fireplace was reused for walkways or ground up as road base. Asphalt was ground up as road base. Gypsum board was turned into new drywall.
Boston Scientific Company, Inc. (Bsci)
Marlborough, MA

BSCI undertook the renovation of a two-story, 30,000 square-foot office building as Phase 1 of a 2-building, 400,000 sq ft project. The general contractor was Payton Construction Corp.; SOS Corp. was demolition subcontractor. The project involved gutting and replacement of interior furnishings and fittings, wall/partition systems, HVAC, electrical, plumbing, and membrane roof. The project was particularly complex because renovation began at the same time as demolition, so that employees could move into parts of the building while other areas were still in construction. The project was carried out to LEED Silver.

Total Waste Reduction: 92% (702 tons recycled, 62 tons disposed)
Cost Savings: $49,983, or 63%

Aspen Skiing Company (ASC); 1999

For a successful salvage, ASC needed an outlet for the materials and products. The project managers planned a parking lot “yard sale” and advertised the event with posters and newspaper announcements. An hour before the sale started, 20 pickup trucks had already lined up filled with eager homeowners, contractors, and hotel owners refurbishing their own facilities. In only 4 hours, all of the items were gone. ASC sold 100 sliding doors, 80 windows, 24 fir closet doors, a few 40-foot beams, and a trash bin full of plywood and TGI (pressed wood “I”) beams. ASC netted $10,000 from the yard sale and earned another $58,000 by selling old furniture to employees at a discount.

Schendler said his biggest piece of advice for other WasteWise partners is to negotiate with contractors to

Kodak Park; Rochester, NY; 2001

40 buildings deconstructed on a 1900 acre campus; buildings 10 to 100 years old
Saved $2.7 million in aggregate over the 40 buildings by not sending material to landfill.
The company recovered more than 50,000 tons of brick, concrete, and asphalt from its old buildings. Kodak stockpiled this material, hired a contractor to crush it into aggregate twice each year, and reused the material onsite as fill. Thomas explained that the cost of new aggregate was comparable to the cost per ton of crushing the salvaged material, but Kodak saved big—nearly $2.7 million—in avoided disposal fees.
MISCELLANEOUS ACADEMIC CASE STUDIES

Wyss Hall; Harvard Business School
Building Type: Graduate Student Housing
LEED Status: Registered LEED Certification
Energy Performance: Mechanical Occupancy sensors for HVAC; 100% of electrical load offset by renewable ener

Hamilton Hall; Harvard Business School
Building Type: Graduate Student Housing
LEED Status: Registered LEED Silver
Energy Performance: 22% more efficient than code, 100% of electrical load offset by renewable energy
Materials: Wheat husk composite wood and recovered rice straw core doors
Water: 30% water use reduction via 0.5 GPM sinks, 2.0 GPM shower heads, dual flush toilets