



**PDHonline Course C348 (2 PDH)**

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# **Construction & Demolition Debris Reduction**

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# WasteWise Update

## BUILDING FOR THE FUTURE

### INSIDE

**CONSTRUCTION  
& DEMOLITION  
DEBRIS  
REDUCTION . . . 4**

**RESOURCE-  
EFFICIENT BUILDING  
MATERIALS . . . . 10**


**RESOURCES . . . 13**



Preserving Resources,  
Preventing Waste

# Building for the Future

**F**rom the first moment of construction until the day it is demolished, a building affects its surrounding environment. It consumes energy, water, and materials; affects the air, land, and water around it; and creates an artificial indoor environment for those who work, live, or play in it. Buildings that are designed, constructed, operated, and ultimately removed in such a way as to minimize their environmental impacts are referred to as “high-performance,” “sustainable,” or “green” buildings—a hot topic in both the environmental and construction arenas.



You can make your organization’s buildings greener by improving their energy and water efficiency, employing renewable sources of energy, improving indoor air quality, and using materials more efficiently. This issue of the *WasteWise Update* looks primarily at the materials efficiency aspects of green buildings, including the reduction, reuse, and recycling of construction and demolition (C&D) debris, and the use of recycled, reused, and otherwise “resource-efficient” building products.

If green buildings are ultimately about the safe and efficient use of resources, then the ways in which materials are used and disposed of in the building process are essential to this growing movement. The United States Geological Survey has estimated that construction accounts for 60 percent of all materials used in the United States for purposes other than food and fuel.<sup>1</sup> This amounts to billions of tons of material used every year to construct buildings, roads, bridges, and other structures.

<sup>1</sup> USGS Factsheet FS-068-98, “Materials Flow and Sustainability” (June 1998)  
<<http://greenwood.cr.usgs.gov/pub/fact-sheets/fs-0068-98/fs-0068-98.pdf>>



## WasteWise Building Challenge

In early 2002, WasteWise will launch the Building Challenge to provide program partners with an opportunity to gain technical assistance and recognition for reducing C&D waste and purchasing recycled-content building products. To help partners develop and implement Building Challenge programs, WasteWise will distribute CD-ROMs containing *Environmental Building News* archives to the first 50 partners that sign up. The CD-ROMs contain every issue of this green building newsletter from 1992 to 2000. For additional information about the WasteWise Building Challenge, please call the WasteWise Helpline at 800 EPA-WISE or send an e-mail to <ww@cais.net>.



The environmental impact of building, therefore, starts when these materials are first harvested (e.g., trees) or mined (e.g., metals, crushed stone, sand, gravel, and gypsum). How they are extracted and how much is taken can affect the surrounding environment, including the condition of soil, streams, and forests. Processing, manufacturing, and transporting these products causes additional environmental impacts, resulting from industrial pollution, the burning of fuel, and the processes employed. Many steps of the production process release greenhouse gases into the atmosphere: burning fossil fuels releases car-

bon dioxide; harvesting trees releases carbon dioxide stored in forests; and landfilling biodegradable materials can lead to methane releases. All of these effects together constitute the life-cycle impact of a building.

Although this *Update* focuses on solid waste and resource conservation issues, it is important to remember that green building has many different aspects, and your organization will benefit most by taking a “whole-building” approach that considers all the environmental impacts—and trade-offs—of the building decisions you make.

# Construction & Demolition Debris Reduction



**C**onstruction and demolition (C&D) debris constitutes the waste generated during construction, renovation, and demolition projects. C&D waste commonly includes building materials and products such as concrete, asphalt, wood, glass, brick, metal, gypsum wallboard, roofing, insulation, doors, windows and frames, flooring, and furniture. The U. S. Environmental Protection Agency (EPA) estimates that approximately 136 million tons of building-related C&D debris were generated in 1996—the majority from demolition (48 percent) and renovation (44 percent). New construction generated only 8 percent of building-related C&D debris.

Such a large and complex waste stream presents many opportunities for reducing the waste and costs associated with building activities. Reducing C&D debris can cut overall project expenses by avoiding disposal costs and the purchase of new materials, by generating revenue from the sale of materials, and by creating opportunities for tax breaks through material donations. Other benefits include conserving landfill space, reducing the environmental effects of producing new materials, helping contractors and building owners comply with local and state regulations, and enhancing the public image of the organization that is reducing the debris. Many WasteWise partners spend significant amounts of time and money constructing, renovating, and/or demolish-



ing public, commercial, or academic buildings—including office buildings, factories, warehouses, and other structures. Tackling the waste stream from these activities allows your organization to extend its WasteWise waste reduction successes into the new arena of C&D.

To minimize the environmental impact of buildings and structures, your organization can take many steps to reuse and recycle used building materials and prevent waste. From incorporating used or environmentally preferable materials into a building's construction or renovation, to disassembling structures for the reuse and recycling of their components, each phase of a building's life cycle offers opportunities to reduce waste.

## Waste Reduction in the Design Phase

Waste reduction opportunities begin with the earliest choices made in the building process, including architectural design and material selection. Effectively balancing resource-efficient design concepts requires the attention of skilled and environmentally conscious building professionals. These concepts include waste prevention, durability, and recyclability.

### Waste Prevention

Waste prevention techniques minimize the amount of materials used during construction and renovation. For example, a technique from the homebuilding field, known as “optimum value engineering (OVE)” or “efficient framing,” reduces the amount of wood used in the framing process without sacrificing structural integrity. Additional information on OVE techniques can be found on the Partnership for Advancing Technology in Housing Technology Inventory at [www.toolbase.org](http://www.toolbase.org).

### Durability

Although durable products can be more expensive and contain more material than their traditional counterparts, they offer many long-term benefits through avoided maintenance and replacement costs. Additionally, products that are more durable can enhance safety and prevent a building’s other high-performance features—such as energy efficiency—from deteriorating. The durability of a building comes not only from the materials used to build it, but from the quality of the construction. For example, building to avoid problems such as water infiltration will do much to ensure that materials last as long as possible.

### Recyclability

Recyclability considers the end-of-life management of building products from the very start. The University of Florida’s Center for Construction and Environment is currently conducting research on the concept of designing buildings to facilitate the ultimate disassembly and reuse of their components.

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## EPA Builds Waste Reduction into New Facility

The foundation of a green building is set long before the digging begins. For EPA’s mammoth 1-million-square-foot laboratory and office complex in Research Triangle Park (RTP), North Carolina, project managers scrutinized every aspect of the design phase—working closely with designers, contractors, and the local environmental agency—to ensure that waste prevention, recycling, and recycled products were incorporated into the construction plan and execution.

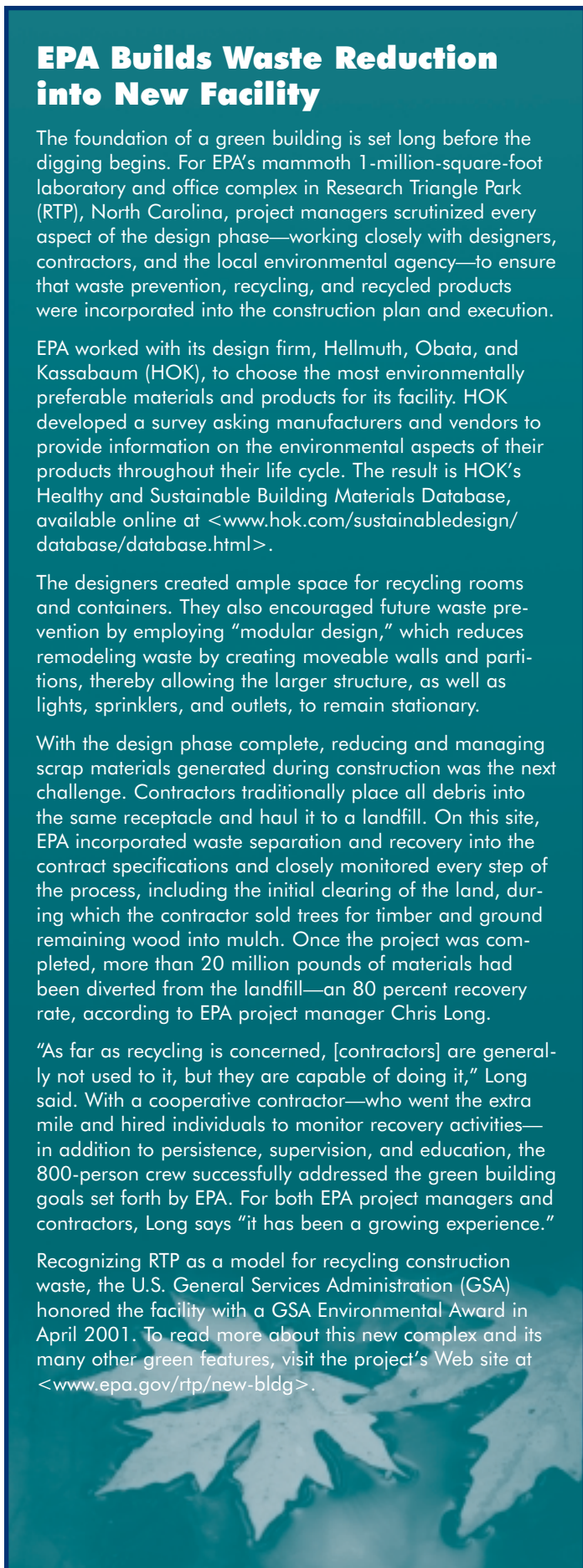
EPA worked with its design firm, Hellmuth, Obata, and Kassabaum (HOK), to choose the most environmentally preferable materials and products for its facility. HOK developed a survey asking manufacturers and vendors to provide information on the environmental aspects of their products throughout their life cycle. The result is HOK’s Healthy and Sustainable Building Materials Database, available online at [www.hok.com/sustainable/design/database/database.html](http://www.hok.com/sustainable/design/database/database.html).

The designers created ample space for recycling rooms and containers. They also encouraged future waste prevention by employing “modular design,” which reduces remodeling waste by creating moveable walls and partitions, thereby allowing the larger structure, as well as lights, sprinklers, and outlets, to remain stationary.

With the design phase complete, reducing and managing scrap materials generated during construction was the next challenge. Contractors traditionally place all debris into the same receptacle and haul it to a landfill. On this site, EPA incorporated waste separation and recovery into the contract specifications and closely monitored every step of the process, including the initial clearing of the land, during which the contractor sold trees for timber and ground remaining wood into mulch. Once the project was completed, more than 20 million pounds of materials had been diverted from the landfill—an 80 percent recovery rate, according to EPA project manager Chris Long.

“As far as recycling is concerned, [contractors] are generally not used to it, but they are capable of doing it,” Long said. With a cooperative contractor—who went the extra mile and hired individuals to monitor recovery activities—in addition to persistence, supervision, and education, the 800-person crew successfully addressed the green building goals set forth by EPA. For both EPA project managers and contractors, Long says “it has been a growing experience.”

Recognizing RTP as a model for recycling construction waste, the U.S. General Services Administration (GSA) honored the facility with a GSA Environmental Award in April 2001. To read more about this new complex and its many other green features, visit the project’s Web site at [www.epa.gov/rtp/new-bldg](http://www.epa.gov/rtp/new-bldg).





## Greening the Code

Building codes establish the minimum acceptable requirements necessary for protecting public health, safety, and welfare in a building's environment. The following examples illustrate how communities are incorporating green or sustainable standards into building codes and guidelines.

- **Santa Monica, California's** Green Building program includes requirements for C&D waste management. The requirements include recycling C&D waste in construction contracts, specifying the reuse of salvaged building and landscape materials, and designing interior building components for future disassembly, reuse, and recycling. Other sections of the code require specifying wood from sustainably managed sources and the use of low-emission finishes and materials to reduce indoor pollution.
- The **U.S. Navy** requires contractors to incorporate green building components into their designs. The Sustainable Development Requirements in the Navy Family Housing Project state:  
  
"All Navy Family Housing Construction, Improvement, Repair and Privatization projects shall incorporate Sustainable Development principles. Application of these principles will reduce consumption of energy, and other non-renewable resources; minimize waste of water and materials; prevent pollution and associated environmental impacts and liabilities, increase energy and resource efficiency, and improve human health. The result will reduce life-cycle operating costs for Navy Families."
- **Portland, Oregon's** building codes mandate that all building projects with costs exceeding \$25,000 (including construction and demolition), must recycle materials generated onsite.



## Contracts and Specifications

Incorporating environmental guidelines into your contracts and specifications will clarify your expectations of architects and builders and ensure that they integrate your goals into the building plans. Sample green building specifications can be used as templates. Leadership in Energy and Environmental Design (LEED), a rating system created by the U.S. Green Building Council, provides green building guidelines that organizations can follow to qualify their buildings as environmentally sound. LEED includes standards on topics such as maximizing the salvage of existing structures, maximizing recycling and reuse during construction, and specifying recycled or reused building materials. Even if your organization does not go through the entire LEED rating process, you can incorporate elements of the LEED standards into your building contract specifications. An increasing number of organizations and governments,

such as the city of Seattle and the U.S. General Services Administration, require that their buildings be built to meet or exceed LEED standards.

A number of organizations and governments have developed their own specifications—for example, New York City created its own high-performance building guidelines (see Resources section for more information). Although most local green building programs have a broad focus, which includes waste reduction and recycled product sections, WasteSpec is a set of specifications that focuses exclusively on waste issues. Developed by North Carolina's Triangle J Council of Governments, WasteSpec provides model language to address the use of waste reduction techniques, reuse of construction waste material, salvage of C&D waste for sale or reuse, and return of unused construction material to vendors. WasteSpec is available free of charge at [www.tjcog.dst.nc.us/cdwaste.htm](http://www.tjcog.dst.nc.us/cdwaste.htm).

## The Construction and Renovation Phases

Once your organization breaks ground on a new construction, renovation, or remodeling project, numerous opportunities for reuse and recycling can be identified. During these phases, you will need to ensure that contractors fulfill the waste reduction goals or specifications outlined in your contracts. Because incorporating reuse and recycling activities into the construction and renovation phases may be new to building professionals, developing new standard operating procedures is recommended. Education and motivation of construction staff may also prove beneficial. One way to motivate contractors is to let them keep revenues from recycling and savings from avoided landfill costs due to waste reduction.

Building contractors should be required to develop a plan for reducing, reusing, or recycling the wastes they generate onsite. First, careful estimation of required materials to be ordered will help reduce the amount of wasted materials. Second, markets for recyclable products should be identified. Some materials (such as metals, cardboard packaging, bricks, concrete, and wood) often have strong markets; others (such as drywall, vinyl products, or carpeting) may vary from region to region. It may take creativity and persistence to find markets for certain materials. One resource is the Construction Materials Recycling Association (CMRA), an association of C&D debris generators, haulers, processors, recyclers, and remanufacturers. CMRA provides information and technical assistance about C&D debris recycling.

After establishing recycling systems at the construction site, both contractors and subcontractors should receive instructions on sorting their waste. Renovation projects in particular may present opportunities for recovering high-quality building components or fixtures for reuse. Hundreds of building material reuse stores around the country accept used materials as a tax-deductible, charitable contribution. Habitat for Humanity's national network of Re-Stores sell used and surplus building materials to fund new building projects. Other groups involved in the resale of building materials include local nonprofit organizations and military groups. The Used Building Materials Association (UBMA), and the Reuse Development Organization (ReDO) also provide information on locating and working with reuse stores. Refer to the Resources section for more information.

### U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System

LEED, a self-certification system developed by the U.S. Green Building Council, rates the "greenness" of new and existing commercial, institutional, and multi-family residential buildings. LEED helps builders design sustainable buildings that save resources and provide environmental and health benefits to owners, occupants, and the community. Buildings must be designed, constructed, and operated according to specific sustainable criteria in order to earn LEED credits. Buildings that meet the LEED criteria are awarded the "LEED Building" designation within the appropriate level of certification (Platinum, Gold, Silver, and Certified). The criteria include both mandatory prerequisites and a range of optional credits.

LEED's commercial building rating system is based on five categories: Sustainable Site Planning, Improving Energy Efficiency, Conserving Materials and Resources, Enhancing Indoor Environmental Quality, and Safeguarding Water. Several credits focus on resource conservation, recycling, and reuse. For example, one of LEED's prerequisites is the "provision of a centralized, ground-floor location for storage and collection of recyclables." LEED credits are also awarded for activities such as:

- Rehabilitating an existing building instead of demolishing and rebuilding.
- Reusing salvaged materials.
- Using materials with high recycled content.
- Developing a construction waste management plan.
- Using local materials.

A similar rating system, LEED Commercial Interiors (LEED CI), is being developed for tenants of commercial buildings and the designers and architects they hire.



## Aspen Skiing Company Prevents Mountains of Waste

No stone was left unturned—literally—when Aspen Skiing Company (ASC) sought to deconstruct its Sundeck Restaurant and Snowmass Lodge and Club in 1999. ASC salvaged as much as it could, including the stones comprising Sundeck Restaurant's fireplace. The company donated the stones to the Aspen Historical Society, which in turn auctioned them for a total of \$25,000. In this project, ASC salvaged 84 percent of the building, saved thousands of dollars, and rebuilt the restaurant and lodge into a LEED-certified complex.

"Deconstruction and salvage takes more time and energy, but it extends the life of the landfill and helps protect natural resources," said Auden Schendler, ASC's Director of Environmental Affairs. Rather than hiring a new contractor, ASC worked with its existing contractor to salvage parts and separate materials.

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.

ASC also rented a grinder to process the concrete, sheetrock, and wood generated from the deconstruction. Grinding these materials reduced their volume by 500 percent, which cut costs by reducing the number of times the contractor sent trucks to the landfill. ASC used the ground concrete as backfill and sent the ground wood and sheetrock to the landfill's windrow composting operation. The landfill manager waived the \$21.50 per-cubic-yard tipping fee for the wood and sheetrock because he could later sell the finished compost.

Schendler said his biggest piece of advice for other WasteWise partners is to negotiate with contractors to incorporate cost savings and revenues into the contract. By demonstrating that deconstruction can be cost-effective, ASC hopes to start a trend among builders, and a broader movement within the skiing industry. For more information on ASC's environmental programs, visit [www.aspensnowmass.com/environment](http://www.aspensnowmass.com/environment).

## The Demolition/Deconstruction Phase

Although Rome's Coliseum is still standing after 2,000 years, most of our buildings are not quite so durable. When a building comes to the end of its useful life, the amount of waste created by its removal can be minimized through waste reduction techniques. Most buildings are taken down through demolition, and rubble is sometimes recycled for uses such as road-building aggregate. In fact, some sites have demonstrated that enormous amounts of debris from the demolition of existing structures can be reused in new structures being built at the demolition site. When the Seattle Kingdome was torn down in March 2000, a remarkable 97 percent of the project waste was recycled into the new stadium complex. This resulted not only in savings of more than \$3 million, but reduced truck traffic to and from the site by an estimated 4,500 trips.

Today, interest in an alternative—or complementary—practice known as "deconstruction" is increasing. Deconstruction maximizes the salvage of building materials for reuse or recycling by selectively disassembling buildings. Currently, valuable items, such as chandeliers and fixtures, are frequently removed from buildings before demolition. Deconstruction, however, goes one level deeper and concentrates on recovering items such as flooring, siding, windows, doors, bricks, plumbing fixtures, ceiling tiles, and structural components. As a result, deconstruction is labor-intensive and often relies on the use of hand tools and manpower to take apart buildings and structures. The potential benefits of deconstruction include job creation, resource conservation, and waste reduction. In the future, mechanized deconstruction using a combination of manual labor and machinery may increase the speed and efficiency of the deconstruction process. When deconstructing buildings, workers should take precautions to protect themselves from exposure to substances such as lead-based paint and asbestos. EPA's Lead Program ([www.epa.gov/opptintr/lead/](http://www.epa.gov/opptintr/lead/)) and Asbestos Program ([www.epa.gov/oppt/asbestos](http://www.epa.gov/oppt/asbestos)) offer useful information about these toxins.

Whereas traditional demolition treats a building as a financial liability, deconstruction recognizes the inherent value in the building's components and can reduce the overall cost of demolition. Before constructing the Four Times Square Office Tower in Manhattan, the contractor first removed six existing buildings. By salvaging all usable materials and recycling as much of the remaining C&D debris as possible, the contractor saved more than \$800,000 by selling the salvaged material and reducing disposal fees.

In fact, not every building will warrant deconstruction. A building should be assessed to determine the condition and





## Disney's Recycle Plus Program Donates Building Supplies

New and used plumbing fixtures, paints, carpeting, and lumber from the Walt Disney World® Resort properties in Orange County, Florida, found a second home through Disney's Recycle Plus program. In 2000 alone, Reedy Creek Improvement District (RCID) and Walt Disney World® Resort donated more than \$65,000 of reusable building supplies to local affordable housing programs, churches, and nonprofit organizations through the Orange County Community Distribution Center. When the program began, it primarily donated unused construction supplies, but it gradually expanded to include virtually any type of building material—new or used—that could be used in an affordable housing program.

In a collaborative effort, Disney worked with the Orange County Community Distribution Center to redistribute the materials to local organizations. Supplies were collected from Disney's numerous properties in Orange County and delivered to the distribution center, which was staffed by county inmates as part of a warehouse training program. By redistributing supplies, the Recycle Plus program simultaneously prevented materials from being sent to a landfill and provided needed supplies for refurbishing and building homes.

value of its materials and identify potential outlets for them. This assessment should look not only at the value of selling salvaged materials, but also the value of giving them away as tax-deductible contributions and the savings from avoided disposal costs. Although the extra labor required to deconstruct a building may represent an added cost, deconstruction is being used in some areas as a prime opportunity to utilize and train at-risk youths, welfare-to-work program participants, and others in the construction trade. For example, the Institute for Local Self Reliance (ILSR) worked with the Hartford (Connecticut) Housing Authority (HHA) to deconstruct six units of a local housing complex. The project trained nine public housing residents, providing them with the skills to obtain full-time positions with a local deconstruction company. In this way, the removal of a building can represent an exciting opportunity for WasteWise partners to empower and engage their surrounding communities.

## Deconstructing Kodak Park

Located in Rochester, New York, Eastman Kodak Company's offices and manufacturing facilities reside on a 1,900-acre park. Six years ago, the company began consolidating

space among its 200 buildings. As part of this effort, Kodak deconstructed more than 40 buildings on the site, reusing as much of the original construction material as possible. George Thomas, manager of Kodak's pollution prevention program, described the effort as "a good way to minimize costs and 'do the right thing.'" Many of the buildings ranged from 10 to 100

years old. Valuable wooden beams prized by collectors were reused by the demolition contractor. The company also 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.

# Resource-Efficient Building Materials



**T**here are many widely available high-performance and cost-effective green alternatives to traditional construction and renovation materials. WasteWise partners familiar with green building methods have noticed a steady increase in the availability, quantity, and variety of recycled construction and renovation supplies over the years. This increase reflects growing demand as more and more organizations are discovering the economic and environmental benefits of green building.

## Sustainable Landscaping

Green building can include the green stuff outside the building too—lawns, gardens, even golf courses. From using hydraulic mulch (a mixture of wood waste and paper fiber), to landscaping lawns with recycled-content rubber edging, organizations can use a variety of environmentally sustainable lawn and garden products. EPA's Comprehensive Procurement Guidelines offer information on an array of recycled-content landscaping materials such as garden and soaker hoses, plastic lumber landscaping timbers, and compost made from yard trimmings or food waste.

Additional information about the uses and benefits of compost can be obtained from the U.S. Composting Council Web site, <[www.compostingcouncil.org](http://www.compostingcouncil.org)>.



Recycled-content products belong to a broader category of green building supplies including products made without hazardous substances, energy-efficient products (including ENERGY STAR®-labeled products, ranging from roofing to appliances to windows), and water-conserving devices<sup>2</sup>. Although there is a wide variety of “resource-efficient” building products, this section of the *Update* focuses specifically on building products with recycled content.

Many recycled-content building products on the market are more common, available, and affordable than you might think. The National Recycling Coalition's Buy Recycled Business Alliance (BRBA) developed case studies of 18 organizations that have incorporated recycled materials into their buildings. These case studies demonstrate the wide range of products being used in construction and renovation projects today. WasteWise partners featured in the BRBA case studies include:

- **Ben and Jerry's** uses countertops made from recycled marble and plastic, and wainscoting and wall paneling with recycled cork.
- **The Body Shop's** American headquarters features carpeting made from 100 percent recycled PET plastic soda bottles and floor tiles containing recycled glass.
- **Bridging the Gap** furnished its headquarters in Kansas City, Missouri, with desks made from discarded wooden doors. It also used a variety of recycled-content and environmentally sensitive products throughout its offices.

<sup>2</sup> For a comprehensive definition of green building products, see the *Environmental Building News* article, “Building Materials: What Makes a Product Green?” at <[www.buildinggreen.com/features/gp/green\\_products.html](http://www.buildinggreen.com/features/gp/green_products.html)>



## The Wider World of Green Buildings

Green buildings and the suppliers, researchers, media outlets, associations, and programs that support and promote them are springing up across the country and around the world. Most of these programs take a holistic approach, treating a building as one unit with many diverse environmental impacts. Following are some of the issues beyond materials and waste that help define the up-and-coming field of sustainable building:

- **Energy Efficiency:** The energy your building uses can be a significant drain on both the environment and your budget. Therefore, energy efficiency is an essential part of sustainable building. EPA's Energy Star for Buildings program offers a comprehensive five-step program to reduce energy consumption in your building. The elements of this program include replacing your lighting and other appliances with more energy-efficient models, improving maintenance and operations procedures, and upgrading heating, ventilation, and cooling systems. Energy Star for Buildings also provides an online benchmarking tool that allows your organization to measure its building energy usage and compare the performance of your building against the average for your building type. If your building scores in the top 25 percent of energy performance, and you meet other requirements (including good indoor air quality), you can qualify to advertise your high-performance building with an Energy Star for Buildings label. See <[www.energystar.gov](http://www.energystar.gov)> for more information.
- **Renewable Energy:** Once you've reduced your building's energy needs, you might want to consider supplying those needs with energy sources that renew themselves naturally. These sources include solar, geothermal, wind, biomass, hydrogen, and other power sources. The U.S. Department of Energy has information about using renewable energy technologies at <[www.eren.doe.gov/RE](http://www.eren.doe.gov/RE)>.
- **Water:** EPA's water efficiency partnership program, known as WAVE (Water Alliances for Voluntary Efficiency), helps organizations identify and implement water conservation activities. WAVE partners sign an agreement to survey water-using equipment and, where profitable, install water-efficient upgrades within a prearranged time frame. Partners also agree to consider using water-efficient equipment in the design of all new facilities. Although WAVE once focused exclusively on the lodging industry, it is now open to organizations with office buildings and educational institutions as well. See <[www.epa.gov/owm/genwave.htm](http://www.epa.gov/owm/genwave.htm)> for more information.
- **Indoor Air Quality:** Whereas other aspects of sustainable building focus on effects on the outdoor environment, buildings create their own indoor environments as well. This is important for organizations to remember because indoor environmental quality can affect the health of those who occupy buildings, impact worker productivity, and even be a source of liability for organizations that do not monitor this issue. EPA's Indoor Environments Program has information about how to improve indoor air quality in building types, including office buildings and schools, at <[www.epa.gov/iaq](http://www.epa.gov/iaq)>.

- **McDonald's** used numerous recycled construction products in a Kent, Washington, restaurant, including tabletops, cabinets, and trash receptacles made of recycled particleboard, ceiling tiles containing recycled paper, and menuboards containing recycled plastic and aluminum.
- **Metro**, a regional government covering three counties in the Portland, Oregon, metropolitan area, located its new headquarters in a 71-year-old building, which it remodeled with components such as 100 percent recycled paint and recycled rubber floor tiles. The agency also salvaged 159 tons of hardwood flooring, carpeting, doors, and fixtures for reuse.
- **Waste Management** built its Government Affairs Office in Washington, DC, with approximately 85 percent reused or recycled materials, including ceiling tiles con-

taining steel slag and newsprint; countertops manufactured from recycled cardboard, newsprint, woodwaste, and recycled steel studs; and furniture containing recycled wood from old movie sets.

## Types of Materials Available

The Comprehensive Procurement Guideline (CPG) Program is part of EPA's ongoing effort to promote the use of materials recovered from the solid waste stream. The program offers purchasing guidelines to federal agencies and their contractors by recommending recycled-content materials. Many non-federal organizations also use the CPG to develop their own recycled-product purchasing programs. The CPG Program recommends high-performance construction products, including:

## King County, Washington, Sets a Green Example

In the fall of 1999, King County's Department of Natural Resources (DNR) moved into the King Street Center Building, a facility designed to be a model of environmental integrity and sustainability. Located in a historic district in downtown Seattle, the 8-story office building encompasses 327,000 square feet.

The building employs a water reclamation system that collects rainwater from the roof, filters the water, and uses it in the building's toilets. The building's water reclamation system also contributes to its sustainability, supplying 64 percent of the annual "flushing budget" and greatly reducing DNR's water costs, particularly during droughts. The system offers environmental benefits as well—each year, the system reclaims 1.4 million gallons of rainwater that would otherwise drain directly to Puget Sound.

Additional features of the King Street Center include recycled-content cement, ceiling tiles, bathroom stall partitions, and paint. Furthermore, the county reused latex paint collected as part of a residential program and installed refurbished carpet squares designed to be replaced individually instead of traditional wall-to-wall carpet.

You can learn more about King County's experiences and sample contract language for green construction and renovation efforts online at [www.metrokc.gov/procure/green/const.htm](http://www.metrokc.gov/procure/green/const.htm).

## LP Harnesses Benefits of Green Building Materials for New Headquarters

When Louisiana-Pacific (LP) moved its headquarters to accommodate a need for more space, it made every effort to create an environmentally sustainable office. Working closely with its architect to ensure this goal was met, 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 building features of LP's new office include:

- 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."

- **Building insulation.** Recycled-content building insulation is available in standard forms (rolls, loose fill, and spray foam) and contains a range of recovered materials, including glass cullet, plastics, paper fiber, and blast furnace slag.
- **Carpet.** Your organization can use recycled fiber polyester or nylon carpet. Environmentally responsible carpet is also available with recycled-content backing.
- **Cement and concrete.** These materials can be made using fly ash recovered from coal-burning power plants and ground blast furnace slag recovered from iron production.
- **Consolidated and reprocessed latex paint.** Consolidated paint, produced by mixing different types of collected postconsumer paint, is only recommended for outdoor applications. Reprocessed paint is sorted according to color, finish, and type during collection and can be used outdoors or indoors.
- **Floor tiles.** Recycled-content floor tiles and patio blocks can contain high percentages of plastic or rubber salvaged from truck and airplane tires.
- **Shower and restroom dividers/partitions.** These dividers can contain between 20 and 100 percent recycled-content plastic or steel.
- **Laminated paperboard and structural fiberboard.** Paperboard contains kraft paper and can be ideal for indoor decorative applications such as millwork and furniture components. Fiberboard is manufactured using recycled wood, cane, or paper and can be used as structural material, insulation, or acoustical tile.

For more detailed information about CPG guidelines for construction and other products, visit [www.epa.gov/cpg](http://www.epa.gov/cpg).



# R e s o u r c e s

## for C&D and Green Building



### ▼ EPA Construction & Demolition Debris Web site

<[www.epa.gov/epaoswer/non-hw/debris](http://www.epa.gov/epaoswer/non-hw/debris)>

This brand-new Web site brings together information from EPA and other sources on C&D debris prevention, reuse, recycling, and management, including numerous documents and links. A companion site on the broader issues of green building will be accessible through this site.

### ▼ Characterization of Building-Related Construction and Demolition Debris in the U.S. EPA530-R-98-010. June 1998.

<[www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf](http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf)>

This report characterizes the quantity and composition of building-related C&D debris generated in the United States and summarizes management practices for this waste stream. It focuses on construction, demolition, and renovation of residential and nonresidential buildings.

### ▼ Building Savings: Strategies for Waste Reduction of Construction and Demolition Debris from Buildings. EPA530-F-00-001. June 2000.

<[www.ilsr.org/recycling/buildingdebris.pdf](http://www.ilsr.org/recycling/buildingdebris.pdf)>

This series of case studies on construction materials diversion provides valuable tips on C&D reuse and recycling. The case

studies, covering projects ranging from an apartment complex to a grocery store, provide details on implementation costs, cost savings, and tips for replication.

### ▼ EPA's Comprehensive Procurement Guidelines (CPG)

<[www.epa.gov/cpg](http://www.epa.gov/cpg)>

CPG provides a wealth of information about buying recycled-content products. Ranging from construction to landscaping products, CPG offers recommended recycled-content levels as well as contact information for manufacturers and suppliers of recycled-content products and materials.

### ▼ EPA's Environmentally Preferable Purchasing (EPP) Program

<[www.epa.gov/oppt/epp](http://www.epa.gov/oppt/epp)>

This Web site features a searchable database containing contract language and voluntary standards for more than 600 products and service categories—many of which relate to construction. Numerous case studies highlighting green construction successes, such as EPA's Region 10 remodeling effort and the Fort Worth Post Office, are also provided.

### ▼ EPA's Jobs Through Recycling Program — Construction Materials Commodity Page

<[www.epa.gov/jtr/comm/construc.htm](http://www.epa.gov/jtr/comm/construc.htm)>

This Web site profiles construction materials reuse and recycling, and provides links to various reports, organizations, and list server postings covering everything from asphalt to particle board.

### ▼ 2000 Buy-Recycled Series: Construction Products. EPA530-F-00-009. June 2000.

<[www.epa.gov/cpg/const-00.pdf](http://www.epa.gov/cpg/const-00.pdf)>

This fact sheet lists EPA's recommended postconsumer recycled-content percentages of various construction products. Geared toward federal facilities and con-

tractors seeking assistance in complying with EPA's Comprehensive Procurement Guidelines, the information provided is also applicable to a wide audience. The fact sheet includes short case studies on local, state, and federal government construction projects.



### ▼ ENERGY STAR®

<[www.energystar.gov](http://www.energystar.gov)>

ENERGY STAR, a collaborative effort between U.S. EPA and the U.S. Department of Energy (DOE), encourages businesses and consumers to make energy-conscious decisions through the purchase of energy-efficient products. ENERGY STAR also qualifies homes and buildings as energy-efficient.

### ▼ EPA's Indoor Environments Division

<[www.epa.gov/iaq](http://www.epa.gov/iaq)>

This Web site highlights information on issues related to indoor air quality. Topics discussed include asthma, radon, and mold. The site also provides indoor air quality information that is specific to homes, schools, and buildings.

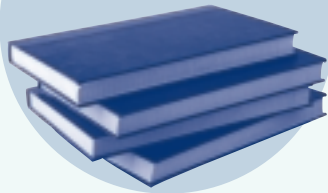
### ▼ Water Alliances for Voluntary Efficiency (WAVE)

<[www.epa.gov/owm/faqw.htm](http://www.epa.gov/owm/faqw.htm)>

This Web site provides information about WAVE, a voluntary partnership program that encourages commercial businesses and institutions to practice water efficiency. Upon joining the program, members receive free technical support and access to water-use analysis software.



## Other Publications



▼  
**A Guide to Deconstruction.**  
**U.S. Department of Housing and Urban Development.**  
**February 2000.**

<[www.huduser.org/publications/pdf/decon.pdf](http://www.huduser.org/publications/pdf/decon.pdf)>

This guide reviews the components and benefits of deconstruction and links it to community revitalization efforts. The guide provides 10 detailed case studies of deconstruction materials reuse and recycling efforts throughout the country.

▼  
**National Recycling Coalition's Buy Recycled Business Alliance Case Studies**

<<http://brba.nrc-recycle.org/casestudies.htm>>

These case studies feature leading U.S. companies that used recycled-content materials and products for building construction and interior design.

▼  
**Designing With Vision: A Technical Manual For Material Choices In Sustainable Construction.**  
**California Integrated Waste Management Board.**  
**July 2000.**

<[www.ciwmb.ca.gov/GreenBuilding](http://www.ciwmb.ca.gov/GreenBuilding)>

This manual highlights sustainable waste management principles for planning, design, and construction of large-scale projects. It includes information on choosing, locating, and purchasing recycled-content building products; provides sample contract language and recycled-content building product specifications; and identifies strategies for reusing and reducing construction materials and managing job-site waste.

▼  
**Sustainable Architecture Compendium.**  
**National Pollution Prevention Center for Higher Education, University of Michigan.**  
**August 1998.**

<[www.umich.edu/~nppcpub/resources/compendia/architecture.html](http://www.umich.edu/~nppcpub/resources/compendia/architecture.html)>

Part of the Pollution Prevention in Architecture Series, this instructive group of reports features recycling and reuse "modules" on topics such as C&D recycling, adaptive reuse, and design for materials recovery.

## Periodicals



▼  
**C&D Recycler. Recyclingtoday Media Group.**

<[www.recyclingtoday.com/magazine](http://www.recyclingtoday.com/magazine)>

This bimonthly journal includes feature stories; industry, product, and equipment news; and editorials on the construction and demolition recycling industry. Articles from the current issue are available online.

▼  
**Environmental Building News**

<<http://buildinggreen.com>>

This leading newsletter on environmentally responsible construction features comprehensive, practical information on topics from energy efficiency and recycled-content materials to land-use planning and indoor air quality. It also includes industry news, product reviews, and case studies. Some articles and article summaries are available online.

▼  
**Environmental Design + Construction. Business News Publishing II LLC.**

<[www.edcmag.com](http://www.edcmag.com)>

This bimonthly journal covers all aspects of environmentally sound building design and construction, including recycled building products and systems of waste disposal and reuse. The Web site includes a searchable online buyers' directory that lists companies offering environmentally preferable products and services.

## Web Sites



▼  
**King County, Washington: Map of Recycled Content Buildings**

<<http://dnr.metrokc.gov/market/encompass>>

This site allows visitors to take a virtual tour of sustainable buildings located in the Pacific Northwest. A list of recycled-content materials used in various buildings is also provided.

▼  
**California Integrated Waste Management Board (CIWMB)**

<[www.ciwmb.ca.gov/condemo](http://www.ciwmb.ca.gov/condemo)>

CIWMB's construction and demolition recycling Web site is an excellent resource, providing commodity profiles, online reports, case studies, and sample C&D recycling ordinances for local governments.

▼  
**Institute for Local Self Reliance's (ILSR's) Building Deconstruction Page**

<[www.ilsr.org/recycling/builddecon.html](http://www.ilsr.org/recycling/builddecon.html)>

Part of ILSR's Waste to Wealth waste reduction and recycling-based economic development program, the building deconstruction page highlights some of the organization's projects and publications.

### ▼ Sustainable Building Sources

<[www.greenbuilder.com/general/BuildingSources.html](http://www.greenbuilder.com/general/BuildingSources.html)>

This site features a Green Building Professionals Directory, Sustainable Building Events, and a Sustainable Building Sourcebook that provides information on building materials as well as water and energy efficiency technologies.

### ▼ Minnesota Sustainable Design Guide

<[www.sustainabledesignguide.umn.edu](http://www.sustainabledesignguide.umn.edu)>

This online guide serves as a design tool that can be used to address environmental issues during the design, construction, and operation of new and remodeled facilities.



### ▼ Associated General Contractors (AGC)

<[www.agc.org/Environmental\\_Info/Recycle\\_This.asp](http://www.agc.org/Environmental_Info/Recycle_This.asp)>

AGC is the largest construction trade association in the country. Their Web site includes fact sheets and a brochure on C&D debris recycling.

### ▼ Center for Resourceful Building Technologies (CRBT)

<[www.crbt.org/index.html](http://www.crbt.org/index.html)>

A project of the National Center for Appropriate Technology, CRBT promotes environmentally responsible practices in construction. CRBT conducts research and provides education on practicing resource efficiency in building design, materials selection, and construction practices.

### ▼ Construction Materials Recycling Association (CMRA)

<[www.cdrecycling.org](http://www.cdrecycling.org)>

This organization supports the needs of the rapidly expanding North American construction waste and demolition debris processing and recycling industry.

### ▼ U.S. Green Building Council (USGBC)

<[www.usgbc.org](http://www.usgbc.org)>

The flagship organization for green buildings, the USGBC rates green buildings through its Leadership in Energy and Environmental Design program. Its more than 500 members include architects, contractors, governments, nonprofit organizations, product manufacturers, and companies.

### ▼ University of Florida Center for Construction and Environment

<[www.cce.ufl.edu](http://www.cce.ufl.edu)>

One of the few academic centers of its kind in the country, the Center for Construction and Environment conducts research and undertakes projects to minimize environmental impacts from building construction and demolition. The Web site includes case studies on past and current deconstruction projects.

### ▼ Used Building Materials Association (UBMA)

<[www.ubma.com](http://www.ubma.com)>

This nonprofit, membership-based organization represents companies and organizations involved in the acquisition and/or redistribution of used building materials. Its Web site features the Used Building Materials Exchange.

## Green Building Codes, Specifications, and Guidelines



### ▼ WasteSpec. Model Specifications for Construction Waste Reduction, Reuse, and Recycling. Triangle J Council of Governments. July 1995.

<[www.tjcog.dst.nc.us/cdwaste.htm](http://www.tjcog.dst.nc.us/cdwaste.htm)>

This 114-page manual provides architects and engineers with model specifications and background information on waste reduction, reuse, and recycling before and during construction and demolition.

### ▼ Navy Family Housing Project Standards

<[www.navfac.navy.mil/doclib/files/85H\\_Final\\_4May00.PDF](http://www.navfac.navy.mil/doclib/files/85H_Final_4May00.PDF)>

This document outlines the standards and criteria for designing, renovating, and constructing Navy family housing and associated facilities. Green building topics include energy efficiency and sustainable development.

### ▼ Leadership in Energy and Environmental Design (LEED)

<[www.usgbc.org/programs/index.htm](http://www.usgbc.org/programs/index.htm)>

LEED—a system designed for rating new and existing commercial, institutional, and high-rise residential buildings—offers an abundance of resources pertaining to green buildings. This site provides an overview of the LEED rating system, links to resources, and a list of LEED-certified and LEED-registered projects.

### ▼ Governor's Green Government Council (GGGC)

<[www.gggc.state.pa.us](http://www.gggc.state.pa.us)>

The state of Pennsylvania's GGGC provides guidelines for creating high-performance green buildings. The council also offers information on Model Green Office

Leasing Specifications and renovating and retrofitting existing structures.

▼  
**New York City Department of Design and Construction**

<[www.ci.nyc.ny.us/html/ddc/home.html](http://www.ci.nyc.ny.us/html/ddc/home.html)>

New York City's High Performance Building Guidelines encompass a wide array of green building topics ranging from design process and site planning to building energy use and material and product selection.

**Recycled/Green Building Product Directories**



▼  
**The Harris Directory**

This computer database for Windows lists construction products made with recovered

materials in a Construction Specifications Institute format. Contact Ms. B.J. Harris P.O. Box 31133 Santa Fe, NM 87594 USA 505/983-2962; e-mail: <[bjharris@icg.org](mailto:bjharris@icg.org)>

▼  
**Oikos Green Product Gallery**

<[www.oikos.com/products](http://www.oikos.com/products)>

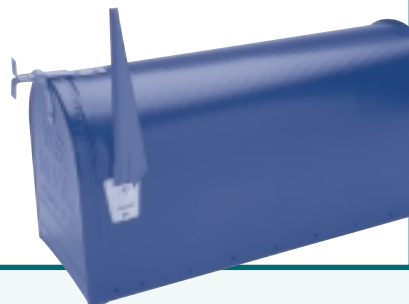
This online gallery provides information on a variety of green building products such as flooring, natural oil-based finishes, non-ozone-depleting insulation foam, and structural components.

▼  
**GreenOrder**

<<http://greenorder.com>>

This online catalog offers information on construction products, including concrete, thermal and moisture protection products, furnishing, and equipment.

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