

Industrial Revolution

Every home makes compromises among different and often competing goals: comfort, convenience, durability, energy consumption, maintenance, construction costs, appearance, strength, community acceptance, and resale value. Often consumers and developers making the tradeoffs among these goals do so with incomplete information, increasing the risks and slowing the adoption of innovative products and processes. This slow diffusion negatively affects productivity, quality, performance, and value. This department of Cityscape presents, in graphic form, a few promising technological improvements to the U.S. housing stock. If you have an idea for a future department feature, please send your diagram or photograph, along with a few, well-chosen words, to elizabeth.a.cocke@hud.gov.

Waste Management at the Residential Construction Site

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Some of the material in this article is from the authors' chapter in the book Integrated Waste Management, Volume I (Laquatra and Pierce, 2011).

Abstract

Construction and demolition (C&D) debris is produced during the construction, rehabilitation, and demolition of buildings, roads, and other structures (Clark, Jambeck, and Townsend, 2006). According to the U.S. Environmental Protection Agency (EPA, 2003), C&D debris amounts to 170 million tons per year, or 40 percent of the solid waste stream in the United States. Although efforts to reduce this debris through reduction, recycling, reuse, or rebuying continue to expand through government mandates, green building incentives, and education, much work remains.

Status Quo

The construction of a single-family home typically produces more than 2 tons of construction and demolition (C&D) debris material that is becoming increasingly difficult and expensive to discard. Some waste disposal facilities are refusing to accept C&D debris. In fact, a survey of home builders indicated that high C&D waste disposal costs negatively affect the economic health of their companies. In response to this situation, progressive and successful builders across the United States are implementing waste management programs as a critical cost-reducing component of the construction process.

Sustainability means that a community or society can continue to do what it is doing forever. But current rates of raw material inputs and energy consumption required to construct, maintain, and then dispose of buildings in the United States are certainly not sustainable for any extended period of time. In addition, the widespread practice of simply burying C&D materials instead of using those materials to reduce the amounts of raw materials extracted from the environment is a strategy that cannot be sustained indefinitely.

Federal Regulations and C&D Debris

Although C&D debris is not explicitly regulated at the federal level in the United States, the Resource Conservation and Recovery Act (RCRA) of 1976, which amended the Solid Waste Disposal Act of 1965, covers the disposal of solid and hazardous waste. RCRA set the following national goals (EPA, 2010).

- Protect human health and the environment from the potential hazards of waste disposal.
- Conserve energy and natural resources.
- Reduce the amount of waste generated.
- Ensure wastes are managed in an environmentally sound manner.

State Regulations and C&D Debris

Through the state authorization rulemaking process, the U.S. Environmental Protection Agency has delegated RCRA implementation responsibility to individual states. Clark, Jambeck, and Townsend (2006) effectively documented the wide variation among states in their regulations concerning the disposal of C&D debris. The authors noted differences regarding definitions, specifically whether states defined C&D debris as one or two categories for regulatory purposes, whether they categorized inert debris, and whether they applied other definitions to C&D debris. They noted which states did and did not have landfill liner requirements and which had specifications for leachate collection. Permitting issues they noted were those pertaining to financial assurance and training for operators and landfill spotters. They also reported on state regulations that are specific to C&D landfills, C&D recycling facilities, and groundwater monitoring requirements, and they reported which states were updating regulations for disposal of C&D debris.

Local Municipal Programs and C&D Debris

Many local governments have instituted programs and issued regulations as a method to reduce the amount of C&D waste flowing to local landfills. Three examples of specific local programs—in Portland, Oregon; Austin, Texas; and Seattle, Washington—are described in this section.

The city of Portland, Oregon, provides an example of a local municipality that has set regulations that require the general contractor of all building projects costing more than \$50,000 to make certain that 75 percent of the waste produced on the jobsite be recycled. The general contractor is responsible for setting up a recycling program, including containers or storage areas separate from garbage for materials being recycled. The general contractor must complete a preconstruction recycling plan that details precisely how and where the following materials will be recycled (Portland BPS, 2011).

- Rubble (concrete and asphalt).
- Land-clearing debris.
- Corrugated cardboard.
- Metals.
- Wood.

The city of Austin, Texas, provides an example of a municipality that uses a green building program to provide incentives to reduce construction wastes. The program sets minimum recycling and reuse levels for construction waste if buildings are to qualify for the Austin Energy Green Building designation. Waste reduction and recycling requirements set forth in the program are designed to help the city meet the goal of a 90-percent reduction in materials sent to landfills by 2040 (Austin Energy, 2010).

As part of the requirements that builders and developers must meet to obtain the Austin Energy Green Building designation, they must set aside space on the construction site for sorting and temporary storage of reusable and recyclable materials. Builders also may be allowed to reuse many of the waste materials on site. For example, waste wood and cleared brush can be chipped and used for onsite landscaping purposes (exhibit 1). During a case study of this issue, a builder proposed that chipped wood be available as a value-added item for each homebuyer: a pile of free mulch for any landscaping the buyer planned to do (Laquatra and Pierce, 2004). Also for the Austin program, gypsum drywall scraps can be ground on site and used as a soil amendment. Concrete can be crushed and used as fill or drainage under garden beds or driveway areas. The program requires that a minimum of 50 percent of the waste generated by the construction project must be recycled or reused (Austin Energy, 2010).

The city of Seattle, Washington, has also set very ambitious targets for reducing waste materials. The goal is to recycle 70 percent of all waste by 2025. As a method to reduce construction waste, the city provides educational materials to contractors and developers on methods to reduce construction waste. The city has an online checklist that describes basic steps in setting up a jobsite reuse and recycling strategy. In addition, the following online resources are also provided: (1) a searchable database for recycling C&D waste, and (2) a recycling directory to identify which materials are easiest to recycle in the region (Seattle DPD, 2010).

Exhibit 1

Producing Mulch on Site by Chipping Wood Waste



Photo by Mark Pierce

Lean construction techniques offer increased value to homebuyers while decreasing waste (Bayer, 2013). Nahmens (2010) reported that lean construction techniques overall reduce material waste by 64 percent and production hours by 31 percent. Thus, waste management techniques, which are an important subset of lean construction, should in principle result in cost savings. These cost savings to the builder can be passed along to the homebuyer. A case study that examined the construction of two houses for which the builder recycled 8.7 tons of waste materials and landfilled 0.9 tons found that the cost of recycling waste was \$710. Standard hauling and landfilling fees if waste was not recycled would have amounted to \$1,403 (U.S. Air Force, n.d.). To our knowledge, no formal studies have been conducted to indicate whether builders are passing along these savings to homebuyers.

Green Building Programs and C&D Debris

Besides regulation, incentives exist for managing C&D debris in ways other than disposal in landfills. A number of green building programs are in effect at the national, state, and local levels throughout the United States. The most well known of these programs is Leadership in Energy and Environmental Design (LEED), which is administered by the U.S. Green Building Council. Through the LEED program, buildings are certified as meeting sustainability standards. LEED focuses on specific areas of environmental health, including resource efficiency. Points are awarded to a development project for minimizing the amount of C&D debris that is sent to landfills. LEED is applicable to all buildings, including homes.

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