Construction and Demolition Case Study

CANMET Advanced Houses Program

Table of Contents

1. Purpose and Background
2. British Columbia Advanced House
3. EnviroHome
4. Kitchener-Waterloo Home
5. Innova House
6. Manitoba Advanced House
7. Hamilton Neat Advanced House
8. Saskatchewan Advanced House
9. Conclusion

Purpose

The Canada Center for Mineral and Energy Technology (CANMET) Advanced Houses Program shows how to reduce waste by using recycled-content building materials and by practicing resource-efficient construction and demolition methods. This study can inform the California building industry about ways to reduce waste generation in building and construction practices.

Background

In 1992, CANMET, the main governmental research and technology development arm of Energy, Mines and Resources Canada, in partnership with the Canadian Home Builders Association, challenged the building industry to design and build houses that promoted energy efficiency and environmental responsibility. This challenge took shape as the National Advanced Houses Competition.

Under the Advanced Houses Program, 10 prototype homes, all winners of a national design competition, were constructed across Canada. Thanks to an impressive array of new ideas, concepts and product prototypes, each home pushed the limits of building technology to meet the program's rigorous technical requirements.

Program Goals

To capture the imagination and enthusiastic support of the entire building industry, CANMET Advanced Houses Program asked for team participation by builders, architects, designers, engineers, manufacturers, researchers, utility specialists, local home builders associations, and local government agencies.

Technical Requirements

Each "advanced house" presented a unique response to the challenges facing the housing industry as outlined in these technical requirements:

- Total purchased energy consumption was only 25 percent of a conventional house.
- Environmental management requirements consisted of 50 percent water reduction; environmentally friendly products; recycling facilities indoors; recycled materials; no chlorofluorocarbons (CFC); and a construction waste management plan that reduced approximately 2.6 tons of waste that conventional houses sent to landfills.
- Each house had to meet requirements regarding indoor air quality, healthy materials, noise limits, humidity control, and room-by-room ventilation.

Conclusion

CANMET's Advanced Homes Program and the homes built under this program have successfully demonstrated both innovative methods for reducing energy consumption and reducing the impact of housing construction on the environment.

This success of this effort is due to the involvement and commitment of a broad range of members of the construction industry, including builders, architects, designers, engineers, manufacturers, researchers, utilities, and local home builders associations as well as local and provincial governments.

All of the demonstration homes were sold to the public and are now occupied by homeowners. After a year of monitoring for performance, there were no problems found in the homes. These demonstration homes serve to develop new products and educate developers, builders, and the public on how homes can be built to conserve resources and with minimal environmental impacts.

More Information:

CANMET Building Group
580 Booth Street, 13th Floor
Ottawa, ON K1A 0E4
Fax: (613) 996-9416

California Department of Resources Recycling and Recovery (CalRecycle)

Construction and Demolition Case Study

Part 2: CANMET Advanced Houses Program

British Columbia Advanced House

This demonstration house is a 2754 sq ft single-family home built in a new subdivision in Greater Vancouver, British Columbia (B.C.), with recycled-content building materials in these areas:

Waste Reduction
Waste reduction was an important consideration in the planning and construction of the B.C. Advanced House. A comprehensive waste management program based on the three Rs—reduce, reuse, and recycle—was undertaken to lessen the impact of house construction and operation.

By choosing to build with prefabricated components and through the use of premanufactured elements such as roof, walls, and floor panels, the quantity of material wasted on the site was greatly reduced and much of the waste wood was reused at other construction sites.

Roofing
The roof showcases a new made-in-British Columbia technology that meets all the Advanced Houses Program criteria. Developed at the University of B.C., the roof tiles are made of a new cement composite creating fire resistant, nonhazardous roofing products.

The main ingredients are wood waste cellulose fibers and by-products of the fertilizer industry, which are chemically combined to create this new product. The product is half the weight of comparable concrete products and it has some of the benefits of wood fiber resilience.

Engineered Wood Products
Throughout the home, structural beams and floor joists are made from engineered wood products. These products provide strength and dimensional stability, eliminate twist and shrinkage, and can withstand loads far exceeding those of conventional lumber. In areas where the structure requires larger beams, parallel strand lumber, which is a layered and laminated wood product, can be used.

Site Drainage
In an effort to create a market for recycled green glass, this project used a mixture of conventional drain rock with 40 percent ground green glass under and around the perimeter of the house as a drainage layer.

Rubber Brick Pavers
A new interlocking paving brick made from recycled rubber tires was used for the patio and on the garden paths.

Drywall
Recycled content gypsum wallboard (manufactured by Domtar) contained recycled gypsum collected as scrap material from other construction sites.

Decking
The deck off the master bedroom is made with a plastic wood, which is locally manufactured, and made of recycled plastic such as that from milk jugs and yogurt containers.

The EnviroHome

This 2200 sq ft residence, built on a 70 ft x 130 ft lot located in a new subdivision in Bedford, Nova Scotia by Clayton Developments, features extensive use of recycled materials in products such as drywall, insulation, siding, roof shingles and concrete, and incorporates the recycled content building materials listed below.

Waste Reduction
All of the construction waste on the EnviroHome site was separated, bagged and weighed. Recyclable waste was reused where possible. Broken masonry was used in the bottom of the chimney, and interior wall cavities were filled with drywall scraps to add thermal mass.

Wood ends were used for blocking and bridging, and other wood waste was burned for heat. The rest went to a landfill site. The

construction of the EnviroHome generated approximately 7520 lb of waste at the site. Approximately 62 percent of this was recycled (4641 lb), another 6 percent was reused (428 lb) at the site, and approximately 33 percent was landfilled (2467 lb).

Insulation
A cellulose insulation produced in Nova Scotia was chosen for the wall and ceiling cavities because of its low cost, thermal performance, and environmental benefits. This product is made from waste newsprint, which saves energy and requires little manufacturing energy.

Drywall
The drywall used is made in Nova Scotia from gypsum bonded with cellulose fibers from recycled paper. There are no separate paper facings like those found on traditional gypsum wallboard. This product also offers excellent sound control, thermal insulation, and fire resistance.

Structural Concrete
The addition of one and a half tons of powerplant fly ash to the EnviroHome's structural concrete helped to reduce environmental damage by using a waste product that has historically caused air and water pollution.

Fly ash, a fine grayish powder, is a by-product of coal-fired electric plants. Much of this fly ash makes its way into ready-mix concrete, where it displaces up to 10 percent of the cement content. This is significant in that the manufacture of cement is energy intensive. The fly ash also increases the strength and workability of the concrete, without increasing the price.

Roofing
The long life roof shingles contain a percentage of recycled newsprint. By choosing a better quality shingle with a long life expectancy, one can further reduce the amount of waste that goes to the landfill site.

Landscaping
Rocks from the excavation were saved and used as landscape features. A compost bin located at the rear of the garage provides organic fertilizer. Food wastes from the kitchen were composted and used instead of chemical fertilizers around the property.

Hardboard Siding
A durable, low-maintenance hardboard siding was used on this home. This product is made from trees that would otherwise be left on the harvest site or used for firewood. Wood from low-value trees and sawmill waste is broken down into fibers, then compressed under heat and pressure. Natural components in the wood fiber provide the bonding agents. In addition, sander dust is used as fuel, replacing oil in the manufacturer's furnaces.

Fireplace
A high-efficiency radiant heat masonry fireplace was installed in the EnviroHome. The refractory (the core of the unit) is made of recycled firebricks, which arrive from the manufacturer as interlocking precast pieces. This ensures a high standard of quality control not attainable in most site-built units.

Construction and Demolition Case Study

Part 3: CANMET Advanced Houses Program

Kitchener-Waterloo Green Home

This demonstration house is a 2500 sq ft single family home built jointly by Kitchener-Waterloo Home Builders Association and Enermodal Engineering Limited.

This home takes a "low tech" approach to energy efficiency and environmental responsibility. The "green home" building shell components are a major departure from conventional building practices. This home is energy-efficient, draft free, durable, made from a minimum of materials, and incorporates the recycled-content building materials listed below.

Waste Reduction
A comprehensive waste management program was undertaken to reduce the impact of house construction and operation on the environment. The program was based on the waste management hierarchy of reduce, reuse, and recycle. The use of premanufactured components, such as ceiling, wall, and floor trusses, resulted in no waste cuttings being generated at the site.

Much of the wood waste from the house was taken by contractors for use on other jobs. Wood pallets and tarpaulin quality packaging were reused for storage of materials at other construction sites. Insulation scraps and other inert materials were placed in the attic for added insulation.

Drywall scraps were inserted in interior walls for extra thermal insulation. Leftover concrete from pouring the floor slab was set in a field, crushed, and used as aggregate on other construction sites.

Wood Truss
Above-grade walls are framed using trusses instead of studs. Each truss is made up of two load-bearing members connected by a thin web. The truss system is factory built with the scraps reused in new trusses, thereby eliminating construction waste.

The truss system uses 35 percent less wood than conventional wood stud walls and site labor requirements are reduced. The load-bearing members are made of laminated strips from fast growing trees and the webs are made from wood scraps.

Insulation
Wall cavities are filled with wet-blown cellulose insulation manufactured from recycled newspapers.

Drywall
The drywall used for this home contains a minimum of 25 percent recycled drywall wastes and is without a paper covering for use on interior walls.

Wood Siding
The exterior cladding is made from scrap wood pressed into an attractive wood siding.

Roofing
Steel roofing was selected instead of asphalt shingles because it has a high recycled material content, lasts the life of the building, and can be recycled. Asphalt shingles were not chosen because they last only 10 to 20 years, emit volatile organic compounds, and present difficulties in safe disposal.

Interior Furnishings
The hardwood flooring was recovered from a demolished building. A refurbished bathtub and sink are used in the lower floor washroom.

Flooring
Floor tiles made from recycled glass, instead of petroleum-based vinyl, are used in the front entrance and bathrooms. Recycled materials were used in the carpeting (manufactured from polyethylene terephthalate [PET] plastic soda pop bottles), and the gypsum underlay for the tile floor contains used paper products.

Bathroom Glass Walls
An interior glass wall made from recycled glass admits natural light into the north side of the bathroom.

Landscaping
Recycled rubber walkway paving units were used.

Innova House

This demonstration house is located in a new community just outside Ottawa and is a 2190 sq ft single family home with four bedrooms. Built by Minto Development, Inc., construction required the support of many public and private sector groups. This house incorporated the following recycled content building materials:

Insulation
The walls are insulated with cellulose fiber insulation that is blown behind a fine mesh prior to installing the wallboard. The insulation is made from recycled cellulose fibers (i.e., old newspapers), which satisfies the requirements of the Canadian Environmental Choice™ Program. The program stipulates that insulating material must contain 100 percent recycled paper fibers and meet stringent performance standards.

Carpet
The Innova House used carpets made from recycled plastic soda pop bottles.

Wallboard
Wallboard in the house contains 30 percent recycled newsprint by volume.

Roof Shingles
Roof shingles are made from recycled materials (i.e., sawdust formed under heat and pressure).

The Manitoba Advanced House

The Manitoba Advanced House is a 2000 sq ft single family home located in south Winnipeg and was constructed by Maintoba Home Builders Association. This project features construction techniques intended to reduce the amount of waste generated at the job site. The house incorporated the following waste management techniques and recycled-content building materials:

Lumber
Scrap lumber generated at the job site during construction of this house was used for blocking where needed.

Packaging Materials
All suppliers of building materials for this project were advised that all packaging materials had to be made of recycled materials or be capable of being recycled.

Roofing
Pine shakes were used instead of asphalt shingles, which require large amounts of nonrenewable energy to produce. Pine shakes cost about 15 percent more than asphalt shingles, but they have a life expectancy of 30 to 50 years, after which they can be recycled.

Drainage
The fill under the foundation and over the plastic drainpipes, or weeping tiles, is an indication of the imagination used. About 30 percent of the fill is empty whiskey bottles, smashed, and pulverized on site by tumbling in a concrete mixer with pea gravel. The ground-up whiskey bottles reduced the amount of gravel required.

Construction and Demolition Case Study

Part 4: CANMET Advanced Houses Program

The Hamilton Neat Advanced House

This demonstration house, located in suburban Hamilton, is 2670 sq ft. It uses a range of innovative, prototype building materials to improve the construction process while enhancing the quality of the finished house. The following recycled content building materials were incorporated:

Roofing
The roofing used was rubber-coated steel, which contained recycled steel.

Wallboard
The wallboard used in this house contained recycled gypsum.

Concrete Aggregate
Recycled concrete aggregate was used for the foundation of the house.

Insulation
The insulation used in this house contains recycled fiberglass.

The Saskatchewan Advanced House

This demonstration house, located in Saskatoon, Canada, is approximately 2500 sq ft, with a 1430 sq ft basement, and explores innovative, prototype building techniques to improve the construction process while enhancing the quality of the finished house. This house incorporated the following recycled-content building materials:

Roofing
The wastes from brickwork and roofing tiles were crushed and mixed with gravel for use as fill under concrete slabs in garages and driveways.

Blocking and Backing
The shorter lengths of lumber left over from the framing process were able to be reused for blocking and backing.

Carpeting
Carpets used were made from recycled soda pop bottles.

Floor Trusses and Beams
The largest piece of dimensional lumber used in this house is 2" x 6". The house was designed to minimize the amount of wood needed for the structure. Framing members were selected on the basis of resource efficiency. Built-up beams and manufactured I-beams were used to build the roof and floor systems. Window headers were preconstructed of wood scraps laminated into the required shapes and sizes.