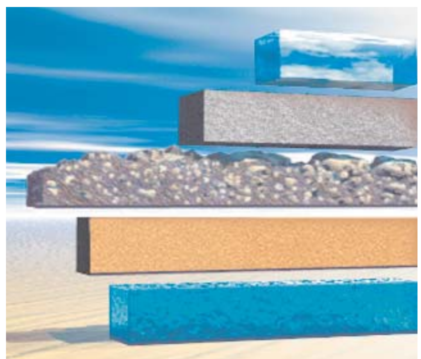
Building Green with Gray Concrete

The buildings in which we live and work have a tremendous impact on our global environment. Sustainability or "green building" seeks to balance resource efficiency, health, and social concerns throughout the life cycle of a structure. Concrete has a variety of benefits to offer in achieving this goal.

What is concrete?

Concrete and cement are often confused. Cement is a gray powder that, when mixed with water, binds sand and stone together to create concrete. Concrete is the world's most abundant building material. This "liquid stone" can be shaped to make roads, bridges, dams, hospitals, and homes. It is extremely strong and durable. The longevity of concrete means less maintenance and replacement when compared to other building products. This contributes to the environmental value of this versatile building material.

Although making cement requires a great deal of energy, cement is only a minor portion (7%–15%) of concrete. The other ingredients, aggregates and water, are sourced and require very low energy to obtain.



Progress from research

The high temperatures needed for cement manufacturing make it an energy intensive process, as with the production of many building materials. Both fuel for heating and the chemical reaction from processing raw materials generate carbon dioxide (CO^2). Global concerns about climate changes have led industry researchers to find ways to minimize CO^2 production. The result is a 29% decrease in carbon dioxide output from cement plants during the past three decades.

Research has also led to the use of industrial by-products in the manufacturing process. Pound for pound, used tires contain about 25% more energy than coal, and the U. S. generates millions of them. In 2004, about 130 million tires were consumed as fuel in cement kilns (out of 290 million produced), reducing fossil fuel consumption and removing them from the waste stream. Concrete can also utilize fly-ash, slag cement, and silica fume as a partial replacement for portland cement. These are by-products from power plants, steel mills, and silicon manufacturing facilities. In reasonable proportions, these by-products confer beneficial properties to concrete. In 2003, 3 million tons of fly-ash was used in the manufacturing of cement and another 12.2 million tons in the production of concrete. (ACAA–2003 data).

A cradle-to-grave perspective

Concrete is an extremely durable material. Life spans for concrete building products are frequently double or triple those of other common building materials. Concrete is virtually unaffected by heat and cold, UV rays, and moisture. This reduces the waste created by the removal and replacement of weathered or moisture damaged materials.

Raw material production

The predominant raw material for cement is limestone, the most abundant mineral on earth and readily available throughout North America. An environmental study conducted in Canada[1] analyzed the site impact of logging, ore mining, and aggregate extraction. It concluded that aggregate quarries take a lesser environmental toll than the other construction materials. Quarries, the primary source of raw materials, can be readily reclaimed for recreational, residential, or commercial use, or they can be restored to their natural state.

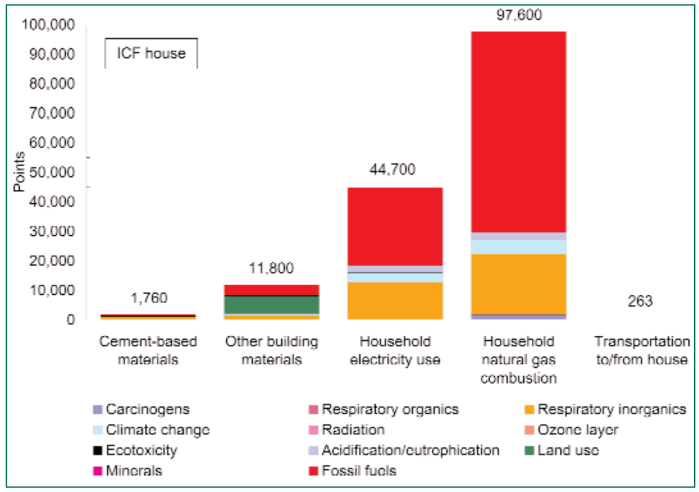
Building Green with Gray Concrete

Construction phase

Ever seen the piles of scrap lumber, sheathing, and packaging materials filling dumpsters at a construction site? Concrete is ordered and mixed for each individual job. On-site scrap and waste are minimized and any leftovers can be recycled or made into large blocks for erosion protection.

Operational phase

Recently developed methods for homebuilding with concrete use less energy than some traditional homebuilding methods. Research revealed that homes built with insulated concrete walls actually use less energy over the life span of a home than typical wood frame construction[2]. Less than 1% of the life cycle energy is due to the manufacture of cement and production of concrete. Household energy use for heating and cooling represent 85 to 95% of the energy use. In about 5 to 7 years, the energy used by a typical wood frame home begins to exceed that of an insulated concrete home. This environmental benefit continues for as long as the home is utilized. The environmental impacts of a home with insulating concrete (ICF) walls are shown in the figure.



Concrete contributes to good indoor air quality as new concrete does not have off-gassing often prevalent in many other new construction materials.

Demolition phase

Although concrete has one of the longest useful life-spans for construction materials, its usefulness does not end after its original purpose. In most urban areas, almost all concrete is crushed and recycled for use in road base and backfill. In some cases, it is recycled for aggregate in new concrete. Research continues to find new applications for recycled concrete.

Versatility

The applications for concrete and cement-based materials is growing rapidly. Stucco, fiber–cement siding, and concrete roof tiles need minimal maintenance and provide long lasting protection from the elements. These products are also useful in fire prone areas where stray sparks can lead to devastating results. Decorative concrete slabs and concrete pavers for patios eliminate the need for costly annual maintenance, associated cleaners, and solvent-based coatings for wood decks. Even with good care, exterior wood structures require replacement long before their concrete counterparts.

The following resources are available to learn more about building green with gray concrete.

1. "Assessing the Relative Ecological Carrying Impacts of Resource Extraction," by Wayne B. Trusty and Associates Ltd. in association with Environmental Policy Research, submitted to Forintek Canada Corp. for its Sustainable Materials Project, August 1994

2. "Ecological Carrying Impacts of Building Materials Extraction," by Dr. Robert Paehlke, Natural Resources Canada, submitted to For3intek Canada Corp for its Sustainable Materials Project, September 1993

3. "Partial Environmental Life Cycle Inventory of an Insulating Concrete Form House Compared to Wood Frame House" by CTL Group, for Portland Cement Association, 2002, Serial No.2464

4. "Life Cycle Assessment of an Insulating Concrete Form House Compared to a Wood Frame House" by CTL Group for Portland Cement Association, 2002, Serial No.2571

5. *Concrete Systems for Homes and Low-Rise Construction–A Portland Cement Association Guide,* VanderWerf, Panushev, Niicholson, Kokonowski, 2005, SP405 $75ND

To learn more about concrete as a sustainable building material:

Portland Cement Association, www.concretehomes.com
Environmental Council of Concrete Organizations, www.ecco.org
www.concretethinker.com

PCA Portland Cement Association
Concrete Homes

5420 Old Orchard Road, Skokie, Illinois 60077-1083
Phone: 847.966.6200 Fax: 847.966.9281 Web: www.cement.org
More information? Helpline 1.888.333.4840 www.concretehomes.com

IS311