Precast Helps Projects Attain LEED Certification

CANADIAN PRECAST/PRESTRESSED CONCRETE INSTITUTE

Precast's proximity, energy efficiency, recyclability and minimal waste are keys to meeting environmental standards

What is “Green” Design?

Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants are in five broad areas:

- Sustainable site planning
- Safeguarding water and water efficiency
- Energy efficiency and renewable energy
- Conservation of materials and resources
- Indoor environmental quality

LEED Certification

- **Project ratings are certified by the CaGBC based on the total point score, following an independent review and audits of selected Credits of documentation submitted by a design and construction team.**
- **With four possible levels of certification (certified, silver, gold and platinum), LEED is flexible enough to accommodate a wide range of green building strategies that best fit the constraints and goals of particular projects.**

Precast Concrete

- **No construction material or product can guarantee LEED Certification of your project**
- **Precast concrete components can help reach as many as 23 of the 26 points needed to achieve LEED certification.**

Precast Attributes

- **Precast concrete components can help achieve LEED certification in a variety of ways:**
  - **Their ability to be recycled**
  - **Local manufacturing capability**
  - **Thermal mass**
  - **Sandwich insulation**
- **These attributes help reduce the expended energy needed to manufacture, transport and erect materials - key LEED requirements..**

Building Reuse (Materials Credit #1).

- **A one-point credit is available for maintaining 75 percent of the existing shell of a building.**
- **An additional point is offered for maintaining 100 percent of the shell, consisting of the skin and frame but not the windows, interior walls and other components.**
- **Concrete's durability gives it a strong advantage in this category**
- **Precast concrete structural systems and architectural panel systems can provide long service life.**

Building Reuse (Materials Credit #1**).**

- **Double tees and hollow core floors and roofs offer long interior spans.**
- **Buildings are easier to remodel or reconfigure as tenant needs change.**
- **This ensures that a structure can remain in place longer with only minor adjustments needed.**

Construction Waste Management (Materials Credit #2).

- **A two-point credit is available for reducing construction, demolition and land-clearing waste that normally ends up in landfills.**
- **At least 50 percent of these materials must be kept out of landfills.**
- **A second credit is offered if 75 percent is diverted.**

Construction Waste Management (Materials Credit #2).

- **This credit can be used in conjunction with the Building Reuse credit.**
- **Four points are available if existing materials, such as precast concrete wall panels, are reused in a project.**
- **The materials preserved can be applied to this credit as well as to Materials Credit #1.**

Construction Waste Management (Materials Credit #2).

- **Concrete's inorganic composition makes it an ideal material to be recycled.**
- **Concrete is frequently crushed and reused as aggregate for road bases or construction fill.**

Construction Waste Management (Materials Credit #2).

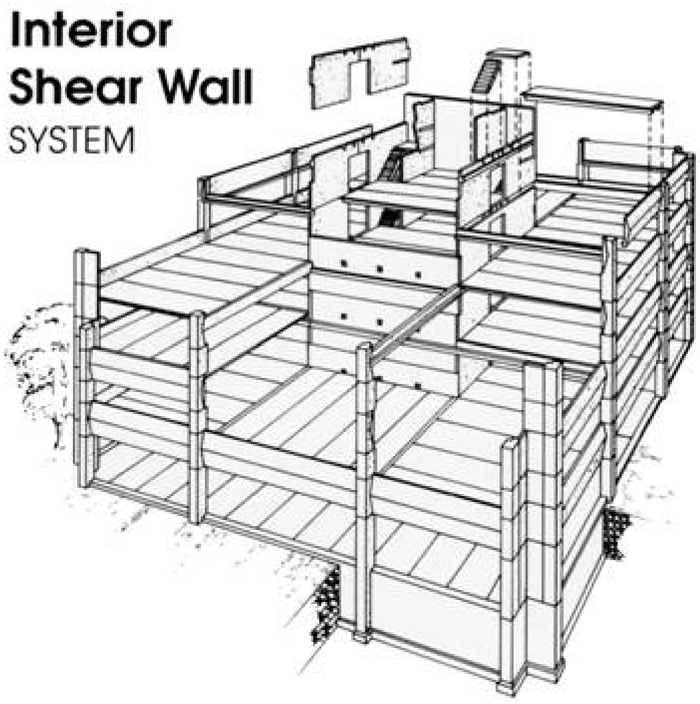
- **For instance, gray water often is recycled in future mixes, between 5 and 20 percent of aggregate in a mix can consist of recycled concrete and sand used in finishing can be reused.**
- **Steel forms and other materials used in casting are reused many times.**

Construction Waste Management (Materials Credit #2).

- **A properly designed precast concrete system will result in:**
  - **smaller structural members**
  - **longer spans**
  - **less material used on-site.**
- **This translates directly into both economic and environmental savings.**
- **Using less material means using fewer natural resources and less manufacturing and transportation energy.**

Construction Waste Management (Materials Credit #2).

- **A beam spanning 7.0 m has a cross section of 300x600 mm.**
- **The top reinforcement is 2-#20 bars.**
- **A reinforced beam requires 4-No.30 bars (A_s = 2,800 mm^2) to carry the load.**
- **A prestressed beam requires 8-13 mm strands (A_s = 792 mm^2) to carry the same load.**
- **The reduction in the area of the main steel reinforcement is about 70%.**



Recycled Content (Materials Credit #4).

- **A two-point credit is received for using materials with post-consumer recycled or post-industrial recycled content of a specific total.**
- **Supplementary cementitious materials can replace a portion of the cement in a mix.**
- **These materials are considered post-industrial recycled ingredients.**

Recycled Content (Materials Credit #4).

- **The most common supplementary cementitious materials:**
  - **Fly ash is the residue remaining from fossil-fuel power plants.**
  - **Silica fume is the by-product from the electric-arc furnace used in the production of silicon or ferrosilicon alloys.**
  - **Slag cement is created from iron blast-furnace slag.**
- ***The use of fly ash can increase setting times. This may be an economic factor in precast concrete manufacturing if casting can not be maintained on a daily cycle.***
- **All these waste products would end up in landfill if not reused. In many cases, the use of fly ash and other supplementary materials can produce a more durable product than a total-cement mix.**

Recycled Content (Materials Credit #4).

- **The best approach is to talk with the precaster in advance and avoid prescribing an amount of fly ash beforehand.**
- **Ask the precaster to use the maximum amount that's effective and give them a performance standard for the application, not just a percentage.**
- **The goal for long-term performance of a building should optimize the use of fly ash, not maximize it.**

Local/Regional Materials (Materials Credit #5).

- **A one-point credit is offered when at least 20 percent of building materials are manufactured within an 800 km (500-mile) radius of the site.**
- **An additional point is offered when half of the regionally manufactured products are extracted or recovered within 800 km.**
- **Precast concrete meets both of these requirements in virtually all cases.**

Local/Regional Materials (Materials Credit #5).

- **Most precast plants are within 200 miles of the project, and the raw materials used to produce the precast concrete components:**
  - **cement**
  - **aggregates**
  - **prestressing strand**
  - **rebar and wire mesh**

  are usually obtained from sources within 320 km (200 miles) of the precast plant.
- **This advantage leads many designers to replace granite, stone and other imported products with precast concrete panels.**

Local/Regional Materials (Materials Credit #5).

Innovation in Design (Innovation and Design Process).

- **Up to four points can be awarded for innovative green design strategies that do not fit into existing LEED categories.**
- **An additional point is available for using LEED-certified professionals on the team.**

Local/Regional Materials (Materials Credit #5).

Innovation in Design (Innovation and Design Process).

- **An innovation credit has been given to projects using concrete that has a supplementary cementing material content of 40 percent, if proper testing for compatibility has been done.**
- **To ensure desired performance, the substitution of fly ash (greater than 30%) and slag cement (greater than 35%) of the Portland cement in precast concrete should be considered a high volume SCM application and its suitability for intended use should be prequalified.**
- ***The use of fly ash can increase setting times. This may be an economic factor in precast concrete manufacturing if casting can not be maintained on a daily cycle.***

Thermal Mass Not Appreciated

- **"Despite vast empirical evidence, modern understanding about thermal mass has taken some time to evolve."**

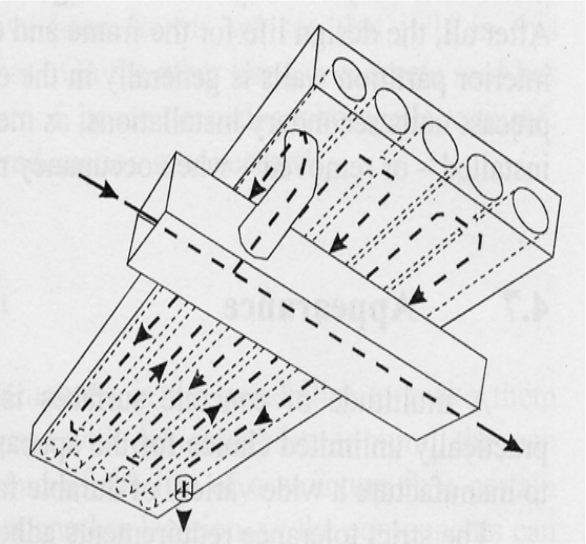
  Report from the Environmental Council of Concrete Organizations (ECCO).
- **Few studies focused on the benefits provided by thermal mass prior to the oil crisis in the early 1970s.**
- **Then, prescriptive relief was addressed with readily available corrective measures, focusing on insulation with minimum R values.**
- **R values neglect thermal-mass characteristics, leading them to be understated.**

ENVIRONMENTAL COUNCIL of CONCRETE ORGANIZATIONS

Thermal Mass Not Appreciated

THERMAL MASS

- **Several systems have been developed utilizing the thermal mass characteristic of precast structures.**
- **In one system, air is circulated in the voids of hollow core floor and roof slabs.**
- **This reduces the size of the installed mechanical system and creates energy savings both for heating in winter as well as cooling in hot summer weather.**



Case Study - UNIVERSITY OF OTTAWA SCHOOL OF INFORMATION TECHNOLOGY & ENGINEERING (SITE)

- **SITE is a 16,380 m^2 'green' facility utilizing state-of-the-art building technology, with active solar thermal mass heating/cooling.**

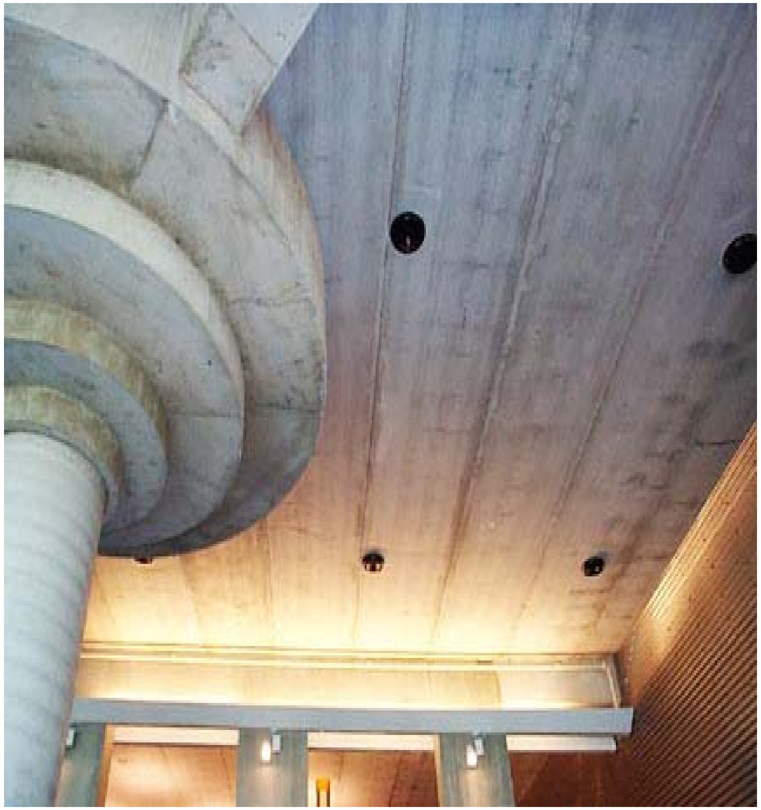
Case Study - UNIVERSITY OF OTTAWA SCHOOL OF INFORMATION TECHNOLOGY & ENGINEERING (SITE)

- **Based upon sustainable design principles, this world leading structure integrates structural, mechanical and electrical systems to facilitate plug-in-capabilities, and act together to form active mass thermal storage in the precast hollow core floor system**.

Case Study - UNIVERSITY OF OTTAWA SCHOOL OF INFORMATION TECHNOLOGY & ENGINEERING (SITE)

WHAT CONCRETE PRODUCTS WERE USED FOR THIS PROJECT?

- **Precast hollow core floor system**
- **Cast-in-place exposed structural walls**
- **Nine 14.5 m high cast-in-place tapered columns that line the glazed western elevation.**
- **Architectural precast concrete exterior wall panels.**



Case Study - UNIVERSITY OF OTTAWA SCHOOL OF INFORMATION TECHNOLOGY & ENGINEERING (SITE)

HOW DID CONCRETE HELP TO ACHIEVE SUSTAINABLE DESIGN AND CONSTRUCTION OBJECTIVES?

- **SITE has become the gateway to Ottawa's downtown core. With three distinct faces, the facility clearly demonstrates that high tech state-of-the-art design and sustainability can be combined into a building of architectural delight.**

Case Study - UNIVERSITY OF OTTAWA SCHOOL OF INFORMATION TECHNOLOGY & ENGINEERING (SITE)

HOW DID CONCRETE HELP TO ACHIEVE SUSTAINABLE DESIGN AND CONSTRUCTION OBJECTIVES?

- **The project combines function and quality in a facility designed to elevate the human spirit.**
- **The SITE building was constructed within budget while exceeding stringent 'green' building requirements.**

Case Study - UNIVERSITY OF OTTAWA SCHOOL OF INFORMATION TECHNOLOGY & ENGINEERING (SITE)

- **This project is designed to collect natural light, distribute it into the facility's core, transfer heat gains to areas of need and maximize natural cooling – all to achieve the lowest energy use.**
- **The University of Ottawa has not been subject to capital cost premiums, operating at only 14.5 kW/ft^2 per year.**
- **The university will reduce its annual energy cost to $375,000 in a 16,380$m^2$ facility with 80% of its exterior glazed.**

Case Study - UNIVERSITY OF OTTAWA SCHOOL OF INFORMATION TECHNOLOGY & ENGINEERING (SITE)

- **Owner:** University of Ottawa
- **Architect:** IKOY Architects, Chief Architect, Ron Keenberg
- **Structural Consultant:** Sauvé Boucher Associates Inc.
- **Construction Manager:** Daoust Construction Canada Ltd.
- **Concrete Supplier:** Lafarge Canada Inc.
- **Concrete Supplier:** Mechanical Engineer
- **Structural Precast Concete:** Granite Prestressed Concrete Ltd.
- **Architectural Precast:** Saramac Inc.

Commercial Building Incentive Program (CBIP)

- **Natural Resources Canada's Commercial Building Incentive Program (CBIP) objective of this incentive is to encourage energy-efficient design practices and to bring about lasting changes in the Canadian building design and construction industry.**
- **The program requirements are based on two documents: the Model National Energy Code for Buildings and CBIP Technical Guide.**

- **SITE Building received the highest score for the Commercial Building Incentive Program (CBIP) in Canada.**

Case Study - CH2M Hill World Headquarters

‘We designed the buildings to maximize the positive and environmentally friendly attributes of precast. The buildings are among the first LEED-certified facilities to feature total-precast structures.

BARBER
ARCHITECTURE

Case Study - CH2M Hill World Headquarters

- **It's only natural that officials at CH2M Hill would give "green" building factors a high priority when planning their new world headquarters in Englewood, CO.**
- **CH2M Hill provides a wide range of infrastructure engineering and construction services — including environmental services — to public and private clients on six continents.**
- **The green attributes designed into the building included a total-precast concrete structural system.**

Case Study - CH2M Hill World Headquarters

- **In creating the three-building campus, designers at Barber Architecture in Denver followed the Leadership in Energy & Environmental Design (LEED) standards created by the U.S. Green Building Council (USGBC).**
- **During the design process, CH2M Hill designated Andrea Kamage, a LEED-accredited professional, to champion their environmental and sustainability concerns, says Michael Barber, the firm's president and director of design.**

BARBER
ARCHITECTURE

Case Study - CH2M Hill World Headquarters

- **The campus consists of the five-story world headquarters building flanked by two four-story buildings.**
- **The corporate headquarters contains 165,000 square feet, while the other two buildings — a regional headquarters and support building — each have 113,000 square feet.**

Case Study - CH2M Hill World Headquarters

Paul Todd, who at the time was associate principal at Barber Architecture

- **In all likelihood, we would have designed the buildings with precast concrete components regardless of the LEED influence.**
- **"I've come to realize that a total-precast building is something of a novel thing nationally," says Todd, "But here in Denver, precast is used extensively for two reasons: cost and schedule."**

Case Study - CH2M Hill World Headquarters

- **Each of the six categories has a number of specific criteria to measure a building's environmental friendliness.**
  - **Atmosphere**
  - **Materials**
  - **Resources**
  - **Indoor Environmental Quality**
  - **Innovation**
- **Design Process It takes 26 points to gain certification, which is the number of points attained at CH2M Hill.**

Case Study - CH2M Hill World Headquarters

- **Todd: “I believe precast made the most impact at CH2M Hill is in Materials & Resources.”**
- **Under that category, one point was awarded for construction waste management.**
- **If a project can divert 50 percent of its construction waste from a landfill, it earns a point.**
- **Precast aids that total, as it provides no on-site waste.**

Case Study - CH2M Hill World Headquarters

- **The building also earned two points for recycled content.**
- **Here again, precast concrete contributed to the LEED certification.**
- **The concrete contains fly ash, a recycled material that replaces some of the cement, a material that takes the most energy to produce in concrete.**

Case Study - CH2M Hill World Headquarters

- **The precast also contains rebar, which uses recycled steel.**
- **A project receives one point if 5 percent of its content uses recycled material and two points if 10 percent is recycled.**
- **CH2M Hill's headquarters garnered both points.**

Case Study - CH2M Hill World Headquarters

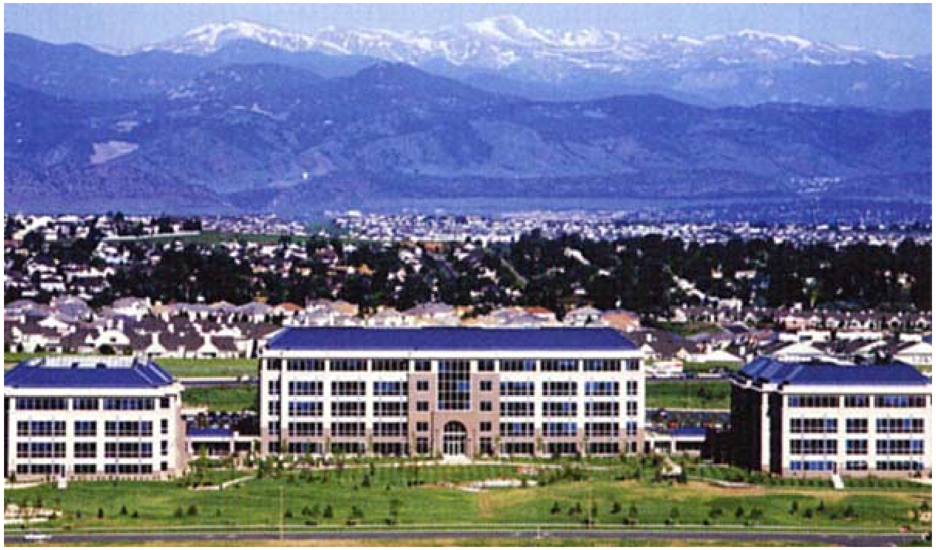
- **Precast also contributed to the building's use of local/regional materials, another LEED criterion.**
- **If a minimum of 20 percent of materials are manufactured within 500 miles of the building, one point is earned.**

Case Study - CH2M Hill World Headquarters

- **Precast concrete helped earn another point, in “Innovation in Design:**
  - **Exemplary Performance of Materials and Resources.”**
- **Fifty nine percent of the project’s materials were produced locally, more than double the 20 percent required for the first credit.**

Case Study - CH2M Hill World Headquarters

- **Structural and architectural precast components used in the CH2M Hill project accounted for 39 percent of the materials used to calculate the local/regional content of the buildings.**



Case Study - CH2M Hill World Headquarters

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Case Study - CH2M Hill World Headquarters

- **Two of the LEED points resulted from a 20 percent savings, compared to a base building — and another point was gained because the buildings achieved a 30 percent reduction in energy cost.**

Case Study - CH2M Hill World Headquarters

- **The load-bearing architectural precast panels on the façade supplied thermal mass. The concrete is so dense that it helps to absorb heat during the day and moderate daily temperature swings.**
- **Recent studies have demonstrated that thermal mass creates more efficiency then designers tend to realize, according to the Environmental Council of Concrete Organizations (ECCO).**
- **Actual energy performance has guided the development of thermal-mass standards, according to a report from ECCO. “These standards have successfully translated the behavior of thermal mass into understandable and easy-to-use terms,”**
- **The result is that thermal mass has become a feasible element of building design.**

Case Study - CH2M Hill World Headquarters

- **Todd: " From complete design to occupancy took just 11 months. Although it was a twin to the regional headquarters building, the interior space planning was different. And it has a data center, which is different. So it required some tweaking of the original design to ensure it met the needs effectively."**
- **CH2M Hill moved into the finished building just one year after final design plans were completed. Several months later, CH2M Hill decided to add the third building, a four-story support structure, again using a total-precast concrete structure. Portions of the third building repeated the design of the first four-story**

LEED® Certification

LEED® Indicates points where precast concrete components helped obtain certification CH2M Hill World Headquarters

■ **Sustainable Site**	**4pts**
■ **Water Efficiency**	**3pts**
■ **Energy & Atmosphere**	**5pts**
■ **Materials & resources**	**5pts**
■ **Indoor air quality**	**5pts**
■ **Innovation and Design**	**5pts**
Total	**26 points**

Thank you

For more information:
www.sustainableprecast.ca