



CONCRETE & SUSTAINABLE DEVELOPMENT



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Introduction

Sustainable Development, Global Warming, CO₂, GHG, Social, Environmental and Economic issues, governments wanting to construct all public buildings that meet sustainable or LEED™ accreditation, GreenGlobes, builders and homeowners wanting green construction to address concerns on energy generation and consumption and impact on the environment - these are all growing issues that owners, designers, material suppliers and contractors must address in order to identify and offer products and services as solutions.

A wide variety of construction methods and concrete products give you the application and techniques to create both beauty and function in ways that improve the impact of buildings on the environment. Sustainable Development is about balancing human needs with the earth's capacity to meet them. Concrete offers a wide range of capabilities to help achieve this balance that must be considered for New, Maintenance/Conservation or Restorative construction.

Bruntland Report of the World Commission on Environment and Development – our Common Future, defines Sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

To address the green building movement a number of new and different green rating systems have been developed. Some of these rating systems include:

- BREAM (<http://www.breeam.org>)
- Green Globe (<http://www.greenglobes.com/>)
- Green Guide for Healthcare (<http://www.gghc.org/>)
- ASHRAE Green Guide (www.ashrae.org)

- LEED (http://www.cagbc.org/green_building_projects/leed_certified_buildings.php)

This is not an exhaustive list and the ones listed above are examples to name just a few that are currently dominant in the market. The current mainstay in green building is the LEED rating system.



Background

Societal thinking is changing as the population now recognizes the importance of addressing these important issues, as well as identifying and further developing new solutions. The concrete and construction industries are addressing these issues head-on to remain both responsible and competitive.

Many sectors of the construction industry are developing ways and practices to address these issues in their manufacturing and supply processes and on job sites. For example, general contractors look at reducing environmental project impact by reducing job site waste material; home builders are realizing that Green Building will become a predominant theme as buyers and investors understand concerns such as long life and energy conservation and what it means to our future energy demands.

At the same time, the concrete industry looks to concrete as being able to offer solutions to the demand for green products to be part of the integral design that will act as a responsible partner to local and global concerns. The concrete industry also looks to an *Environment or Green Concrete* rating designation that identifies and addresses suppliers' facility operations, production and manufacturing processes and practices relative to the reduction of CO₂ footprint, conservation of water, reuse and recycling of materials and use of by-products to offer sustainable solutions. It is important that the concrete industry properly communicate its own processes and successes.

Concrete, as with other building materials, has embodied energy: it takes energy to manufacture and construct a

concrete building or structure, however concrete's lower embodied energy from cradle to end of life to cradle can be used smartly. Concrete can be used as an integrated design to optimize Sustainable Development and Construction. Concrete can also assist the owner or architect in obtaining up to 23 LEED points.

Concrete plays a vital role in reducing the operational energy requirements of buildings. This massive potential cost reduction (and advantage) is especially important as the operational environmental impact of buildings (energy requirements) is far greater than their embodied impact.

The concrete industry uses the latest conservation and recycling practices and technologies for the manufacturing, production and operational processes to assist in making concrete part of a sustainable solution. Concrete is one of the world's best products for our Sustainable Construction and Development future as more people, specifiers and contractors understand the many solutions concrete offers. These practices and technologies continue to advance.

The intent of the annex is to begin the process of bridging standards with specifiers intentions - a 'green building' that fits appropriately within existing standards and vice versa. Moving forward, building green should not be an informative piece but the reality of all construction. This is the first step in that process.



What are the Solutions?

The following examples use the LEED rating system and will give owners, designers and consumers insight into the major features and benefits of using concrete in an integrated solutions design to address sustainable development and construction.

LEED has six main credit categories:

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (MR)
- Indoor Environmental Quality (EQ)
- Innovation and Design Process (ID)

Each category is divided into credits and what is unique and challenging about the LEED rating system is the approach to 'greening' the building is a holistic approach – projects are LEED certified; products contribute to LEED points through their footprint reduction, recyclability, life cycle and other attributes that LEED system values.

IN CANADA ALONE, A 30% REPLACEMENT OF PORTLAND CEMENT BY SLAG, FLY ASH OR BOTH BY THE CONCRETE SUPPLIER COULD REDUCE POTENTIAL CO₂ EMISSIONS BY MORE THAN 2 MILLION TONNES PER YEAR.



1. Sustainable Sites (SS)

Building site selection, orientation and exterior surface are integral parts of sustainable design. In the current Canadian publication, LEED Canada – NC v. 1.0, there are a total of 14 points available in the Sustainable Sites section. The use of concrete and cement can help in securing 5 of these points:

Redevelopment of Contaminated Sites - Cement can be used to solidify and stabilize contaminated soils and reduce leaching concentrations to below regulatory levels.

Reduced Site Disturbance: Protect or Restore Open Space & Development Footprint - Concrete parking garages on the lower floors of a building can be used to limit site disturbance. Parking garages within buildings help maintain existing natural areas that would be consumed by paved parking.

Stormwater Management: Rate and Quantity – Pervious Concrete can reduce the rate and quantity of storm water runoff because they increase infiltration of StormWater. This replenishes ground source water and water tables.

Heat Island Effect: Non-Roof – Required use of light-colored and/or open grid pavement for at least 50% of the site's non-roof impervious surfaces. This requirement can be met by using conventional Portland cement concrete or Pervious Concrete paving rather than asphalt for 50% of all sidewalks, parking lots, drives and other

impervious surfaces. Using materials with higher albedo will reduce the heat island effect—consequently saving energy by reducing the demand for air conditioning - and improve air quality.



2. Water Efficiency (WE)

Concrete manufacturing conserves potable water use. Admixtures are used part of the operations and manufacturing processes to reduce the water requirement of the mix and non-potable (grey) water: recycling water that has already been used in the process thereby reducing and conserving the use of potable water.

Admixtures reduce the amount of Portland cement which in turn reduces the CO₂ contribution and footprint.

Process water and storm water is continuously captured and reused for truck wash/clean and slurry is used as an ingredient back into the manufacturing process for zero discharge from the facility. This reduces the energy consumption footprint and maximizes previously produced products and resources.

Innovative products and applications in the concrete industry such as Pervious Concrete Pavements address Storm Water Management by eliminating or reducing runoff water. This application can greatly reduce costly Storm Water capture, treatment and facilities requirements. In addition, land use is better optimized.



3. Energy and Atmosphere (EA)

Truck emissions and fuel consumption (fossil fuels) are reduced on Concrete pavements because of less rolling tire resistance.

User Costs are reduced because of fewer delays on Concrete pavements for road repair and maintenance, detours, goods delivered late and fewer emissions from truck and car idling.

Alternate fuels (used tires and waste products) can be used in Portland cement's manufacturing process which reduces coal and natural gas demand and consumption.

The high thermal mass characteristics of concrete can lower the energy operational costs (e.g. electric, natural gas or oil) for homes and businesses which reduce the overall energy consumption and production requirements (MNEBC or ANSI/ASHRAE/IESNA 90.1-1999). Building applications such as Insulated Concrete Forming systems can increase the savings.

Concrete's light-colored/high albedo materials (reflectance of at least 0.3) for use in roofs and pavements, reduces energy and cooling costs as it does not act as a "heat island-sink effect". This fact drastically decreases the temperature and energy costs in cities and towns and subsequent energy demands.

4. Materials and Resources (MR)

Concrete contains local labor and materials.



Concrete partners are responsible community based businesses, material suppliers, employers and taxpayers who drive an environmental and sustainable culture through their own organizations and those of their suppliers.

Concrete is 100% resource re-used. Common practice is to recycle returned product and all materials both on and off site. Concrete can be crushed and aggregates reused in new concrete or reclaimed and used as road base reducing the demand for non-renewable aggregate resources.

High or Ultra-High Performance Concrete addresses forward thinking designs for thinner post-tensioned slabs or smaller building columns concretes to reduce material consumption and impact.

Concrete pavements of all types offer a longer life identified by a Life Cycle Analysis offering a higher return (lowest cost) and best value on taxpayers' dollars.

Aggregate consumption reduction in concrete pavement by 50% more than a traditional flexible pavement, which means reduced use of a non-renewable resource,

reduced truck traffic, lower emissions and fewer road hazards.

Concrete recycles by-product or waste materials such as fly ash, slag (ground granulated blast furnace slag), and silica fume or mineral products as part of its standard manufacturing process, meaning these products actually reduce the CO₂ footprint of Portland cement by up to 50%. These by-products do not then need to be land-filled. Concrete can utilize high volumes of these supplementary cementing materials to further contribute to the requirements of LEED or similar green building accreditation systems as a recycled content. High Volume Supplementary Cementing Material categories (HVSCM) are detailed in CSA A23.1-04.

Sustainable or Green High-efficiency concrete manufacturing facilities designations reduce all environmental impacts.



5. Indoor Environmental Quality (EQ)

Concrete has any number of architectural finishes that release no VOCs and are healthy for indoor air quality environments.

Thermal mass characteristics of concrete and radiant floor heating construction can assist in the reduction of energy required for air movement and offer healthier indoor air quality.



6. Innovation and Design process (ID)

Accelerated strength performance for faster form stripping times, more efficient form use and earlier project completion times.

Designing with High Performance Concrete for thinner (or smaller) elements reducing product requirements.

Self Consolidating mixes to minimize truck unloading, reducing placement time, vibration, noise, labor and related emissions.

Supplier Computerized Ordering, Dispatch and GPS systems to optimize scheduling and minimize truck waiting time, delivery as well as emissions on projects.

Systematic Project planning and scheduling for project entry and exit, pump locations and inventory to minimize truck delivery and wait time and emissions from delivery.

Use of alternate Supplementary Cementing Materials and mineral fillers such as crushed limestone to increase recycled content in concrete; further reducing CO₂ footprint.

Pervious Pavements to deal with Storm Water Management issues – an application that can greatly reduce costly storm water capture, treatment and facilities requirements. Land use is optimized.

Green Roofs for usable space and any other product or application to positively affect our green spaces, water consumption and collection and energy use.

Greater durability for homes, buildings and infrastructure to withstand ever increasing natural disasters, fire and security issues, responsibly saving lives, investment and property.

Pavements for highways, streets and parking areas that have high light reflectance require fewer lighting standards and lower powered / higher efficient bulbs can be used to reduce energy purchase and use. This also means higher visibility for safer parking lots.

Thermal mass being used as an integrated design with a building's HVAC systems.

Non-destructive concrete testing methods can eliminate or minimize waste of product and material samples that are required for "destructive testing".

Structural elements using both reinforcing steel and concrete create a highly efficient structural system and provide protection against possible corrosion. Reinforcing steel is also produced from 100% recycled scrap feedstock.



Roles and Responsibilities

As we look toward Sustainable Development and the world's future we see specifications of owners and designers embracing today and tomorrow's technology and innovation with the

obvious intent of having a positive impact on construction.

The issues of Sustainable Construction should be regarded on products from cradle to end of life to cradle. It is important to consider the total affect of a product on society from a social, environmental and economic perspective. Careful consideration and fact-based data begins with the extraction and manufacturing of raw materials such as aggregates, admixtures and cements, through the manufacturing and production and delivery processes and finally at end of service.

The Canadian Ready Mixed Concrete Association (www.crmca.ca) has developed the Environmental Management Practices guide in conjunction with Environment Canada for use in each provincial association and is used to address Water, Waste, Solid Waste, Chemical, Fuel, Air, Noise Management issues. The guide also addresses facility decommissioning and facility issues such as spills and spill response and can be found at CRMCA member web sites.

A number of capacity building and resource tools for Sustainability and Sustainable Development have been developed by partners such as Cement Association of Canada (www.cement.ca), Portland Cement Association (www.pca.org) and National Ready Mixed Concrete Association (www.nrmca.org).

Summary

Roadblocks to sustainable construction do exist however. Decisions that hold back the application or advancement of sustainable construction can be made based on false or incomplete information. It is confusing for the designer, contractor and supplier to hear that an owner has a desire to use sustainable construction only to see that ill-prescribed or ill-informed methods or products cannot achieve the goals. A great deal of education is being undertaken by the concrete and construction industry. Through these educational efforts more owners and designers and contractors are now realizing that concrete can be enhanced to provide performance (e.g. desired strength gain, set and stripping times with high volumes of SCM).

Owners are becoming aware of what true technologies are readily available in the marketplace and how to take advantage of them. The concrete industry is continually working with stakeholders and partners to provide an environment of information and education.

Innovation also lies in the minds of all users as new applications, technologies and designs are developed to meet future Sustainable requirements. The internet is allowing this information to be shared instantly and globally which greatly reduced the time from which an idea is born until it is brought to market. The concrete industry is a partner in providing solutions to our ever increasing needs.

Please contact us for your Sustainable needs at www.rmcao.org.