SUSTAINABLE DESIGN & DEVELOPMENT

Sustainable buildings are good for the environment and for the people who occupy them. Precast concrete is the best sustainable material on the planet for total building systems. Oldcastle incorporates sustainability principles and concepts in the design of its buildings and consistent with budget constraints and customer requirements.

TOTAL PRECAST BUILDING SYSTEMS

Total Precast Building Systems refers to an integrated assemblage of prefabricated concrete building components, made in quality-controlled factory conditions. Systems building contributes to reducing initial construction and lifecycle costs in various ways. By using prefabricated precast concrete building components:

- Job site waste during construction can be avoided.
- Ultimate erection of a systems building is orderly and fast, resulting in reduced construction time and faster building closure, the results of which are greater on-site construction material, labor and energy savings.
- The durability of precast concrete creates a long life cycle and requires less replacement and maintenance through the life of the building.
- The sustainable properties of precast concrete are beneficial to the planet.

SUSTAINABLE PROPERTIES OF PRECAST CONCRETE

Sustainable properties of precast concrete include the following:

- **Resource Efficient**
  Concrete is made from three of the earth's most abundant resources:
  - Water
  - Stone, sand and gravel aggregates
  - Cement which is predominantly limestone, the most abundant mineral on earth

  Furthermore, concrete can also include recycled components such as fly ash, slag cement, and silica fume, all waste by-products from power plants, steel mills, and other manufacturing facilities.

- **Ecologically Preferable**
  Compared to logging for wood products and iron ore mining for steel production, the extraction from the earth of aggregate and limestone is the least disruptive to land and the fragile ecology that it supports; and aggregate and limestone quarries can be restored to nature reserves, parks and other recreational, commercial or residential uses. Furthermore, concrete minimizes construction waste and can be recycled.

- **Highly Durable**
  Concrete actually gets stronger with age. It can take years, even decades, for concrete to fully hydrate and reach its highest strength. The Pantheon in Rome, a concrete building circa 180 a.d., is still in use. While most modern buildings are not expected to last as long as the Pantheon, the longer the life span of the building, the more sustainable benefit it has.

- **Recyclable**
  Concrete can be crushed and reused as aggregate in new concrete mixtures particularly for infrastructure projects such as roads, sidewalks, and bridges, as well as for environmental erosion control. The ASTM definition of coarse aggregate includes crushed concrete, and the definition of manufactured sand includes crushed concrete fines. The U.S. Army Corps of Engineers and the Federal Highway Commission encourage the use of recycled concrete. Furthermore, the steel used for its reinforcement, normally obtained from recycled steel, can be recycled again.

SUSTAINABLE DESIGN

RESOURCE MANAGEMENT

The responsible management of energy and environmental resources is the greatest challenge in the building industry. Labels such as "environmentally friendly" or "green" are not just catchy marketing phrases at Oldcastle. We believe in maximizing opportunities for long-term sustainable development with our products.

According to the World Commission on Environment and Development, *sustainable development* is development that meets "the needs of the present without compromising the ability of future generations to meet their own needs."[1] *Sustainable design* is the art of designing buildings that do just that by conserving energy, water and other resources without polluting either indoor or outdoor environments, and using resources without depleting or damaging them.

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- **Energy Efficient**
  - The thermal mass of concrete saves energy in buildings by reducing temperature swings. The mass of the concrete stores heat during the day and releases it slowly for night heat; similarly, the coolness stored during the night helps to reduce air conditioning loads during the day.
  - Concrete has low energy requirements for its production.
  - Concrete has low transportation energy costs because it is generally produced locally.

- **Excellent Indoor Air Quality**
  The quality of the indoor air is crucial to the well-being of the occupants. Building owners and occupants are increasingly demanding "green" buildings that minimize the type of pollutants that lead to "sick building syndrome."

  Precast concrete has extremely low emissions of the type of off-gassing substances that plague many buildings with "sick syndrome." Precast concrete is also one of the best building materials available to inhibit or prevent mold growth. Concrete is non-organic and mold requires moist organic nutrients to grow. Furthermore, the low permeability rating of precast concrete inhibits the penetration of mold spores from the exterior.

  Concrete alone cannot achieve goals of reducing indoor air pollutants. Designers must carefully choose low volatile organic compounds (VOC) materials such as carpet, partitions and paint; and engineers must carefully design the mechanical systems for appropriate levels of ventilation and air circulation. But, in conjunction with these design choices, precast concrete is by far the best building material to achieve beneficial indoor air quality.

ENERGY PERFORMANCE

Well-informed building owners look for bottom-line savings in energy efficient building design and technologies. Factors which shape the energy performance of buildings include the following:

- **Building Envelope**
  The building envelope includes everything that separates the interior of a building from the outdoor environment including the roof, walls, windows, doors, and other closures.

  - **Exterior Walls**
    Oldcastle's precast concrete sandwich panels, consisting of an exterior wythe of concrete (typically 2"-3" thick), an inner layer of rigid insulation (typically 2" thick), and an interior wythe of concrete (typically 5"-8" thick), are an ideal product for energy conservation. The concrete walls include the thermal mass properties that absorb and retain heat and the insulation provides low thermal conductivity (high R-value).

  - **Thin Brick**
    Thin Brick embedded on precast panels is an energy efficient solution to all masonry projects. The raw clay materials, fuels used for manufacturing and shipping, and construction waste are about twenty-five percent of those used in full-bed-depth brick projects. Furthermore, precast panels with embedded brick do not require sources of energy loss such as the weep holes and air space required in conventional masonry construction.

  - **Windows**
    Energy efficient windows include options such as low conductance gas (e.g. argon gas) between the panes of glass, and low-emissivity (low-e) coatings to suppress heat flow.

  - **Roofs**
    White or reflective roofing helps reflect heat and keep buildings cool; and roof gardens add valuable/useable space while providing energy efficiency.

  - **Foundations and Basement Slabs**
    Insulating both foundations and basement slabs is important for energy efficiency.

  - **Air Leakage Control**
    Air leakage is one of the greatest areas of heat and energy loss. Air leakage typically occurs around windows, doors and building joints. Precast concrete panels are extremely efficient at reducing potential sources of air leakage because there are few joints; and concrete has excellent characteristics for preventing the passage of air and moisture.

- **Solar Heat Gain**
  Solar heat gain contributes to the need for high cooling loads, one of the greatest consumers of energy. The higher the solar gain, the greater the energy consumption. Building orientation, shading devices, and light reflectance characteristics of office buildings can help to control the amount of solar gain.

  The *orientation* of a building on the site contributes heavily to its ability to offset solar gain. Rectangular buildings placed in an east-west orientation will have the least amount of glazing in the direction of the morning and afternoon sun and the most amount of glazing on the north and south facades. The north façade receives very little sun and the south face can be controlled with shading devices and, to some extent, solar control glass. Oldcastle Glass®, www.oldcastleglass.com, can provide additional information on the variety of best glass choices to meet the owner's needs and contribute to the sustainable aspects of design.

  Precast concrete also is generally a light color (high-albedo) which helps to reflect solar radiation to reduce cooling loads. Dark colored materials such as roofs, paving and walls cause an effect called "heat islands," a growing concern in urban and suburban areas where temperatures are higher than rural areas because the surfaces capture solar gain. Light-colored precast concrete roof pavers, and roof garden waterproofing systems are products available from Oldcastle to help reduce the "heat island" effect.

- **Lighting and Daylighting**
  Through proper design, including glass selection and shading devices, natural light from windows ("daylighting") can be used to significantly reduce the amount of artificial lighting. Effective daylighting and energy efficient light fixtures and controls can help to significantly reduce building energy costs.

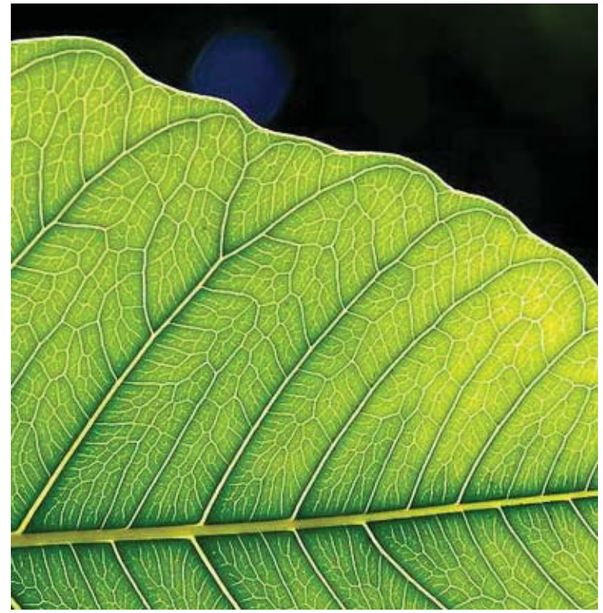
- **Mechanical and Ventilation Systems**
  Strategies for energy efficient mechanical and ventilation systems include:
  - Ventilation Air Management
  - Energy Efficient Equipment
  - Waste Heat Recovery
  - Digital Climate Controls
  - Use of Renewable Energy Systems

- **Water Efficiency**
  There are several strategies to create water resourceful developments:
  - Low-Flow and Automatic Shut-Off Fixtures
  - Water Efficiency Landscaping
  - Rain Water Collection & Distribution (Water "Harvesting")
  - Recycled Treated Waste Water

- **Renewable Energy Systems**
  There are an increasing number of renewable energy choices that help to protect the environment and contribute to sustainable development.

  - **Geothermal** – use of the relatively constant temperature of soil or surface water as a heat source and sink for a geothermal heat pump to provide heating and cooling for buildings.

  - **Solar** – use of the sun's energy and light to provide heat, light, hot water, electricity, and even cooling, for buildings. Strategies include:
    - Photovoltaics - the conversion of sunlight into electricity from semiconducting materials, now commercially available as roof panels and even roof shingles.
    - Passive Solar Heating, Cooling and Daylighting – design features such as building materials that absorb and slowly release the sun's heat, like concrete.
    - Solar Hot Water and Space Heating and Cooling – use of the sun to heat either water or a heat-transfer fluid in collectors to provide energy-efficient hot water and hot water heat.



  - **Biomass** – plant derived organic matter available on a renewable basis, including dedicated energy crops and trees, agricultural food and feed crops, agricultural crop wastes and residues, wood wastes and residues, aquatic plants, animal wastes, municipal wastes, and other waste materials – all used to produce a variety of fuels including the liquid fuels ethanol, methanol, biodiesel, and gaseous fuels such as hydrogen and methane.

  - **Fuel Cells** – use of hydrogen (the third most abundant element on the earth's surface, where it is found primarily in water and organic compounds) to produce heat and electricity for buildings.

LEED™ CERTIFICATION

The Leadership in Energy and Environmental Design (LEED) green building rating system is administered by the U.S. Green Building Council (USGBC), a coalition of building industry leaders working to promote buildings that are environmentally responsible, profitable and healthy places to live and work.

LEED certification is typically voluntary, yet there are increasing numbers of tax benefits and/or grants being offered for green buildings. Many U.S. government agencies and some states and localities are mandating that LEED requirements be met, and some are even requiring LEED certification for public buildings.

While civic pride for building "green" can bring some satisfaction to building owners, tangible economic benefits that come from certification will generate the most enthusiasm. For example, meeting many of the green building practices that lead to LEED certification can result in energy and cost savings over the life of the building. Furthermore, workers in LEED certified environments can have increased productivity translating directly into company profits.

The Oldcastle Precast Residential Building System can help owners and designers achieve LEED certification. The LEED rating system divides credits and prerequisites into five categories:

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Indoor Environmental Quality
- Innovation and Design Process

Prerequisites and credits are based mostly on established governmental or trade group standards. The number of points a project earns determines the level at which a project can be certified. The certification levels are Platinum, Gold, Silver and Certified.

Compliance with LEED prerequisites and obtaining LEED credits can be obtained through:

- Recycling concrete (particularly applicable to roads, parking, sidewalks, and fill materials)
- Construction waste management (precast concrete is very efficiently produced with little waste)
- Use of pervious concrete pavement (to reduce stormwater runoff)
- Optimizing energy performance of the building envelope (Concrete's thermal mass is a benefit)
- Using regionally produced concrete products (Oldcastle has plants in most U.S. regions)

LEED certified professionals should be included on the design team for each project in order to determine the potential for maximizing concrete's many sustainable benefits.

RESOURCES

There are numerous programs available for designers and owners to learn more about energy conservation and high performance building design. A listing of some of the available resources includes:

1. Report of the World Commission on Environment and Development to the United Nations General Assembly, 1987, www.un.org/documents/ga/res/42/ares42-187.htm.
2. U.S. Green Building Council – www.usgbc.org
3. *Using Concrete to Maximize LEED™ Points*, Martha VanGeem and Medgar L. Marceau, *Concrete International*, pp. 69-73, November 2002.
4. "What is Green Building, and Why Does It Matter?" Anne Balough, www.concretenetwork.com
5. Environmental Council of Concrete Organizations - www.ecco.org
6. *Ecological Carrying Capacity Effects of Building Materials Extraction*, Dr. Robert Paehlke, Natural Resources Canada, 1993.
8. U.S. Department of Energy - www.eere.energy.gov
9. Sustainable Buildings Industry Council - www.sbicouncil.org
10. Energy Star - www.energystar.gov
11. U.S. Environmental Protection Agency – www.epa.gov/heatisland/about/index.html
12. *Achieving Sustainability With Precast Concrete*, Martha VanGeem, P.E., LEED A.P., *PCI Journal*, pp. 42-61, January-February, 2006.
13. *Some Aspects of Sustainability*, Adam Neville, D.Sc., A&M Neville Engineering, London England, *PCI Journal*, pp. 72-75, January-February, 2006.

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