What is Green Building?

The topic of green building extends into a broad array of concerns related to our built environment and the affects it has on our natural environment. Green building design and construction is the accumulation of several building techniques that work to reduce the ecological footprint, or the amount of land and its resources needed to produce the energy, provide water, and materials used to construct and operate the buildings we inhabit. Furthermore, green building methods are increasingly associated with smart growth principles that include the siting of buildings, density of development, transportation choice, and land conservation. In short, Green building is the process of design, construction and operation of a building and its site that minimizes impact on our environment and improves indoor environmental quality.

Why is green building important?

The evidence of human impacts on the environment has become acute. Science supports the argument that greenhouse gasses, of which humans are mass producers, are found to at least exacerbate global warming. Water resources are shrinking while water is being diverted to surface systems rather than replenishing aquifers. Our water resources continue to be polluted; now primarily by the affects of non-point source pollution rather than centralized polluters such as coal burning plants (although they remain a major contributor to air and water pollution), a far more complicated solution is needed to effectively deal with the aggregated pollution caused by many distributed polluters. Clearly, business as usual provides an uncertain future at best; worst case is environmental and subsequently economic collapse. Our building and development regime is a major contributor to our environmental problems, accounting for the following impacts :

- 12% of fresh water supplies and 80% of portable water supplies
- 40% of greenhouse gas emissions
- 40% of raw materials use
- 30% of waste output
- 37% of total energy use
- 68% of electricity consumption

These statistics illustrate significant room for improvement in our current development regime. Green building seeks to design, construct, and operate buildings in order to reduce their impact on the environment to sustain our natural systems and provide a healthier environment.

Aspects of Green Building

Energy

When looking at the statistics of environmental impacts of our buildings energy consumption quickly stands out, particularly with regard to consumption of electricity. The need for electricity has become pervasive in our homes, we need it

to heat and cool our homes, run appliances such as washers, dryers, and refrigerators, illuminate the interior and exterior of the house, power electric devices such TVs, and computers. Green building can approach the problem of energy production in two ways, first through alternative energy sources and second, through conservation.

Alternative sources of energy can be broken down into two separate categories of distributed and centralized generation. Distributed generally refers to energy sources that are produced on-site serving a single building with centralized generation referring to mass produced energy such as hydroelectric dams, and nuclear power plants. Scales of production run the entire spectrum in between, and one source of energy may be harnessed on either end of the spectrum. Some examples of alternative sources of energy include:

- **Solar panels** – photovoltaic panels produce electricity using the sun, panels can also be used to heat water. Solar Thermal uses panels to heat water that is used for domestic hot water use, in some cases can supplement the heating of a home. (Typically distributed but have been used centrally to produce energy for many users)
- **Windmills** - can be distributed, but most frequently used centrally in areas with consistent wind.
- **Geothermal Heating/Cooling** – uses the earths stable temperatures to heat in the winter and cool in the summer.
- **Fuel Cell** – captures chemical energy in order to produce electricity with little to no pollution as a by-product.
- **Bio-Fuels** – uses any fuel produced from biomass or it's metabolic byproduct. This source of energy has been garnering a large amount of press recently as bio-fuels can be developed from corn, rice husks, sugar cane, and used vegetable oil available from any restaurant fryolator. Bio-Fuels can also be collected from capped landfills that produce methane from biodegradable waste contained in them.
- **Hydroelectric** – dams are familiar energy producers to the City of Lowell, they provided the basic logic for siting mills here. They continue to be a viable source of energy and are a valuable source in a portfolio of energy offerings.

Energy production using alternative fuels and methods has become a hot topic and often overshadows simple improvements in order to conserve energy, but conservation through improvements in efficiency and behavioral change can reduce our energy needs substantially. Conservation can be addressed in several ways, many of which have been practiced in the recent and far past:

- **Insulation** – Including the building envelope, sealing air leaks, and installing insulated windows.
- **Building Design** – Buildings can be more efficient by merely designing them to take advantage of the vast amount of free energy produced by the sun. Solar orientation can help heat the house with passive solar energy and ventilation at the roof of the building can help circulate air and allow heat to

escape during warmer months. Coniferous trees can shield cold winds in the winter and deciduous trees can provide shading of the sun in the summer while allowing the sun's rays to heat a building during the winter.

- **Efficiency** – Replacing aged appliances and electronic equipment with newer models featuring energy star rating systems can quickly reduce Energy. Light bulbs should be replaced with compact fluorescent light bulbs. Light sensors and thermostats that automatically turn off when not used can also help to reduce electrical needs.

Water Conservation & Regeneration

Recognizing that water is largely what makes our planet inhabitable, water conservation and regeneration is extremely important, and although buildings use a small percentage of fresh water resources buildings and supporting infrastructure has a deep impact on the quality and availability of our water resources. There are two goals when implementing green building techniques to address water resources; the first is to reduce water use through conservation and collection thereby reducing the need to draw from surface water sources or aquifers. The second is to manage storm water run-off in order to reduce non-point source pollution and regenerate groundwater supply.

In an urban setting the primary culprit in the depletion and pollution of water resources is pervasive development of impervious surface in our built environment. These surfaces, including asphalt and concrete in parking lots, roads, and building roofs, prevent water flow from percolating into the ground water system. Instead it is diverted directly to surface water such as rivers and lakes, carrying pollutants including oil, gas, and heavy metals from cars that collect on these surfaces with it. Impervious surfaces also heat water run-off impacting the environment as it reaches surface water altering the delicate balance of the ecosystem in rivers and lakes. Lastly, and not necessarily related to water resources but affected by green building techniques is the heat island effect caused by vast areas of impervious surfaces.

Low Impact Development (LID) is a site planning approach that looks at a buildings context and uses best management practices (BMP) to mimic the water processing capabilities of a non-developed natural location. LID basically works to capture rainwater, recycling for use on-site or slowly regenerating it into the groundwater system, filtering pollutants through the use of natural vegetation. The following are some of the BMP used to achieve improved rain water management, it is important to note that each site is unique and no single solution or combination of solutions will be successful for all sites.

- **Green Roof** – A vegetated roof that slows and absorbs a portion of rainwater runoff. Green roofs also reduce the heat island affect as vegetation absorbs the heat from the sun apposed to reflecting it, and insulates the building reducing heating and cooling costs.
- **Bioretention** – Includes vegetated swales, bioretention slopes, rain gardens and basins. All of these mechanisms are used to slow, and infiltrate water

run-off rather than delivering it directly to culverts or other surface water. These techniques frequently work to filter and cool the water as well reducing harmful impacts to the environment.

- **Planter Boxes** – Elevated structures placed adjacent to a building in order to intercept rainwater run-off from a buildings downspouts. They are vegetated with ornamental and natural plants to help absorb and filter water.
- **Pervious surfaces** – Asphalt or concrete paving that is porous to allow water to flow through, or paving blocks placed to provide gaps for water to flow through.
- **Rain Barrels or cisterns** – Container designed to capture rainwater for reuse and can be sized for single-family homes to big box retailers.

LID also looks to site planning strategies that preserve existing high quality and/or sensitive natural elements such as wetlands, riparian buffers, mature trees, steep slopes, floodplains, woodlands, and highly permeable soils. The challenge is to balance development needs, preservation of natural elements, and use of BMP appropriately to the site and its context.

Waste Reduction

An exorbitant amount of waste is generated during the site preparation and construction phase of development as well as the ongoing day-to-day operations of the building's tenants. The core goal in waste management of Green building is to reduce the amount of waste that ends up in landfills. Waste reduction includes procurement decisions and processes that reduce waste in transporting materials over long distances, manufacturing, and use of alternative materials in order to reduce demand for virgin materials. Waste reduction is achieved by:

- Reusing materials in existing buildings or procuring recycled materials,
- Recycling what is non-usable in construction rather than sending it to landfills
- Providing locations and processes that makes recycling convenient for building tenants,
- Utilizing materials harvested or manufactured regionally.

Green building also means that materials are chosen to reduce harmful harvesting practices that exacerbate the depletion of finite resources or damage sensitive ecosystems. For instance certified timber can be procured from timber companies using sustainable harvesting practices, reducing the demand to harvest highly valuable woodlands such as the Brazilian rainforests or old growth forests in the West.

Indoor Environmental Quality

The intent is to provide a more comfortable and healthful environment for a building's occupants. This is largely achieved by providing adequate access to fresh air through proper ventilation, access to natural lighting, and reduction of air contaminates particularly Volatile Organic Compounds.