Recent trends in the Green Building Concept

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***Abstract*— Green building concept, in broader terms, involves a building, which is designed, built, operated, maintained or reused with objectives to protect occupant health, improve employee productivity, use wisely natural resources and reduce the environmental impact. In other words the green building process incorporates environmental considerations into every stage of the building construction. This process focuses on the design, construction, operation and maintenance phases and takes into account the lot design and development efficiency, energy and water efficiency, resource efficiency, indoor environmental quality, building-owner maintenance and the building's overall impact on the environment**

***Keywords*— Green building, Environment, Waste reduction, Energy efficiency, Material efficiency**

I. INTRODUCTION

When the pre historic man constructed a hut for the first time using bamboo trees and coconut leaves to protect himself from sun and rain, he was starting to exploit nature for his humble needs. Apart from killing the trees he also disturbed the natural habitat of the insects and birds in those trees and interfered in the cycles of nature. That was a beginning. Now, it is beyond imagination, how much damage has been inflicted on earth by the construction of various types of buildings using sand and water from the rivers, stones from the mountains, cement manufactured from the ingredients dug from the land. In addition, carbon emission from the buildings and manufacture of construction materials warm up the air and space [1]. But, after getting conscious about the environment and after feeling the environmental responsibilities, the way our people try to address this problem is wonderful. One of the intelligent initiatives is the concept of "Green Buildings"[2].

The concept of Green Buildings envision a new approach to save water, energy and material resources in the construction and maintenance of the buildings and can reduce or eliminate the adverse impact of buildings on the environment and occupants.

II. GREEN BUILDING OVER CONVENTIONAL BUILDING

By preferring Green Building over a conventional building we help this planet earth and the people to retain nature to a maximum extent possible in three ways with reference to the location of the buildings [3].

1. Retain the external environment at the location of the building.
2. Improve internal environment for the occupants
3. Preserve the environment at places far away from the building

A. Green Buildings Retain the Environment at the location of the Building.

Suppose we propose a multistoried office complex to accommodate thousands of officers and staff, it requires a vast area. Therefore selection of a site for such a building complex should consider retention of local vegetation, wild life, natural water courses etc. Either a site with bio diversity should be avoided or the building should be planned to reduce site disturbance

Land

The landscaping and the exterior design in a green building shall be in such a way that there is more shaded area, the light trespass is eliminated and local species of plants are grown.

Energy efficiency

Green buildings often include measures to reduce energy consumption – both the embodied energy required to extract, process, transport and install building materials and operating energy to provide services such as heating and power for equipment[4]. As high-performance buildings use less operating energy, embodied energy has assumed much greater importance – and may make up as much as 30% of the overall life cycle energy consumption. To reduce operating energy use, high-efficiency windows and insulation in walls, ceilings, and floors increase the efficiency of the building envelope, (the barrier between conditioned and unconditioned space). Another strategy, passive solar building design, is often implemented in low-energy homes. Designers orient windows and walls and place awnings, porches, and trees to shade windows and roofs during the summer while maximizing solar gain in the winter. In addition, effective window placement (day lighting) can provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy costs. Onsite generation of renewable energy through solar power, wind power, hydro power, or biomass can significantly reduce the environmental impact of the building.

Water efficiency

Reducing water consumption and protecting water quality are key objectives in sustainable building. One critical issue of water consumption is that in many areas, the demands on the supplying aquifer exceed its ability to replenish itself [5]. To the maximum extent feasible, facilities should increase their

dependence on water that is collected, used, purified, and reused on-site. The protection and conservation of water throughout the life of a building may be accomplished by designing for dual plumbing that recycles water in toilet flushing. Waste-water may be minimized by utilizing water conserving fixtures such as ultra-low flush toilets and low-flow shower heads. Bidets help eliminate the use of toilet paper, reducing sewer traffic and increasing possibilities of re-using water on-site. Point of use water treatment and heating improves both water quality and energy efficiency while reducing the amount of water in circulation. The use of non-sewage and grey water for on-site use such as site-irrigation will minimize demands on the local aquifer.

Materials efficiency

Building materials typically considered to be 'green' include timber from forests that have been certified to a third-party forest standard, rapidly renewable plant materials like bamboo and straw, dimension stone, recycled stone, recycled metal, and other products that are non-toxic, reusable, renewable, and/or recyclable (e.g., Linoleum, sheep wool, panels made from paper flakes, compressed earth block, adobe, baked earth, rammed earth, clay, vermiculite, flax linen, sisal, sea grass, cork, expanded clay grains, coconut, wood fiber plates, calcium sand stone, concrete (high and ultrahigh performance, roman self-healing concrete , etc. [5]. The EPA (Environmental Protection Agency) also suggests using recycled industrial goods, such as coal combustion products, foundry sand, and demolition debris in construction projects. Building materials should be extracted and manufactured locally to the building site to minimize the energy embedded in their transportation. Where possible, building elements should be manufactured off-site and delivered to site, to maximize benefits of off-site manufacture including minimizing waste, maximizing recycling (because manufacture is in one location), high quality elements, better OHS management, less noise and dust

B. Green buildings improve internal environment for the occupants

Light: In a designed green building the occupants shall feel as if they are in outdoor location. The interior and exterior designs shall go hand in hand by blending the natural and artificial lighting and presenting transparent views wherever possible [6].

Air: In the air conditioned environment, a green building shall be specially equipped to ensure the Indoor Air Quality for a healthy atmosphere. Even the nasal feelings shall be pleasant free from the odour of paints and furnishings.

A comfortable atmosphere at work stations improve the attendance of the staff and increase the productivity.

C. Green buildings preserve the environment at places far away from the buildings.

We all know that a building is constructed using cement, sand, steel, stones, bricks, and a lot of finishing materials. These materials are quarried or procured from far away from the location of the buildings. Building materials are responsible for about 20 percent of the greenhouse gasses emitted by a building during its lifetime; Green buildings shall use the products that are non-toxic, reusable, renewable, and/or recyclable wherever possible. Locally manufactured products are preferred so that the collective material environment of the locality remains a constant and moreover the fuel for the transport of materials is saved. As we see, our food and domestic products are tagged with green as a fashion of eco-friendly practices; building materials are also going green. The futuristic green buildings are to use green materials which are in research stage now[4,5,6].

Green wood: A Stanford team has done a research for wood alternate. Hemp fibers and biodegradable plastic when pressed together and heated form layers and this material is as strong as wood. When buried in land fill, it degrades faster. This wood creates more raw materials when it breaks down. Microbes produce methane gas when they decompose this wood substitute and other debris thrown into landfills. Another type of bacteria absorbs this gas and turns it into plastic that can be used to create a new wooden plank. By this cycle, there is a continuous source of raw material for this wood. When this material at research comes to market, it may help to control deforestation and promote the rainfall.

Green Cement: Bruce Constantz at Calera, based in Los Gatos, has developed a green method to produce both cement and aggregate, another component of Concrete [7]. Their method sequesters Carbon Di Oxide from power plant flues and mixes the gas with sea water to produce the mineral raw materials of concrete. For every ton of green cement Calera manufactures half a ton of fly ash from coal plants is used apart from preventing production and emission of Carbon Di Oxide.

Other Green Building materials: Renewable plant materials like bamboo (because bamboo grows quickly) and straw, lumber from forests ecology blocks, dimension stone. recycled stone, recycled metal are some of the other materials used in a Green Building[4]. Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by the following aspects:

III. REDUCING ENVIRONMENTAL IMPACT

Green building practices aim to reduce the environmental impact of buildings, and the very first rule is, do not build in sprawl (spreading in disordered fashion). No matter how much grass you put on your roof, no matter how many energy-

efficient windows, etc., you use, if you build in sprawl, you've just defeated your purpose. Buildings account for a large amount of land. The International Energy Agency released a publication that estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and for 24% of global carbon dioxide emissions.

IV. LIFE CYCLE ASSESSMENT (LCA)

A life cycle assessment (LCA) can help avoid a narrow outlook on environmental, social and economic concerns by assessing a full range of impacts associated with all the stages of a process from cradle-to-grave (i.e., from extraction of raw materials through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling). Impacts taken into account include (among others) embodied energy, global warming potential, resource use, air pollution, water pollution, and waste [3].

Although LCA is widely recognized as the best way to evaluate the environmental impacts of buildings it is not yet a consistent requirement of green building rating systems and codes, despite the fact that embodied energy and other life cycle impacts are critical to the design of environmentally responsible buildings.

V. OPERATIONS AND MAINTENANCE OPTIMIZATION

No matter how sustainable a building may have been in its design and construction, it can only remain so if it is operated responsibly and maintained properly. Ensuring operations and maintenance(O&M) personnel are part of the project's planning and development process will help retain the green criteria designed at the onset of the project. Every aspect of green building is integrated into the O&M phase of a building's life [5]. The addition of new green technologies also falls on the O&M staff. Although the goal of waste reduction may be applied during the design, construction and demolition phases of a building's life-cycle, it is in the O&M phase that green practices such as recycling and air quality enhancement take place.

VI. WASTE REDUCTION

Green architecture also seeks to reduce waste of energy, water and materials used during construction. During the construction phase, one goal should be to reduce the amount of material going to landfills. Well-designed buildings also help reduce the amount of waste generated by the occupants as well, by providing on-site solutions such as compost bins to reduce matter going to landfills. When buildings reach the end of their useful life, they are typically demolished and hauled to landfills. Deconstruction is a method of harvesting what is commonly considered "waste" and reclaiming it into useful building material. Extending the useful life of a structure also reduces waste – building materials such as wood that are light and easy to work with make renovations easier.

To reduce the impact on water treatment plants, several options exist. "Greywater", wastewater from sources such as dishwashing or washing machines, can be used for subsurface irrigation, or if treated, for non-potable purposes, e.g., to flush toilets and wash cars. Rainwater collectors are used for similar purposes [7].

Centralized wastewater treatment systems can be costly and use a lot of energy. An alternative to this process is converting waste and wastewater into fertilizer, which avoids these costs and shows other benefits. By collecting human waste at the source and running it to a semi-centralized biogas plant with other biological waste, liquid fertilizer can be produced. This concept was demonstrated by a settlement in Lubeck Germany in the late 1990s. Practices like these provide soil with organic nutrients and create carbon sinks that remove carbon dioxide from the atmosphere, offsetting greenhouse gas emission. Producing artificial fertilizer is also more costly in energy than this process.

VII. COST AND PAYOFF

The most criticized issue about constructing environmentally friendly buildings is the price. Photo-voltaic, new appliances, and modern technologies tend to cost more money. Most green buildings cost a premium of <2%, but yield 10 times as much over the entire life of the building. The savings in money come from more efficient use of utilities which result in decreased energy bills .Studies have shown over a 20 year life period, some green buildings have yielded $53 to $71 per square foot back on investment[6].

VIII. REGULATION AND OPERATION

As a result of the increased interest in green building concepts and practices, a number of organizations have developed standards, codes and rating systems that let government regulators, building professionals and consumers embrace green building with confidence [5]. In some cases, codes are written so local governments can adopt them as bylaws to reduce the local environmental impact of buildings..Green building codes and standards, such as the International Code Council's draft International Green Construction Code, are sets of rules created by standards development organizations that establish minimum requirements for elements of green building such as materials or heating and cooling.

IX. CONCLUSIONS

The benefits of green building include cost savings from reduced energy, water, and waste; lower operations and maintenance costs; and enhanced occupant productivity and health. Consequently, even small changes in productivity and health translate into large financial benefits. Despite data limitations and the need for additional research in various areas, the findings of this report point to a clear conclusion: building green is cost-effective and makes financial sense today. Architects will influence the future built environment and, by pushing for green buildings, there is an opportunity to

design healthy, environmentally sound buildings which will better serve the human being.

X. RECOMMENDATION FOR CONTINUED GREENING

The following recommendations can help local communities as they begin or enhance their green building programs.

- Use architects as a resource:.
- Hire a director of sustainability:
- Train and accredit municipal employees:
- Keep it simple.
- Implement additional sustainability initiatives.

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