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Developing architectural technologies for green buildings

Akshita Mandhyan

First Semester, B.Arch., National Institute of Technology, Raipur, India, C.G., 492010, India.

Abstract
It is experienced that present day people refer to 'Green Technology' with giving a very little thought to the environment. It has become more of a commercialization or branding gimmick. Green Technology aims at stepping into future, bringing out new innovations in hand with the nature, to curb the negative impacts of human involvement. Green technology ensures sustainability, waste reduction, innovation and viability. Introduction of Green technology into architecture has led to the birth of 'Green buildings'. Green buildings do not just become 'green' by simple implementation of eco-friendly systems such as solar collectors, photovoltaic cells, biological recycling systems, building automation systems, etc into the building although these help but there's more to it. There are various other factors which determine how 'Green' the building is! It includes everything, from the choice of building materials to be used for construction to its response to the environment around, the prevailing winds, temperature, humidity, sun paths and angles, etc. The wise use of these for natural light, ventilation, vegetation automatically reduces artificial energy consumption, thereby creating a 'living building'. Architects should attempt designing buildings with eco-friendly materials, proper orientation, and thermal comfort. This research identifies the present context and suggests guidelines for architects/ planners to follow and develop eco-friendly environment.

Keywords: Green Buildings, Green Technology, Heat Gain, Energy Conservation, Water Conservation, Natural ventilation, Thermal, Architecture, Recycling, Environment

INTRODUCTION

The Green Concept

'A Green building should create delight when entered, serenity and health when occupied and regret when departed' – Perhaps this is one of the most inspiring definitions of a Green building, articulated in the book 'Natural Capitalism.

With rising energy costs, tightening budgets, increasing populations and diminishing resources, it is becoming increasingly important that buildings and individuals conserve or – go green! Green or sustainable building practices help to create healthier and more resource efficient models of:

- Construction
- Renovation
- Operation
- Maintenance
- Demolition

Introduction of architectural technologies to build a Green building comprises increasing the efficiency with which buildings and their sites use and harvest energy, water, materials, and reducing building impacts on human health and the environment, through better design, construction, operation and removal – the complete building cycle life.

*Corresponding Author

Akshita Mandhyan
First Semester, B.Arch., National Institute of Technology, Raipur, India, C.G., 492010, India.

Email: akshita.mandhyan@gmail.com

Green Buildings Are Costlier, A Myth

Considerable research has been carried out with regards to the concept of introduction of green technologies in the architecture of a building. While many green materials and technologies do cost more, it has been demonstrated that many green strategies and technologies actually cost the same and some even cost less than traditional "not-so-green" technologies. By blending the right mix of green technologies that cost less with green technologies that cost the same or slightly more, it is possible to have a green building that costs the same as a conventional one. Often the key to a cost effective green building and site design lies within the interrelationships and associated cost and performance trade-offs that exist between different building systems. For example, the use of high performance windows and window frames increases the first cost of the building envelope, however the resulting reduction in the size and cost of the buildings heating and cooling system more than offsets the added cost of the better glazing system. The result is a building that has a comparable or perhaps even a lower first cost, a higher comfort level, lower energy use, and lower energy bills and operating cost for the life of the building.

Architectural Technologies That Build A Green Building Ensuring Energy Conservation

Low energy house or Zero energy building are constructed so as to reduce the energy consumption to the minimum which includes both embodied energy and operating energy. Use of artificial heating, air conditioning, ventilation, lighting and other electric devices are responsible for a major portion of energy consumed by the building.

Heating

A building is heated by various methods that include direct, indirect and isolated heat gain.

Direct heat gain

Direct heat gain includes the heat gain that takes place through direct collection of heat from the sun. It can be retained by the building materials or be avoided with use of reflective materials. This direct heat gain is very effective for buildings that require passive solar heating while in hotter climate; it becomes a bane especially with excessive use of glass for windows on the southern side. Such windows are called solar windows. Some of this heat is used immediately; rest gets absorbed by the walls, floor, ceiling and the furniture which just adds up to work of the air conditioner. Therefore, excessive use of glass should be avoided for reducing the energy consumptions for cooling the building.

Indirect heat gain

In the indirect gain, the heat from the sun is collected by a storage mass and then transferred to the interior space. The storage mass doesn't directly receive the heat of the sun rays. Several indirect gain passive solar systems are mentioned in Table I.

Table 1. Indirect gain passive solar systems

SYSTEM TYPE	REQUIREMENTS	HEATING CHARACTERISTICS
i)Masonry thermal storage wall	South-facing wall and glazing Required. Storage wall should Be within 25 ft.	System is slow to warm up and slow to cool In the evening, with small temperature swings
ii)Water thermal Storage wall (water wall)	South-facing wall and glazing Required. Storage wall should Be within 25 ft.	System is slow to warm up and slow to cool In the evening, with small temperature swings
iii)Thermal storage Roof (roof pound)	Flat or low slope roof required Skylights are discouraged. Another supporting structure For the roof required.	Low temperature swings, can provide Heating in winter and cooling in summer.

Isolated gain

An isolated gain system has its main parts separate from the main living area of the house. Sun rooms, solariums and solar green houses use a combination of direct and indirect gain system features. The sunlight is absorbed by the air and thermal mass of the room. The heat is then moved to the rest parts of the room by conduction. It is important to keep in mind that some heat gain will take place in summer too so appropriates shades and louvers must be used to control unwanted heat gain in the building.

Ventilation

Ventilation is defined as the exchange of air to the outside and also, the circulation of air within the building. It is classified into two types – forced and mechanical ventilation. Excess humidity, odors, and contaminants can often be controlled via dilution or replacement with outside air. However, in humid climates much energy is required to remove excess moisture from ventilation air. This leads to an increased requirement for artificial or mechanical ventilation for cooling using mechanical systems' fans, ducts, dampers, and control systems to introduce and distribute cool outdoor air when appropriate. Kitchens and bathrooms typically have a mechanical exhaust to control odors and sometimes, humidity. Kitchens have another problem to deal with such as smoke and grease.

Design guidelines are offered in building regulations and other related literature and include a variety of recommendations on many specific areas such as:

- Building location and orientation
- Building form and dimensions
- Indoor portions and layout
- Window typologies, operation, location and shapes
- Other aperture types (doors and chimneys)
- Construction methods and detailing
- External elements (walls, screen)

Natural ventilation is recommended for maximum energy consumption. It is the process of supplying or removing air from an indoor space without using mechanical means. Wind is the main mechanism of wind driven ventilation, buoyancy-driven ventilation occurs as a result of the directional buoyancy force that results from temperature differences between the interior and exterior. Wind driven ventilation is determined by three main factors – wind speed, wind direction relative to the building orientation and the shape of the building.

Ensuring Water Conservation and Efficiency

The concept of Green buildings that are into practice these days focus on optimum use of water with an eye on its circulation, economic utilization, discharge, preservation and it re-use, thereby safeguarding the ecological balance. On one hand high water consumption touches the project profitability while on the other hand it has contributed greatly to environmental protection while easing the passing phase of a project.

Zero Discharge buildings

100% water recycling and Zero discharge buildings have become a reality. Moreover, its economic use in specific areas like irrigation, flushing of toilets and semi-conductor and in specific geographical areas where there is scarcity of water has made zero water discharge a necessity.

Zero Discharge system conserves more than 90% waste water as compared to a conventional system and enhances the project profitability by cost reduction.

It implements a combination of physical, chemical and biological treatment operations. Wastewater streams from the assembly and engine plants are individually pretreated before being mixed with sanitary and cafeteria wastewaters. Following biological treatment, the stream is ultra filtered. This final stream is sent to a three-stage reverse-osmosis system, where it is separated into an ultrapure water phase and highly concentrated brine stage. The brine is distilled until it results in a solid salt, which is disposed of as waste.

Low water discharging fixtures

Installing low-flow fixtures and aerators saves water and money. Aerators for faucets and showers require an initial capital investment, but they often pay back the investment in less than a year, especially when they are used often. Many utilities and city governments offer incentives to purchase and install low-flow fixtures. These improvements yield annual water savings of almost $160,000, after an initial capital cost of only $90,000.

Rainwater harvesting systems

A rainwater harvesting system comprises the components of various stages for transporting rainwater through pipes or drains, filtration, and storage in tanks for reuse or recharge. The common components of a rainwater harvesting system involved in these stages are catchments, coarse mesh, gutters, conduits, first flushing, filter, storage facility and recharge structures.

High efficiency drip irrigation systems

Drip irrigation is the most efficient method of irrigating. While sprinkler systems are around 75-85% efficient, drip systems typically are 90% or higher. This means much less wasted water! For this reason drip is the preferred method of irrigation in the desert regions. But drip irrigation has other benefits which make it useful almost anywhere. It is easy to install, easy to design, can be very inexpensive, and can reduce disease problems associated with high levels of moisture on some plants.

Unlike sprinkler irrigation, drip irrigation systems are much more forgiving of design error, the cost of over sizing the materials is minimal, and so a prescriptive design method works very well for almost everyone. To prepare a fully engineered drip irrigation design requires a massive number of difficult mathematical calculations.

Pressure compensating emitters are used for an elevation difference of over 1.5 meters (5 feet) in the area being irrigated. For more level areas turbulent flow emitters work great and are often less expensive. For gravity flow systems use of short-path emitters is recommended, they typically work better than the others at very low water pressures.

For most soil types 2.0 l/hr (0.6 gph) emitters work well and are more economical. For sandy soil use of 4.0 l/hr (1 gph) emitters is recommended.

Reclaimed water or storm water irrigation

Storm water is rainwater that runs from roofs, roads, other hard surfaces and parks into storm water drains. It then flows into creeks, the harbor and the ocean. Storm water can be captured, treated and used for non-drinking purposes by an integrated approach to storm water harvesting, focusing on smaller, local schemes which provide an alternative water source but also deliver river health, water quality and flood mitigation benefits.

Root zone treatment technique

Raw effluent (after removing grit or floating material is passed horizontally or vertically through a bed of soil having impervious bottom. The effluent percolates through the bed that has all the roots of the wetland plants spread very thickly, nearly 2,500 types of bacteria and 10,000 types of Fungi, which harbor around roots, get oxygen form the weak membranes of the roots and aerobically oxidize the organic matter of the effluent.

Reeds, Phragmites *australis* is considered to be the best plant because of its roots form horizontal rhizome that guarantee a perfect root zone filter bed.

CONCLUSION

Building a green building is not just a matter of assembling a collection of the latest green technologies or materials. Rather, it is a process in which every element of the design is first optimized and then the impact and interrelationship of various different elements and systems within the building and site are re-evaluated, integrated, and optimized as part of a whole building solution.

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