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Time for Green Technologies with Respect to Buildings

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ABSTRACT "TIME FOR GREEN HOMES IN INDIA."The paper discusses key issues that are of critical importance in the evolution of an environmentally-responsive architecture, -that is an architecture aimed at achieving occupant thermal and visual comfort with little or no recourse to non-renewable energy sources. These are: knowledge, performance and the urban context. The result is a simple eco friendly Green Building where one possibly have the best form of natural light and fresh air, all the while recycling and reusing wastes for maximum benefit. Such technology will reduce our dependence on external sources of energy and water - indeed, the best way to reduce the impact of global warming. It would lead to sustainable development.

Green Building is the integration of several energy efficient, environmentally sound measures, products, and construction practice in a housing project. Green-Housing practice is a step towards Sustainable Building Design

INTRODUCTION----What is Green Home ?

A Green Building is one that is ideally constructed with a smart design, and requires minimal maintenance. The overall harm to the environment is at a minimum and the residents remain healthy. It uses less water and energy. Generate less waste. This is all compared to conventional building.

In a country like India where the population is ever increasing, so are the demands. The demand for houses, shopping malls, hotels, commercial complexes etc. are on the rise. An emerging alternative is to go Green in housing too inorder to have sustainable development.

There are many tangible and non tangible benefits of Green Buildings. Green Buildings are not new to India. In India, there is a millennia-old reservoir of knowledge that can help reduce energy consumption in buildings today. Ancient Indian spiritual thought integrates humans with the cosmos, presenting an understanding that the processes of the cosmos are directly related to human existence. With this understanding, ancient Indian civilization has always respected its environment. Typical principles include climate-responsive design, use of local and sustainable materials, water harvesting, etc.

We have begun using green principles like water harvesting and waste management in projects. It emphasize the use of eco friendly building materials like fly-ash cement and blocks, steel and tiles, recycled aluminum, bamboo based products, green roofing products and so on. On the technology front too, there are a lot of options available to build Green Buildings. Energy saving air conditioners, high performance glass windows, water saving solutions, composting toilets, and efficient building management systems are just some of them. Tapping solar energy is another method used by Green homebuilders in India. The use of a photovoltaic array on the rooftop is a good source of alternate energy as are solar thermal arrays. This way energy can be obtained from the environment, stored and used as required. A combination of innovative green ideas and high technology may be able to address India's energy and water needs.

The economic benefits of green buildings should be understood from the point of view of operation of the building and the resultant savings in its lifetime. At the construction stage, monetary savings can result from choice of building materials. The first costs savings = costs and savings from incorporating green features into a building.

Life-Cycle Costs/Savings = costs/savings over a building's or feature's useful life. The first cost of the green buildings vary significantly depending on specific project goals. While there are many significant benefits that are 'no additional cost' (like no west facing openings), some features will cost more in both design and material cost.

MATERIALS & METHODOLOGY

Construction of Green Building in present scenario is indeed a challenging job considering scanty open spaces, forced vertical expansion with pre-determined orientation of building, un touch ability towards recycled material, New equipments and fixtures using more water and energy and least awareness for environment. One need to understand meaning of sustainable development before experimenting on it.

Understanding "sustainable development"

Sustainable : 'long lasting', Development : improving the wellbeing of people, raising living standards and increasing facilities. The main Principle of Sustainable Development : the need of the present should be met without compromising the ability of future generation to meet their own needs.*

The research conducted for the construction of Green Building in present scenario has been classified in following six chapters. The work is still in progress and is not registered any where rightnow. There can not be any copy book style for Green building. The approach varies from site to site and prevailing site conditions and existing environment. The detailed methodology is not discussed because of constraint of write up limited to 8 number of pages only.

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The ultimate aim is to have sustainable development with least effect on environment and the building must consume optimum water and energy with best indoor environmental quality.

1. SITE PLANNING & SUSTAINABLE DEVELOPMENT

The major ecological features of the site should be identified, including the site geology, hydrology, vegetation, wildlife and prior site history. Developments on existing brownfield sites, urban infill areas and on other non-greenfield locations can be encouraged. Project impacts on surroundings after construction can be minimized by addressing Heat island effects and reducing light pollution.

One must draw site sedimentation and erosion control plan as per NBC Part 10, section 1 and chapter 4. Develop site nearby to already developed site with minimum basic facilities available at walking distance. Commuting facility in form of rail / bus also available at walking distance to reduce pollution and land development impacts from automobile use. Provide adequate parking facility with preference for low emitting vehicles, carpools to discourage use of single occupancy vehicles. Limit disruption and pollution of natural water bodies by managing quality of storm water runoff. Minimize impact on microclimate, human and wildlife habitat by reducing thermal gradient between developed and undeveloped areas on roof and non roof. Use roofing material with high SRI, install high albedo and vegetated roof surface. Use light coloured open grid pavement with pervious surface for parking lot, walkways, plaza etc. Hence the strategy for Green Building design will be **Analysis and Inference,** to understand the problem and its context, characterize important requirements, establish relative priorities and to determine desired objectives.

Application: To formulate design strategies, to apply strategies which establish relationships between architectural form, space and energy.

Evaluation : To monitor the performance of the building, to evaluate the performance with respect to the analysis of the requirement priorities and objectives.

Indirect fallout of unrestrained human activity will be Global warming, Green house effect, Ozone layer depletion, increased co2 level, increased temperature, soil erosion, flash floods and reduced ecological footprint.

2.ENVIRONMENT ARCHITECTURE

The passive building design enables to develop buildings that are comfortable with very little or even without use of any artificial device. These design concepts can be in form of Passive Heating, Cooling and Ventilation system.

The passive heating system is based on collection of naturally available energy, storage of collected energy and use of stored energy in controlled fashion for achieving thermal comfort. This is achieved by use of solar energy, use of ambient energy and use of internal source of heat.

The solar passive concepts are through direct, indirect and combined of both solar heat gain. Indirect heat gain through normal glazed thermal storage wall and trombe wall is very effective. The disadvantage of direct heat gain for space heating, is that the space gets heated up rapidly. Similarly, after sunset, space gets cooled rapidly too. In contrast, a thermal storage wall for indirect heat gain absorbs solar radiation for several hours before it begins to heat up the living space but it continues to provide heat even after the sunset. The most appropriate strategy for overcoming the disadvantages of individual direct and indirect heat gain methods would be through a combination of direct and indirect gain method through Thermosiphon Air Panel, which is essentially a solar energy collector for air heating without a storage medium that is usually fitted in a south wall of a building for supplying warm air to building space.

Selection of proper orientation is also important to take advantage of prevailing breezes in warm and humid climate and for prevention of hot winds in hot and dry climate. The buildings in cluster can be spaced such that they shade each other mutually. The amount and effectiveness of the shading, however, depends on the type of building clusters. Shading by trees and vegetation is very effective method of cooling the ambient hot air and for protecting the building from solar radiation.

As a result of the absorbed solar radiation and due to convective heat gain from the hotter ambient air, the external surface of the building gets heated. This heat gets transmitted through the building fabric to the internal envelope. One solar heat gain factor(g) or sometimes also called as solar heat factor, is an indication of fraction of the heat of solar radiation transmitted into the building. It is defined as the ratio of heat transmitted into the building to the incident solar energy on that surface.

Air cavities within walls or an attic space in the roof ceiling combination reduces the solar heat gain factor. (SHF)

Ventilation plays an important role for passive cooling of building. Air flow in a building is either due to pressure differences, caused by temperature differences (stack effect) or due to pressure differences of the wind. Windows play a dominant role in inducing indoor ventilation due to wind forces. There can be number of other innovative ideas for passive architectural design depending on site conditions. Enough space is not available to pen down test cases and study cases.

3.WATER CONSERVATION

The water conservation has been experimented with three 'R", i.e. Reduce, Recharge and Reuse. There are many ways of achieving this. It also depends on site and climatic conditions. There are many innovative ways of achieving three 'R". Water consumption can also be reduced by monitoring of water use, prevention of losses and through water-efficient management techniques such as, providing a Main control valve, Moisture sensor controller, Turf and each type of bedding area must be segregated into independent zones based on watering needs, Drip irrigation, Time based controller, Use of pressure regulating devices to maintain optimal pressure to prevent water loss and many other innovative methods for watering. Irrigation water can also be conserved through Drought tolerant species, which do not require supplemental irrigation, Bio-dynamic farming and Hydroponics.

Efficient plumbing fixtures, faucets with low flow aerators and taps having 10-12 LPM and 6-8 LPF, touchless sensors, waterless urinals can also contribute to water conservation.Falling rain can provide some of the cleanest naturally occurring water that is available anywhere. Most modern technologies for obtaining drinking water are related to the exploitation of surface water from rivers, streams and lakes, and groundwater from wells and boreholes. However, these sources account for only 40% of total precipitation.

It is evident, therefore, that there is considerable scope for the collection of rainwater when it falls, before huge losses occur due to evaporation and transpiration and before it

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becomes contaminated by natural means or man-made activities. In areas which have regular rainfall the most appropriate alternative is the collection of rainwater, called "rainwater harvesting".
The term "rainwater harvesting" is usually taken to mean "the immediate collection of rainwater running off surfaces upon which it has fallen directly". This definition excludes run-off from land watersheds into streams, rivers, lakes, etc. The runoff can be diverted to percolation tank, recharge bore / well to recharge ground water level.

Gray water can be treated and reused for flushing and irrigation, thereby reducing consumption of potable water and also reduces load on municipalities to treat sewage. One can also design zero discharge campus. Here black soil can treated to get organic fertilizers. Bio-gasifiers can be used to obtain methane gas, which can be further used to run generator set for green energy.

That T-shirt you're wearing cost 2000 litres of water. India consumes 13% of the world's water and has the highest water footprint in the world. For a country facing extreme water shortages right now, India's water consumption levels are suprising. For one thing, the nation's water footprint is the highest in the world: as of data released in 2005, India consumes a whopping 13% of the world's water. What's a water footprint anyway?

The water footprint of a country is defined as the total volume of freshwater used to produce goods and services consumed by the people of that country. A country's water footprint is generally determined by four major factors: volume of consumption, consumption pattern, climate, and agricultural usage.

4. ENERGY CONSERVATION
Achieve minimum energy performance of building by various means such as roof and envelope design of the building, which is the main source of solar heat. The doors, windows, layout of the house, environment as well as height & width of the house are responsible for keeping the house cool. Summer or winter, the greenery around the house helps you to keep the house cool. The atmosphere gets hot due to sun rays entering through the terrace, walls and doors in summers. If trees and plants are there around the house then the house remains naturally cool.

The solar heat reduction inside the building will ease down cooling load, which will require lesser ton of A.C. to achieve comfort level, which would have been on higher side if roof and envelope where not treated. This can also be achieved by three tier cooling system. Even geo-thermal cooling will help us to achieve comfort level with lesser use of conventional energy, which emits carbon during generation. Hence operating cost of building is reduced. Even hydro energy and atomic energy are not preferred because of their biological, ecological and catastrophic impact. Hence hybrid energy is preferred, which can be generated by many ways in the building.

The cooling load inside the building is also reduced by way of passive building design, orientation of building, forced and natural ventilation, emmitivity, absorptivity and reflectivity property of material, shape and colour of structure, SHGC value of glazing, buffer space provided on west and south side of building, minimum U value for glazing, wall and roof assembly. Various shading devices will also help us to prevent solar heat inside the building. Observe SEER, Seasonal Energy Efficient Ratio and MERV factor, Minimum efficiency reporting value and COP. ECBC and ASHRAE norms prove to be handy to optimize energy performance of the building.

The lighting load inside the building can be reduced by proper LPD, star rated electric fixtures, LED fixtures and son. There are many other ways to do it and needs more pages for explanation. One can even attempt Net zero home by above stated ways and means.

5. EFFICIENT BUILDING MATERIALS & RESOURCES
Building material must be carefully selected for it's various properties such as R value, U value, SRI, emmitivity, absorptivity and reflectivity etc. Preference to be given to renewable and rapidly renewable material. Salvaged material can also prevent the use of virgin material. Regional material can lead to boost local economy and also reduce carbon emission and use of fossil fuels. Construction Waste management during execution will reduce the waste material sent to landfills and resulting pollution. Solid waste management during post occupancy is much required because it imparts to maximum pollution. If it is properly handled than one can retrieve large amount of recyclable waste, which can be sent back to industry to preserve virgin material and organic waste can be used for bio-gasifire leading to zero discharge campus.

6. INDOOR ENVIRONMENTAL QUALITY
Studies show that many times indoor pollution takes more of a toll on your health than outdoor pollution. As we walk through our homes, the air turbulence created by our moving bodies stirs up a combination of dust and debris that can be very irritating to the lungs.
Indoor Air Pollution and Irritants: Human skin particles, pollen, and smoke are all part of this bothersome brew of irritants. The most irritating are dust mites. Dust mites are microscopic creatures that feed on dust especially flakes of skin. Household cleaners and pesticides are full of
chemicals. People are even bothered by low levels of these compounds. Ironically, indoor air is now recognized as being full of many of the same chemicals we've spent so much time reducing outdoors. Another common source of indoor air pollution is drycleaned clothes, which emit a number of chemicals that may be harmful. Fortunately, homeowners these days have a wide range of options that can help them breathe more easily and comfortably in the home.
Reduce and alter indoor chemical use: Pay close attention to the labels on household products. If possible switch to natural products that contain fewer toxic chemicals. When you do need to use a stronger chemical, use it sparingly and follow all the precautions explained on the
label. Air out drycleaned items: Don't immediately store drycleaned items in a closet. Take the plastic off and allow your clothing to air out for a day or two in a space with good air circulation. Then, recover the items with plastic and store them in a closet. Install an electronic air cleaner
Electronic air cleaners can extract 30 times as much dust as ordinary filters, but they cost a lot more. Open the windows: Don't keep your home tightly sealed all of the time. Years ago homes weren't nearly as insulated as they are today. However, one drawback to this is that indoor toxins also get sealed inside. It's important to air out your home regularly by opening windows and using fans to draw outside fresh air inside. Installing an attic or whole house fan is a great way to bring a big breath of fresh air indoors. Add plants to your home:Plants can do a great job of helping to remove the indoor toxins from home. And, some plants work harder at it than others. A few that have been shown to work well: Boston fern, spider plant, English ivy, areca palm, and peace lillies. A good rule of thumb is two plants per hundred square feet. Create more lung space by achieving minimum

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20% glazing factor, encourage the use of materials with low emissions so as to reduce adverse health impacts for building occupants by avoiding high VOC paints and varnish, use CRI certified carpets, avoid occupant's exposure to indoor airborne contaminants before occupying the premises and finally provide minimum 75% of daylighting to ensure connectivity between the interior and the exterior environment.

RESULTS

The above stated applications are implemented at many residential, institutional and factory buildings have resulted in achieving comfort level inside the building by minimizing A.C. load. The operating cost of the building has reduced with reduced energy performance of building. Pay back period is calculated with cost benefit ratio. All this could have been given but limited space has prevented to do so.

CONCLUSION

The Green building can be achieved by various ways and means. There can not be a particular copy book style. It depends on following criteria. Site conditions, Climatic conditions, Rainfall Willingness to spend additional amount to achieve more green building criteria, Calculation of cost benefit ratio, life cycle and payback period, Understanding / knowledge of Green features adopted, it's use and benefits by the User and the visitors.

There are two recognized Institutions in India for certifying Green buildings. It is IGBC and GRIHA-Home. The Green building is not necessarily residential building. It can be Commercial, Factory, Institutional and any other type of building. Government has to play a key role to take this movement to masses and motivate masses to adopt Green norms for the building they construct. The question going unanswered are, How do we meet growing demand for Green building material and equipment? What steps Government to take for Green Buildings? How do we reach out the Green Home concept to mass and more people, particularly the users and consumers?

This can be achieved by following ways. Uniform guidelines for construction of Green Buildings, make it voluntary or statutory requirement through legislation, Implementing agency, Monitoring agency to monitor green features operate satisfactory during post occupancy period, Motivation to public to adopt Green norms by giving incentives in form of House tax loan interest rebate, Cheaper recycled material than virgin material, Priority to be given for approval to Green building proposals, Fiscal incentives for green building material Extra F.S.I., Subsidy in House tax, Reduced power tariff in proportion to renewable energy generated, etc. Buildings are one of the major pollutants that affect urban air quality and contribute to climate change. Hence, the need to design a green building, the essence of which would be to address all these issues in an integrated and scientific manner. It is true that it costs a little more to design and construct a green building. However, it is also a proven fact that it costs less to operate a green building that has tremendous environmental benefits and provides a better place for the occupants to live and work in. Thus, the challenge of a green building is to achieve all its benefits at an affordable cost.

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