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Architectural and Technical Approach for Self-Sustainable Building

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Abstract : Growth of population and demand in energy has leaded us to create and find new ways to quench our thirst for energy. By giving the solutions for energy demand the environment must not be on stake, fitting in architecture and building design to create a more greener and eco-friendlier as well as sustainable design to reduce the carbon per capita. Filling the blank new spaces created in the sustainable architecture has opened the ideas of eco-friendly and sustainable designs to carry our increasing demand of energy and comfort. Using sustainable architecture and technologies, and introducing the technology that uses the renewable source of energy and not depending on fossil fuels. Building architecture so as it can be self-sustained by its own renewable energy source.

Keywords: Renewable Energy, Self-Sustainable Building, Solar, Wind, Biomass, Architectural Orientation.

Introduction

Green buildings are becoming increasingly common for both residential and commercial structures. The high demand for green design integrates world consciousness for the environment and sustainability. In many cases green structures may provide a lower lifetime cost alternative to conventional building methods, but has a higher sustainability future if developed correctly and efficiently. Although green technology is more expensive than traditional technologies, it has the potential to have a shorter payback period due to significantly reduced utility bills. With the current economic condition, cost-effective designs will certainly drive the market forward. The idea of green design is still a new concept. Therefore, the definition of what is, and what is not green has sometimes been confusing.

1. Previous work study

Shiv Lal et al. have studied that the residential and commercial buildings demand increases with rapidly growing population. It leads to the vertical growth of the buildings and needs proper ventilation and day-lighting. The natural air ventilation system is not significantly works in conventional structure, so fans and air conditioners are mandatory to meet the proper ventilation and space conditioning. Globally building sector consumed largest energy and utmost consumed in heating, ventilation and space conditioning. This load can be reduced by application of solar chimney and integrated approaches in buildings for heating, ventilation and space conditioning. They concluded that it is a sustainable approach for these applications in buildings. The authors are reviewed the concept, various method of evaluation, modelings and performance of solar chimney variables, applications and integrated approaches. **Peter et al.** studied in their paper a conceptual framework aimed at implementing sustainability principles in the building industry. The proposed framework based on the sustainable triple bottom line principle, includes resource conservation, cost efficiency and design for human adaptation. Following a thorough literature review, each principle involving strategies and methods to be applied during the life cycle of building projects is explained and a few case studies are presented for clarity on the methods. The framework will allow design teams to have an appropriate balance between economic, social and environmental issues, changing the way construction practitioners think about the information they use when assessing building projects, thereby facilitating the sustainability of building industry. **Grierson and Moultrie** worked in their research that the paradigm shift for sustainable buildings requires a transformation of the architectural design process. This paper examines how sustainability is embedded into design methodology and mapped onto, or has transformed, the design process. Interviews with a sample of Scottish architectural and multi- disciplinary practices were undertaken to explore the common approaches and barriers to sustainable design. Case study methodology was also employed to consider exemplar buildings and the value of post-occupancy evaluation is discussed. Within the context of the global environmental perspective, UK and Scottish legislation, sustainable principles and blueprints, a process model is developed to provide a framework for discussion and review. The first creative step is given as an alignment of practice ethos with established architectural philosophies and principles, from across the sustain ability spectrum, to move towards at ypology of sustain able building design.

2. The concept of "green"

3.1 Overview of "Green Concept" in Building Design

There are large amounts of materials used and energy consumed during the construction and operation of an average building. The world's population has grown exponentially since the Second World War, and there is currently pressure on available land and natural resources. As a society, we will eventually be faced with the depletion of our most widely used source of energy, the non- renewable fossil fuels. There are many ways in which these organizations are taking steps to reduce consumption such as developing new types of vehicles, energy sources, recycled materials, and designing environmentally friendly buildings. These environmentally friendly buildings are also known as "green" buildings.

Example of Existing Green Building

To illustrate the benefits of integrating green concepts in building design, construction and operation, a few examples of green buildings are provided. These examples also help to answer the question "what is a green building?"

The Chicago Centre For Green Technology (CCGT), Chicago, U.S.A.

In 1999 the Chicago Department of Environment embarked on an ambitious project known as The Chicago Centre for

Green Technology (CCGT). The Department gathered a team of architects and engineers who produced the final designs and oversaw the construction of a building that would serve as an example for companies and 7 homeowners all over North America.An amount of $5.4 million was spent renovating an existing two-storey, 40 000 ft2 building, that was to be converted into a green building. The project team incorporated many of the most advanced green technologies available at the time in the design of the CCGT. The idea was to design a building that would reduce the demand on natural resources and energy while decreasing the production of pollution and waste. The building was to do this without forcing occupants to change their habits drastically. The teams design focuses on four major areas: lighting, water, earth, and air. The following is a brief summary of the compilation of green technologies used in Chicago.

➢ **Lighting**

Purpose: to reduce fossil fuel emissions released when electricity is produced.

CCGT design includes:

- Photovoltaic cells.
- Passive light designs including a greenhouse with heat absorbing tiles and skylights.
- Smart lighting, which adjusts the electrical lights according to the available natural light, thus lowering electricity requirements.
- Motion-sensitive lights that turn themselves off when the room is empty.

➢ **Water**

Purpose: To reduce pollution due to storm water runoff water and to reduce the demand on the municipal sewer system.

CCGT design includes:

- Green roof (with succulent plant stores water in its roots and leaves and therefore does not need to be watered during drought)
- Cisterns (holding tanks used to collect rain water)
- Disconnected downspouts (drain to soil not sewer)
- Bio swales (ditches with water-loving plants which filter pollutants)

➢ **Earth**

Purpose: To reduce the demand on natural resources provided by such as oil, wood, and minerals.

CCGT Design includes:

- Promotion of alternate forms of transportation by providing bike racks, showers, electrical outlets in the parking lot for electric cars, and close to major bus routes.
- Demolition waste was recycled when possible.
- Use of recycled materials in the furnishings in the building.

➢ **Air**

Purpose: Reduce air pollution and the need for heating and cooling using non-renewable resources.

CCGT design includes:

- A ground source heat pump and pipe system that carries a (non-toxic) liquid similar to antifreeze through a series of looped pipes 200 feet (61 m) below ground level. The liquid is used to regulate the temperature in the building.
- Highly effective insulation, including the green roof, that lowers heating and cooling costs. Use of natural gas to heat the building
- Use of local materials in the construction and operation of the building. This reduces pollution related to transportation and helps the local economy.
- Use of less harmful chemical products both for the construction and for the maintenance of the building.
- The green roof atmospheric carbon dioxide to oxygen through the natural process (photosynthesis) of the plant life. The roof also absorbs rainwater and thus reduces the amount of water released into the city's sewer system.

➢ **LEED and C2000 Rating systems**

LEED Accreditation

In the United States the most prominent green building accreditation program is the Leadership in Energy and Environmental Design (LEED) rating system.

This is a program defining and rating green buildings. A Canadian equivalent rating system is currently under development.

It is expected to focus on the same major areas that the LEED rating system does.

These areas are:

- Sustainable Site Planning
- Safeguarding Water and Water Efficiency
- Energy Efficiency and Renewable Energy
- Conservation of Materials and Resources
- Indoor Environmental Quality

The LEED rating system awards points for how a building's design deals with specific solutions for the above-mentioned issues.

The United States Green Building Council (USGBC) uses the LEED checklist to rate a building. Depending on the total points achieved for solutions related to the above areas, a rating for the building is awarded as follows:

Certified 26-32 points
Silver 33-38 points
Gold 39-51 points
Platinum 52-60 points

Benefits

The benefits of receiving a rating from LEED include increased publicity and promotion of high quality design. The rating also gives designers' a method of comparing new designs to old designs in order to determine their success.

Drawback

Application for a LEED assessment costs the builder extra money and it does not change the building once it is built.

4. Self sustainable technologies

4.1 Smart Lighting/ Power Saving Electronics

Simplest way to reduce energy is by using power saving electronics and smart lightings. These devices are designed to turn off when not in use. Smart lights contain photo sensors that read how much natural light is entering in the building and dim electric lights when there is enough natural light. Sometime smart lights are equipped with motion detection sensors so as to automatically shut off the lights when no one is in the room. The major benefit of smart lighting and power saving electronics is that they reduce energy consumption. The reduction in energy implies reduced electricity costs.

4.2 Solar Water Heating

Solar water heating panels are a system of uses glazed collectors that uses the sun's energy rather than electricity or gas to heat water. A solar water heater uses glazed collectors that are mounted on roof and is connected to storage tank.

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Fluid is pumped to the glazed collectors where it is warmed by the solar energy, and returned to a heat exchanger where heat from the fluid is used to heat the water. The water is then collected in an insulated water storage tank so as the water can be used when the sun is not shining. A typical system will provide 50% to 75% of the water-heating load.

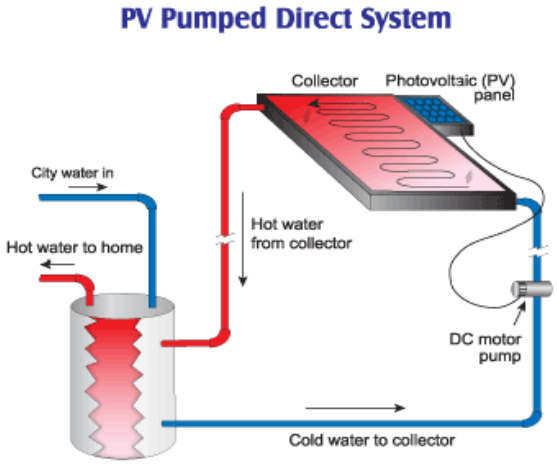

Fig. 1: Solar Water Heating

4.3 Wind Turbine

Fig. 2: Wind Turbine

Wind turbines are powered by the wind to produce energy. They do not use up natural resources and do not produce greenhouse gases. They are an efficient, clean way to produce energy. Wind turbines are relatively low-cost. A 50-kW turbine will be enough to satisfy the daily energy need of a house.

4.4 Solar Panels

Every building whether home, industry, institution or commercial establishment can generate some solar power by installing PV panels on the roof top. Sometimes this can be a BIPV (building integrated).

Fig. 3 : Solar Panels

4.5 Urban Bio Gas Plant

Due to scarcity of petroleum and coal it threatens supply of fuel throughout the world also problem of their combustion leads to research in different corners to get access the new sources of energy, like renewable energy resources. Solar energy, wind energy, different thermal and hydro sources of energy, biogas are all renewable energy resources. But, biogas is distinct from other renewable energies because of its characteristics of using, controlling and collecting organic wastes and at the same time producing fertilizer and water for use in agricultural irrigation. Biogas does not have any geographical limitations nor does it require advanced technology for producing energy, also it is very simple to use and apply. Deforestation is a very big problem in developing countries like India, most of the part depends on charcoal and fuel-wood for fuel supply which requires cutting of forest. Also, due to deforestation It leads to decrease the fertility of land by soil erosion. Use of dung, firewood as energy is also harmful for the health of the masses due to the smoke arising from them causing air pollution. We need an ecofriendly substitute for energy. Kitchen waste is organic material having the high calorific value and nutritive value to microbes, that's why efficiency of methane production can be increased by several orders of magnitude as said earlier. It means higher efficiency and size of reactor and cost of biogas production is reduced. Also, in most of cities and places, kitchen waste is disposed in landfill or discarded which causes the public health hazards and diseases like malaria, cholera, typhoid. Inadequate management of wastes like uncontrolled dumping bears several adverse consequences. It not only leads to polluting surface and groundwater through leachate and further promotes the breeding of flies, mosquitoes, rats and other disease bearing vectors. Also, it emits unpleasant odour & methane which is a major greenhouse gas contributing to global warming. Mankind can tackle this problem(threat) successfully with the help of methane, however till now we have not been benefited, because of ignorance of basic sciences – like output of work is dependent on energy available for doing that work.

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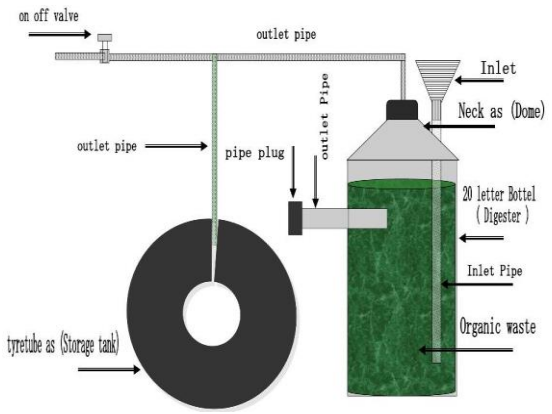

Fig. 4: Urban Bio Gas Plant

5. CONCLUSION

The motivation for this project stems from recent green trends. Green technologies are rapidly developing and readily available.

- Throughout each step of the design, the project focused on green alternatives to traditional construction practice.
- The goal of the project was to reveal the potential that sustainable living has to become standard practice.
- Overall, this was a very smooth transition, as early on it was decided that individuals would keep working with the sustainable elements they had previously researched and would also take responsibility for those corresponding sections of the modelling tool.
- This personal maintenance of the basic knowledge of the systems being analyzed helped to save time and avoid confusion, as team members did not have to conduct a total handoff of information to someone unfamiliar with the characteristics of that sustainable element.
- The downside of this approach is that it kept information fragmented amongst group members.
- However, to address this issue and help maintain a cohesive analysis and report, team members adhered to a consistent schedule of weekly group meetings and maintained open lines of communication between meetings through the use of email and electronic databases such as Drop Box and Google Docs.

References

i. *Shiv Lal, S.C. Kaushik, P.K. Bhargav, (2013), "Solar chimney: A sustainable approach for ventilation and building space conditioning", International Journal of Development and Sustainability, ISSN: 2168-8662, Volume 2 Number 1, Pages 277-297, ISDS Article ID: IJDS12110901.*

ii. *Peter O. Akadiri, Ezekiel A. Chinyio, Paul O. Olomolaiye (2012), "Design of A Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector", Journal of Buildings, 2, 126-152, ISSN 2075-5309, doi: 10.3390/buildings2020126.*

iii. *David Grierson, Carolyn Moultrie (2011), "Architectural Design Principles and Processes for Sustainability: Towards a Typology of Sustainable Building Design", Design Principles and Practices: An International Journal Volume - 5, Number – 4, ISSN1833-1874.*

iv. *Gan, G. (2011), "General expressions for the calculation of air flow and heat transfer rates in tall ventilation cavities", Building and Environment, Vol. 46 No. 10, pp. 2069-2080.*

v. *Macias, M., Gaona, J.A., Luxan, J.M. and Gomez, G. (2009), "Low cost passive cooling system for social housing in dry hot climate", Energy and Buildings, Vol. 41 No. 9, pp. 915-921.*

vi. *GRIERSON,D.2009, Towards Sustainable Building Design, Design Principles and Practices: An International Journal, Volume3, Number3, 2009, ISSN1833-1874.*

vii. *LEED New Construction v,2,2 Reference Guide, Third Edition, US Green Building Council, Washington, DC 4.*

viii. *LEED Home Reference Guide, US Green Building Council, Washington, DC 5.*

ix. *LEED New Construction & Major Renovation Reference Guide, Version 2.2, Second edition September 2006, US Green Building Council, Washington, DC.*

x. *Renewable Energy: Wikipedia.com*