International Journal For Technological Research In Engineering
Volume 7, Issue 5, January-2020 *ISSN (Online): 2347 - 4718*

A FORMULA OF RETAINABILITY

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Abstract: In recent years, sustainability concept has become the common interest of numerous disciplines. The reason for this popularity is to perform the sustainable development.
The Concept of Green Architecture, also knavery, water and new materials are utilized as well as amounts of waste causing negative effects to health and environment is generated. In order to limit these effects and design environmentally sound and resource efficient buildings; "green building systems" must be introduced, clarified, understood and practiced.
This paper aims at highlighting these difficult and complex issues of sustainability which encompass the scope of almost every aspect of human life.

I. INTRODUCTION

Sustainability is comprehensive therefore a complex subject. It is of vital importance to all because it deals with the survival of human species and almost every living creature on the planet. Sustainable and eco-friendly architecture is one of the main aims that humans for creating a better life have made as the ultimate model for all their activities.
For this reason, moving towards a greener architecture is well-thought-out the main goal of the present architecture of our time.
At the rate the development needs of this world is using the scarce and limited resources found on the earth, it is becoming obvious that unless there are major changes to Man's thinking and behavior, the future of civilization as known today is dubious. This complex subject has no straight forward solution, especially considering that sustainability is a goal for all to reach as they continually strive to reach towards it.Green architecture produces environmental, social and economic benefits.
Environmentally, green architecture helps reduce pollution, conserve natural resources and prevent environmental degradation.
Economically, it reduces the amount of money that the building's operators have to spend on water and energy and improves the productivity of those using the facility And, socially, green buildings are meant to be beautiful and cause only minimal strain on the local infrastructure.
The buildings in which we live, work, and play protect us from nature's extremes, yet they also affect our health and environment in countless ways. As the environmental impact of buildings becomes more apparent, a new field called "green building" is gaining momentum.
Green, or sustainable, building is the practice of creating and using healthier and more resource efficient models of construction, renovation, operation, maintenance and demolition.

1.1. Green Architecture

Green architecture, or green design, is an approach to building that minimizes harmful effects on human health and the environment.
The "green" architect or designer attempts to safeguard air, water, and earth by choosing eco-friendly building materials and construction practices (Roy,2008).

1.2. Green Architecture and Green Design

Green architecture defines an understanding of environment-friendly architecture under all classifications, and contains some universal consent (Burcu, 2015), It may have many of these characteristics:

- Ventilation systems designed for efficient heating and cooling
- Energy-efficient lighting and appliances
- Alternate power sources such as solar power or wind power
- Non-synthetic, non-toxic materials
- Locally-obtained woods and stone
- Responsibly-harvested woods
- Adaptive reuse of older buildings
- Use of recycled architectural salvage
- Efficient use of space

While most green buildings do not have all of these features, the highest goal of green architecture is to be fully sustainable. Also Known As: Sustainable development, eco-design, eco-friendly architecture, earth-friendly architecture, environmental architecture, natural architecture (USGBC, 2002).

II. METHODOLOGY

In order to achieve the stipulated aim, the study presented in this paper, traces the following steps:
1. General overview on applying “Green Architecture “as a concept of sustainability.
2. Defining Considerations for Green Building.
3. Defining the benefits of applying criteria for Green Building strategies that could maximize energy efficiency, and indoor air quality.
4. Describing case Study potentials in terms of Green Building aspects.

III. CONSIDERATION FOR GREEN BUILDING

Green building involves consideration in four main areas: site development, material selection and minimization, energy efficiency, and indoor air quality.
• Consider site development to reduce the impact of development on the natural environment. For example, orient the buildings to take advantage of solar access, shading and

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wind patterns that will lessen heating and cooling loads.
• Carefully select materials that are durable, contain recycled content, and are locally manufactured to reduce negative environmental impacts. A growing market exists of quality recycled products at affordable prices.
• Incorporate energy-efficient design into buildings to create an efficient and comfortable environment. Take advantage of the natural elements and technologies to conserve resources and increase occupant comfort/productivity while lowering long-term operational costs and pollutants (CBFEE, 1999).
• Design for high indoor air quality to promote occupant health and productivity.
• Minimize the waste in construction and demolition processes by recovering materials and reusing or recycling those (CGB, 2009).

IV. THE PRINCIPLES OF GREEN BUILDING DESIGN

The green building design process begins with an intimate understanding of the site in all its beauties and complexities. An ecological approach to design aims to integrate the systems being introduced with the existing on-site ecological functions performed by Mother Nature.
These ecological functions provide habitat, respond to the movements of the sun, purify the air as well as catch, filter and store water. Designers can create features in their buildings that mimic the functions of particular eco-systems. Species that thrive in natural ecosystems may also utilize habitats created in man-made structures.
Creating new habitat on structures in urbanized areas is especially important to support bio-diversity and a healthy ecosystem (Thomas, 2009). The following points summarize key principles, strategies and technologies which are associated with the five major elements of green building design which are:
Sustainable Site Design; Water Conservation and Quality; Energy and Environment; Indoor Environmental
Quality; and Conservation of Materials and Resources. This information supports of the use of the USGBC LEED Green Building Rating System, but focuses on principles and strategies rather than specific solutions or technologies, which are often site specific and will vary from project to project (USGBC).

Fig.1: Elements of green building design by author (USGBC).

4.1. Water Systems

Water - often called the source of life - can be captured, stored, filtered, and reused. It provides a valuable resource to be celebrated in the process of green building design.
According to Art Ludwig in Create an Oasis out of Grey water, only about 6% of the water we use is for drinking. There is no need to use potable water for irrigation or sewage.
The Green Building Design course introduces methods of rainwater harvesting, grey water systems, and
living pools (BCKL, 2009).
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 or by using water for washing of the cars.
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 (fig5) 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 (Stephen & Harrell, 2008).

4.2. Natural Building

A natural building involves a range of building systems and materials that place major emphasis on sustainability. Ways of achieving sustainability through natural building focus on durability and the use of minimally processed, plentiful or renewable resources, as well as those that, while recycled or salvaged, produce healthy living environments and maintain indoor air quality. Natural building tends to rely on human labor, more than technology.
As Michael G. Smith observes, it depends on "local ecology, geology and climate; on the character of the
particular building site, and on the needs and personalities of the builders and users (Smith, 2002).
The basis of natural building is the need to lessen the environmental impact of buildings and other supporting systems, without sacrificing comfort or health. To be more sustainable, natural building uses primarily abundantly available, renewable, reused or recycled materials. The use of rapidly renewable materials is increasingly a focus.

4.3. Passive Solar Design

Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces. The building itself or some element of it takes advantage of natural energy characteristics in its materials to absorb and radiate the heat created by exposure to the sun. Passive systems are simple, have few moving parts and no mechanical systems, require minimal maintenance and can decrease, or even eliminate, heating and cooling costs (BCKL, 2009).
Passive solar design uses that to capture the sun's energy:

- Solar passive features
- Shape and form of buildings.
- Orientation of the facades.
- Design of Building plan and section.
- Thermal insulation and thermal storage of roof.
- Thermal Insulation and thermal storage of the exterior walls.

Homes in any climate can take advantage of solar energy by incorporating passive solar design features and decreasing carbon dioxide emissions. Even in cold winters, passive solar design can help cut heating costs and increase comfort (BCKL, 2009). Solar buildings are designed to keep enviro
Major Components: Orientation, double glazed windows, window overhangs, thermal storage walls roof, roof painting, Ventilation, evaporation, day lighting, construction material

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etc.
Designs depend on direction & intensity of Sun & wind, ambient temp., humidity etc. Different designs for different climatic zones.

4.4. Green Building Materials
Green building materials are generally composed of renewable rather than non-renewable resources and are environmentally responsible because their impacts are considered over the life of the product. In addition, green building materials generally result in reduced maintenance and replacement costs over the life of the building, conserve energy, and improve occupant health and productivity. Green building materials can be selected by evaluating characteristics such as reused and recycled content, zero or low off-gassing of harmful air emissions, zero or low toxicity, sustainably and rapidly renewable harvested materials, high recyclability, durability, longevity, and local production (Cullen, 2010).
The materials common to many types of natural building are clay and sand. When mixed with water and, usually, straw or another fiber, the mixture may form cob or adobe (clay blocks). Other materials commonly used in natural building are: earth (as rammed earth or earth bag), wood (cordwood or timber frame/post-and-beam), straw, rice-hulls, bamboo and stone. A wide variety of reused or recycled non-toxic materials are common in natural building, including urbanite (salvaged chunks of used concrete), vehicle windscreens and other recycled glass (Woolley , 2006).
One-half of the world's population lives or works in buildings constructed of earth. Straw bale construction is now gaining in popularity and Many jurisdictions in California have adopted the Straw bale Building Code. Green Building Design favors natural building for its local availability, ease of use, lack of toxic ingredients, increased energy efficiency, and aesthetic appeal (NAOHB, 1998).
Several other materials are increasingly avoided by many practitioners of this building approach, due to their major negative environmental or health impacts. These include unsustainably harvested wood, toxic wood-preservatives, Portland cement-based mixes, paints and other coatings that off-gas volatile organic compounds (VOCs), and some plastics, particularly polyvinyl chloride (PVC or "vinyl") and those containing harmful plasticizers or hormone-mimicking formulations (Woolley , 2006).

4.5. Living Architecture
The environment like our bodies can metabolize nutrients and waste. Living Architecture focuses on these processes, integrating ecological functions into the buildings to catch, store, and filter water, purify air, and process other nutrients. Living Architecture also addresses biophilia, the documented health benefits associated with being in touch with living systems in the built environment (Susan, 2008).
4.5.1. Green roofs
serve several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, increasing benevolence and decreasing stress of the people around the roof by providing a more aesthetically pleasing landscape, and helping to lower urban air temperatures and mitigate the heat island effect (Vandermeulen, 2011)
There are two types of green roof:
1. Intensive roofs, which are thicker, with a minimum depth of 12.8 cm, and can support a wider variety of plants but are heavier and require more maintenance.
2. Extensive roofs, which are shallow, ranging in depth from 2 cm to 12.7 cm, lighter than intensive green roofs, and require minimal maintenance (Volder, 2014).
The term green roof may also be used to indicate roofs that use some form of green technology, such as a cool roof, a roof with solar thermal collectors or photovoltaic panels.
Green roofs are also referred to as eco-roofs, vegetated roofs, living roofs, green roofs and VCPH (Wilmers, 1990). (Horizontal Vegetated Complex Partitions).
4.5.2. Green Walls
Also known as vertical greenery is actually introducing plants onto the building façade. Comparing to green roof, green walls can cover more exposed hard surfaces in the built environment where skyscrapers are the predominant building style (Jonathan, 2003).
According to Ken (Ken,2008), if a skyscraper has a plant ratio of one to seven, and then the façade area is equivalent to almost three times the area. So, if the building is covered two thirds of the façade, this have contributed to doubling the extend of vegetation on site. So a skyscraper can become green, thus increasing the organic mass on the site (Wilmers, 1990).
There are three types of Green Walls:
The green walls can be divided into three fundamental types according to the species of the plants; types of growing media and construction method.
1. Wall-climbing Green wall is the very common and traditional green walls method. Although it is a time consuming process, climbing plants can cover the walls of building naturally.
Sometimes they are grown upwards with the help of a trellis or other supporting systems (Wilmers, 1990).
2. Hanging-down Green Wall is also another popular approach for green walls. It can easily form a complete vertical green belt on a multi-story building through planting at every story compare to the wall-climbing type (Wilmers, 1990).
3. Module Green Wall is the latest concept compared to the previous two types. It requires more complicated design and planning considerations before a vertical system can come to place. It is also probably the most expensive green walls method (Jonathan, 2003).

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