Urban Planning and Architectural Design for Sustainable Development

Green Architect a Concept of Sustainability

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Index: seventeen chapters in twenty five pages,

1 - Abstract:

Last and past few 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** is the theory, science and style of buildings designed and constructed in accordance with environmentally friendly principles. **Green Architecture** strives to minimize the number of resources consumed in the buildings construction, use and operation, as well as curtailing the harm done to the environment through the emission, pollution and waste of its components.

To design, construct, operate and maintain building energy, water and new materials are utilized as well as amount of water causing negative buildings.

Green Architecture system must be introduced, clarified, understood and practiced.

2 - Definitions:

- **Green Architecture** also known as (Sustainable Architecture, Sustainable building, Green building, Green design, Green construction, Sustainable development, Eco-design, Eco-friendly architecture, Environmental architecture, Natural architectural ...etc.).
- **Green Architecture** practice expands and complements the classical building design concerns of economy, utility, durability and comfort.
- **Green Architecture** is the practice of creating and using healthier and more resource efficient models of construction, renovation, operation, maintenance and demolition.
- **Green Architecture** refers to both a structure and application of processes that are environmentally responsible and resource-efficient throughout building's life cycle, from planning to design, construction, operation, maintenance, renovation and demolition, this requires close cooperation of the architect, engineers, contractor and the client at all project stages.
- **Green Architecture** is an approach to building that minimizes harmful effects on human health and the environment.
- **Green Architect** or **Green Designer** attempts to safeguard air, water and earth by choosing eco-friendly building materials and construction practice.

3 – Introduction & Foreword:

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 human for creating a better life have made as the ultimate model for all their activates, for this reason

moving towards a **greener architecture** is well-thought-out the main goal of the present architecture of our time.

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** produce environmental, social and economic benefit, environmentally **green architecture** helps reduce pollution, conserve natural resources and prevent environmental degradation, economically it reduces the amount of money that the building's operator have to spend on water and energy and improve 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 Architecture**" is gaining momentum.

4 - In General:

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective of green buildings is to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water and other resources.
- Protecting occupant health and improving employee productivity.
- Reducing waste, pollution and environment degradation.

A similar concept is natural building, which is usually on a smaller scale and tends to focus on the use of natural materials that are available locally; other related topics include sustainable design and **green architecture**.

Green architecture principles can very easily be applied to retrofit work as well as new construction.

5 - The Principles of Green Architectural Design:

The **green architectural** design process begin with an intimate understanding of the site in all its beauties and complexities, an ecological approach to design aims to integrate the system 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 created futures in their buildings that mimic the functions of particular eco-system, species that thrive in natural ecosystems

may also utilize habitats created in man-made structures, creating new habitat on structures in urbanized areas in especially important to support bio-diversity and a healthy ecosystem.

The following points summarize key principles, strategies and technologists which are associated with the **five** major elements of **green architectural** design (There is explaining in detail for the above five elements in chapter six) which are:

A. Sustainable site design.
B. Conservation of materials and Resources.
C. Minimization, Water conservation and Quality.
D. Energy and Environment.
E. Indoor environmental quality.

This information supports of the use of the **USGBC** (US Green Building Council) **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.

5 – 1 Water System:

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 architectural** design.

According to Art Ludwig in created 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 architectural** design course introduces methods of rainwater harvesting, grey-water system and living pools.

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 and heating improves both water quality and energy efficiency while reducing the amount of water circulation, the use of non-sewage and grey-water for on-site use such as site-irrigation will minimized demands on the local aquifer.

5 – 2 Natural building:

A natural building involves a range of buildings 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 buildings tends to rely on human labor more than technology.

The basis of natural building is the need to lessen the environmental impact of buildings and other supports systems without sacrificing comfort or health, to be more sustainable natural building uses primarily abundantly available, renewable, reuses or recycled materials, the use of rapidly renewable materials is increasingly a focus.

In additional to relying on natural building materials, the emphases on the architectural design is heightened, the orientation of a building, the utilization of local climate and site conditions, the emphases on natural ventilation through design, fundamentally lessen operational costs and positively impact the environmental, building compactly and minimizing the ecological footprint is common as are on-site handing of energy acquisition, on-site water capture, alternate sewage treatment and water reuse.

5 – 3 Passive solar design:

Passive solar design refers to the use of the sun's energy for the buildings 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 system are simple, have few moving parts and no mechanical system, require minimal maintenance and can decrease, or even eliminate heating and cooling coasts.

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 plans and sections.
- 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 winter passive solar design can help cut heating costs and increase comfort, Solar buildings are designed to keep environment comfortable in all season without much expenditure on electricity **30% to 40%** saving with additional **5% to 10%** cost towards passive features.

Major components:

- Orientation and Day lighting.
- Double glassed window and Window overhangs.
- Thermal storage walls roof.
- Roof painting.
- Ventilation and Evaporation.
- Construction materials.

Designs depend on direction and intensity of sun and wind, ambient temperature, humidity. Etc. different designs for different climatic zones.

5 – 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 reduce 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 reuse and recycled content, zero or low off-gassing of harmful air emissions, zero or low toxicity, sustainability and rapidly renewable harvested materials, high recyclability, durability, longevity and local production.

The materials common to many type of natural building are clay and sand, when mixed with water and usually, straw or another fiber, the mixture may from cob or adobe (clay blocks), other materials commonly used in nature 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.

One-half of the world's population lives or works in building constructed of earth straw bale construction is now gaining in popularity and many jurisdictions in California have adopted the straw bale building code, **green architectural** design favors natural building for its local availability, case of use, lack of toxic ingredients, increased energy efficiency and aesthetic appeal.

Several other materials are increasingly avoided by many practitioners of this building approach, due to their major negative environmental or health impact, these include unsustainably harvested wood, toxic wood-preservatives, Portland cement based mixes, paints and other coating 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.

5 – 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 the documented health benefits associated with being in touch with living systems in the built environment.

Throughout history greening of outside walls and roofs of buildings has taken place, reasons for doing so were the increase of insulation (Keep cool in summer and keep cold out in winter), improve aesthetics, improve indoor and outdoor climate, reduce the greenhouse gases such as carbon dioxide **(CO_2)**, carbon monoxide **(CO)** and nitrogen dioxide **(NO_2)** as well as increasing ecological values by creating habitats for birds and insects.

5 – 5 – 1 Green roof:

Serve several purposes for a building, such as absorbing rainwater providing insulation, creating a habitat for wild life, increasing benevolence and decreasing stress of the people around the roof by providing a more aesthetically pleasing landscape, and helping to lower urban air temperature and mitigate the heat island effect, there are **two** types of green roofs:

A. Intensive roofs: which are thicker, with minimum depth of **12.8cm** and can support a wider variety of plants, heavier and require more maintenance.
B. Extensive roofs: which are shallow, ranging in depth from **2cm to 12.7cm** lighter than intensive roofs and require minimal maintenance.

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 roof are also referred to as eco-roofs, vegetated roofs, living roofs, green roofs and **HVCP** (Horizontal Vegetated Complex Partitions).

5 – 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 exposal hard surfaces in the built environment where skyscrapers are the predominant building style, and there are **three** types of green walls, the green walls can be divided into **three** fundamental types according to the species of the plants, type of growing media and construction method:

A. Wall-climbing green walls: is the very common and traditional green walls method, although it's a time consuming process, climbing plants can cover the walls of building naturally, sometime they are grown upwards with the help of a trellis or other supporting systems.
B. Hanging-down green walls: 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.
C. Module green walls: 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.

6 – Green Architecture Consideration:

Green architecture involves consideration in **five** major elements:

A. Site development: Consider site development to reduce the impact of development on the natural environment for example orients the buildings to take advantage of solar access, shading and wind patterns that will lessen heating and cooling loads.
B. Material selection: Carefully select materials that are durable, contain recycled content, and are locally manufactured to reduce negative environmental impact, a growing market exists of quality recycled products at affordable prices.
C. Minimization: Minimize the waste in construction and demolition processes by recovering materials and reusing or recycling or recycling those.
D. Energy efficiency: 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.
E. Indoor air quality: Design for high indoor air quality to promote occupant health and productivity.

7 - Green Architecture Characteristics:

Green architecture defines an understanding of environment-friendly architecture under all classifications, and contains some universal consent; it may have **many** of these characteristics:

- Ventilation system designed for efficient heating and cooling.
- Energy-efficient lighting and appliances.
- Water-saving plumbing fixture.
- Landscape planned to maximize passive solar energy.
- Minimal harm to the natural habitat.
- Alternate power source 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 architecture** does not have these entire features, the highest goal of **green architecture** is to be fully sustainability.

Wind Power

8 – Green Architecture Goals:

The concept of sustainability development can be traced to the energy (especially fossil oil) crisis and environmental pollution concerns of the **1960s and 1970s, the Rachel Carson book "Silent Spring" published in 1962** is considered to be one of the first initial effort to describe sustainable development as related to green building, there are a number of motives for building green including environmental, economic and social benefits, however modern sustainability initiatives call for an integrated and synergistic design to both new construction and in the retrofitting of existing structure.

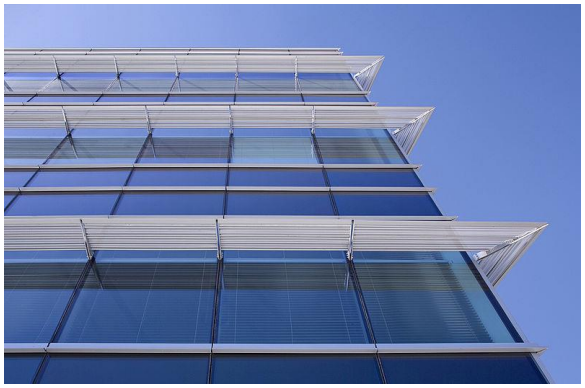
Green building brings together a vast array of practices, techniques, skills to reduce and ultimately eliminate the impacts of buildings on the environment and human health, It often emphasizes taking advantage of renewable resources, e.g. using sunlight through passive solar, active solar, photovoltaic equipment and using plants, tress through green roofs, rain gardens, reduction of rainwater run-off, many other techniques are used such as using low impact building materials or using packed gravel or permeable concrete instead of conventional concrete or asphalt to enhance replenishment of ground water.

While the practices or technologies employed in green building are constantly evolving and may differ from region to region, fundamental principles persist from which the method is derived: **Siting and structure design efficiency, Energy efficiency, Water efficiency, Materials efficiency, Indoor environmental quality enhancement, Operation and maintenance, Optimization and waste, Toxics reduction.**

The essence of green building is an optimization of one or more of these principles, also with proper synergistic design, individual green building technologies may work together to produce a greater effect, On the aesthetic side of **green architecture** or sustainable design is the philosophy of designing a building that is in harmony with the natural features and resources surrounding the site, there are several key steps in designing sustainable buildings: **Specify green building materials from local sources, Reduce loads, Optimize systems and generate on-site renewable energy.**

Green architecture involves Goals in **eight** main areas:

A. Life cycle assessment.
B. Siting and structure design efficiency.
C. Energy efficiency.
D. Water efficiency.
E. Materials efficiency.
F. Indoor environmental quality enhancement.
G. Operations and maintenance.
H. Reduce impact onto electricity network.



Exterior Light Shelves-Green office building, Denver Colorado

Eco-house at Findhorn Eco village with a turf roof and solar panels

9 – Reducing environmental impact:

Globally, buildings are responsible for a huge share of energy, electricity, water and materials consumption, the building sector has the greatest potential to deliver significant cuts in emissions at little or no cost, buildings account for **18%** of global emissions today, or the equivalent of **9 billion** tons of CO_2 annually, if new technology in construction are not adopted during this time of rapid growth, emissions could double by **2050**, according to the United Nations Environment Program there are **three** rules:

A. First Rule: Green building practices aim to reduce the environmental impact of building, since construction almost always degrades a building site, not building at all is preferable to green building in terms of reducing environmental impact.
B. Second Rule: Every building should be as small as possible.
C. Third Rule: Not to contribute to sprawl, even if the most energy-efficient, environmentally sound method are used in design and construction.

Hanging gardens of one central Park, Sydney

10 – Green Architecture Benefits:

Green Architecture is not simple development trends, it is an approach to building suited to the demands of its time, whose relevance and importance will only continue to increase

- Comfort, because a well-design passive solar home or building is highly energy efficient, it is free of drafts, extra sunlight from the south window makes it more cheerful and pleasant in the winter than a conventional house.
- Economy, if addressed at the design stage, passive solar construction doesn't have to cost more than conventional construction and it can save money on fuel bills.
- Aesthetics, passive solar buildings can have a conventional appearance on the outside, and the passive solar feature make them bright and pleasant inside.
- Environmentally responsible, passive solar homes can significantly cut use of heating fuel and electricity used for lighting, if passive cooling strategies are used in the design, summer air-conditioning costs can be reduced as well.

11 – Cost and Payoff:

The most criticized issue about construction environmentally friendly buildings is the price, photo-voltaic, new appliances and modern technology tend to cost more money, most green buildings cost a premium of **< 2%** but yield **ten times** as much over the entire life of building, in regards to the financial benefits of green building over **twenty years** the financial payback typically exceeds the additional cost of greening by a factor of **4-6 times**, and broader benefits such as reductions in green house (**GHCs**) and other pollutants have large positive impacts on surrounding communities and on the planet, the stigma is between the knowledge of up-front cost versus life cycle cost, the saving in money come

from efficient use of utilities which result in decreased energy bills, it is projected that different sectors could save **130 billion dollars** of energy bills, also higher worker or student productivity can be factored into savings and cost deductions.

Numerous studies have shown the measurable benefit of green building initiatives on worker productivity, in general it has been found that there is a direct correlation between increased productivity and employees who love being in their work space, specifically worker productivity can be significantly impacted by certain aspects of green building design such as improve lighting, reduction of pollutant, advanced ventilation systems and the use of non-toxic building materials, in (The business case for Green building (http://www.usgbc.org/articles/business-case-green-building)) the **U.S.** green building council gives another specific example of how commercial energy retrofits increase workers health and thus productivity, people in the **U.S.** spend about **90%** of their time indoor, **EPA** studies indicate indoor levels of pollutant may be up to **ten times** higher than outdoor levels, **LEED**-certified buildings are designed to have healthier, cleaner indoor environmental quality, which means health benefits for occupants.

Studies have shown over **twenty year's** life period, some green buildings have yielded **53-71** dollars per **square foot** back on investment.

Confirming the rent ability of green building investments, further studies of the commercial real estate market have found that **LEED** and energy star certified buildings achieves significantly higher rent, sale prices and occupancy rates as well as lower capitalization rates potentially reflecting lower investment risk.

12 - Case Study:

The study area has a typical Mediterranean climate, it's characterized by a long fairly warm second and a short slightly rainy temperature winter, precipitation falls mainly during the coldest season from autumn to spring, the prototype is therefore designed for the warm humid climate of northern western coast hinterland in Alexandria region.

- Localized indigenous knowledge(IK):
  In additional to IK development professionals treasure this local knowledge, finding it extremely useful in solving complex problems of health, agriculture, education and the environment both in developed and in developing countries, enhancing the ways that knowledge has been adapted, applied and disseminated.
  Investigations from existing housing units within the study area habitat demonstrated the combination of indigenous architectural elements leading to much more efficient buildings in terms of adaptability to IK, major IK concepts applied:

A. Courtyard homes: are more prevalent in the study area, as an open central court can be an important aid to cooling house in warm weather, courtyard draws fresh air down through the wind catch.

The comforts offered by a courtyard-air, light, privacy, security and tranquility provide the shadows are properties nearly universally desired in human housing, courtyard used for many purpose including: cooking, sleeping, working, playing, gardening and even place to keep animals.

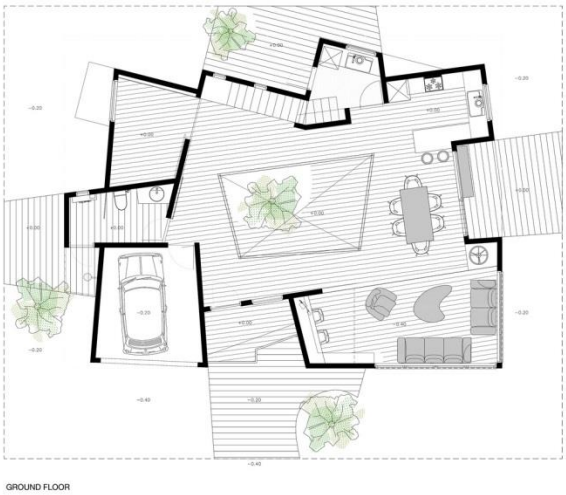
Courtyard house 1

Courtyard house 2

B. Thickness of stone wall: The walls are designed to provide insulation, sunlight filter through increase wall thickness **(40-50) cm**.
C. Roof: It is placed a mixture of sand and lime mortar above the linoleum protect the bishop from the impact of the sun's heat and reduce the permeability of water falling from the rain in the winter.
D. Narrow opening: Narrow opening and high from the ground to prevent the entry of heat during the day for the inside and maintain them for the night.

❖ Housing prototype Suggestion:

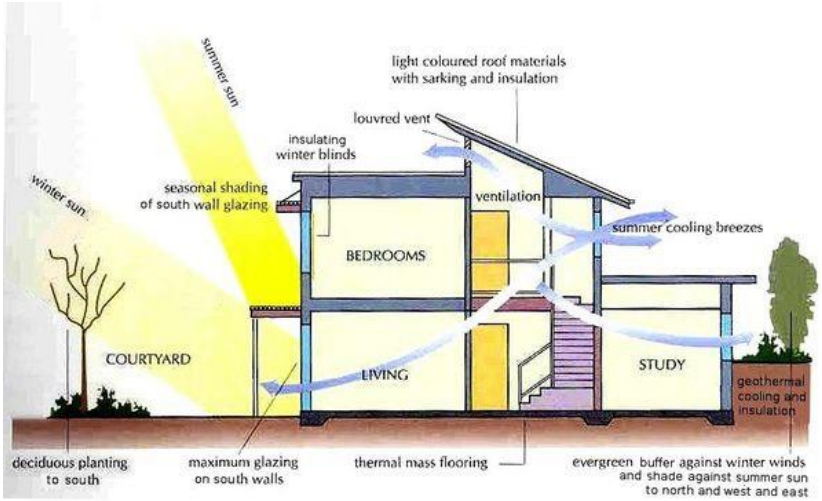
This study produced prototype referred to as Typical Housing Prototype (THP) which is built with a central courtyard, single-story two bedrooms.



House Proto Type Floor Plan Example

Feature were considered to optimize the integration of passive design strategies, building orientation determines the amount of solar radiation it receives, in addition to other elements such as evergreen trees were planted on north side to act as a wind break in winter, while deciduous trees on south side to shade in summer only.

- In this study case we have **seven** main elements:
    A. Courtyard design: The central courtyard allows spaces for relaxation and interaction of occupant keeping their activities away from neighbors in addition to passive cooling strategies; it achieves enough daylight penetration, reduces solar heat and promotes cooling breezes while keeping out hot and dusty wind.
    B. Sun angles and shadings: The design does not oversize the amount of south-facing windows as oversizing can lead to overheating, horizontal exterior overhangs are used on the south side of the building to block direct summer sun, ideal proportions for an overhang must calculate by latitude to block summer sun but not block winter sun.



Winter and Summer Sun / Overhangs Example

C. Thermal mass: the walls of the house are thick and massive, the high mass walls are cooled from the cool night time temperatures, in turn the walls then cool the occupant during the day by accepting the heat radiating from their bodies.

D. Construction materials:
   - **Walls**: Solid **8 inch** masonry which could be double wall for maximizing thermal mass.
   - **Roof**: Flat light weight concrete **(20) cm** and plaster **(1) cm**.
   - **Floor**: Slab on grade covered by carpet or casework.

E. Rain water harvesting: The roof of the building consist of gutters or pipes that deliver rainwater falling on the roof top to the storage tank, harvested water can be used for toilet flushing and garden irrigation.

F. Aquifer water: Well pumps are built to be used for extracting water from an underground source.

G. Energy system:
   - **Biogas plant production**: Biogas is one of many renewable energy systems that provide greater independence at very low cost, produced gas from anaerobic digestion of organic materials will usually be piped from the top of the tank to a biogas cooking stove and/or biogas lights.
   - **Photovoltaic (PV array)**: Photovoltaic panels are installed on south facing roof which is inclined with an angle to maximize the amount of electricity produced.
   - **Solar domestic hot water**: Solar hot water systems are used to collect energy from the sun in panels or tubes to produce domestic hot water used in the house.

3D Model of the Suggested Proto Type Example

13 - Green Buildings Examples:

- Beer Shiva's City Hall by Architect Arieh Rachmimov, Israel.
- US EPA Kansas City Science and Technology Center, USA.
- Hanging Gardens of one Central Park, Sydney.
- Blu Homes mkSolaire, A Green Building by Michelle Kaufmann.
- Taipei 101, the tallest and largest green building of LEED platinum certification in the world since 2011, Taiwan.
- Exterior Light Shelves – Green Office Building by Janelle Penny.
- Eco-Sustainable small house, Japan.

Beer Shiva's City Hall

US EPA Kansas City Science and Technology Center

This facility features the following green attributes: LEED 2.0 Gold certified, Green power, Native landscaping

Hanging Gardens of one Central Park, Sydney

Blu Homes mk Solaire, a garden building designed by Michelle Kaufmann

Taipei 101, the tallest and largest green building of LEED platinum certification in the world since 2011

Shelves sample

Eco-Sustainable small house

14 – Green Architecture Institutes:

Leadership in Energy and Environmental Design **(LEED)** is a set of rating systems for the design, construction, operation and maintenance of green architecture which was developed by the United States Green Building Council **(USGBC).**

Other certificates system that confirms the sustainability of buildings is the British **BREEAM** (Building Research Establishment Environmental Assessment Method) for buildings and large scale development.

Currently World Green Building Council is conducting research on the effect of green buildings on the health and productivity of their users and is working with World Bank to promote green buildings in emerging markets through **EDGE** (Excellence in Design for Green Efficiencies) market transformation program and certification.

15 – International frameworks and assessment tools (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, in some cases codes are written so local governments can adopt them as bylaws to reduce the local environmental impact of buildings.

Green building rating systems such as **BREEAM**(United Kingdom), **LEED**(United states and Canada), **DGNB**(Germany), **CASBEE**(Japan) and **VERDE**(Spain) help consumers determine a structure's level of environmental performance, they award credits for optional building features that support green building in categories such as location and maintenance of building site, conservation of water, energy, building materials, occupant comfort and health, the number of credits generally determines the level of achievement.

Green building codes and standards such as the international code council's draft international green construction code are sets of rules created by standard development organizations that established minimum requirement for elements of green building such as materials or heating and cooling.

Some of the major building environmental assessment tools currently in use include (United states/International green construction code (**IGCC**)).

- IPCC Fourth Assessment Report: Climate change **2007**, the fourth Assessment Report (**AR4**) of the United Nation Intergovernmental panel on climate change (**IPCC**), is the fourth in a series of such reports, the **IPCC** was established by the World Metrological Organization (**WMO**) and United Nations Environment Programme (**UNEP**) to assess scientific, technical and socio-economic information concerning climate change, its potential effects and options for adaptation and mitigation.

- UNEP and Climate Change: United Nations Environment program **UNEP** works to facilitate the transition to low-carbon societies, support climate proofing efforts, improve understanding of climate change science and raise public awareness about this global challenge.
- GHG Indicator: The Green house indicator **UNEP** guidelines for calculating greenhouse gas estimation for businesses and Non-Commercial Organization.
- Agenda 21: Agenda 21 is a programme run by United Nations (**UN**) related to sustainable development, it is a comprehensive blueprint of action to be taken globally, nationally and locally by organizations of the **UN**, Governments and major groups in every area in which humans impact on the environment, the number of **21** refers to the **21st century**.
- FIDIS's PSM: The International Federation of consulting engineering (**FIDIC**) project sustainability management guidelines were created in order to assist project engineering and other stakeholders in setting sustainable development goals for their projects that are recognized and accepted by as being in the interests as a whole, the process is also intended to allow the alignment of project goals with local conditions and priorities and to assist those involved in managing projects to measure and verify their progress.

  The project sustainability management guidelines are structured with themes and sub-themes under the three main sustainability heading of social, environmental and economic, for each individual sub-theme a core project indicator is defined along with guidance as to the relevance of that issue in the context of an individual project.
  The sustainable reporting framework provides guidance for organization to use as the bases for disclosure about their sustainability performance and also provides stakeholders a universally applicable, comparable framework in which to understand disclosed information.

  The reporting framework contains the core product of the sustainability reporting guidelines, as well as protocol and sector supplements, the guidelines are used as the bases for all reporting, they are the foundation upon which all other reporting guidance is based and outline core content for reporting that is broadly relevant to all organization regardless of size, sector or location, the guidelines contain principles and guidance as well as standard disclosures – including indicators – to outline a disclosure framework that organizations can voluntarily, flexibly and incrementally adopt.

  Protocols underpin each indicator in the guidelines and include definitions for key terms in the indicator, compilation methodologies, intended scope of the indicator and other technical references.

  Sector supplements respond to the limits of a one-size-fits-all approach, sector supplements complements the use of the core guidelines by capturing the unique set of sustainability issues faced by different sector such as mining, automotive, banking, public agencies and others.

- IDP Environment Code: The **IDP** environment code was launched in **February 2008**, the code is intended as a good practice global standard for measuring the environmental performance of corporate buildings, it is aim is to accurately measure and manage the environmental impact of corporate buildings and enable property executives to generate high quality, comparable performance information about their buildings anywhere in the world, the code covers a wide range of buildings types (from offices to airports) and aims to inform and support the following
    - Creating an environmental strategy.
    - Inputting to real estate strategy.
    - Communicating a commitment to environmental improvement.
    - Creating performance targets.
    - Environmental improvement plans.
    - Performance assessment and measurement.
    - Life cycle assessment.
    - Acquisition and disposal of buildings.
    - Supplier management.
    - Information systems and data population.
    - Compliance with regulations.
    - Team and personal objectives.

  IDP estimate that it will take approximately **three years** to gather significant data to develop a robust set of baseline data that could be used across a typical corporate estate.

- ISO/TS 21931-2006: Sustainability in building construction-framework for method of assessment for environmental performance of construction works-part 1, buildings is intended to provide a general framework for improving the quality and comparability of methods for assessing the environmental performance of buildings, it identifies and describes issues to be taken into account when using methods for the assessment of environmental performance for new or existing building properties in the design, construction, operation, refurbishment and deconstruction stages, it is not an assessment system in itself but is intended be used in conjunction with and following the principles set out in, the **ISO 14000** series of standard.

16 - Conclusion:

- **Green Architecture** system must be introduced, clarified, understood and practiced.
- **Green Architecture** have more than (ten names and six definitions) and all of them refers to economy, utility, comfort and durability, through construction, renovation, maintenance and demolition to reduce harmful effects on the buildings, human health, environment by using eco-friendly materials, design and construction practice.

- **Green Architecture** has five main principles: Sustainable site design, Water conservation and Quality, Energy and Environment, Indoor environmental quality, Conservation of materials and Resources.
- **Green Architecture** has many characteristics: Ventilation system designed for efficient heating and cooling, Energy-efficient lighting and appliances, Water-saving plumbing fixture, Landscape planned to maximize passive solar energy, Minimal harm to the natural habitat, Alternate power source 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.
- **Green Architecture** involves consideration in five main areas: Site development, materials selection, Minimization, Energy efficiency and indoor air quality.
- **Green Architecture** involves Goals in many main areas: Life cycle assessment, Siting and structure design efficiency, Energy efficiency, Water efficiency, Materials efficiency, Indoor environmental quality enhancement, Operations and maintenance, Reduce impact onto electricity network, Optimization and waste and Toxics reduction.
- **Green Architecture** can reduce environmental impact through three rules which are mentioned in chapter nine.
- **Green Architecture** benefits are Comfort, Economy, Aesthetics and environmentally responsible.
- **Green Architecture** most green buildings cost a premium of < 2% but yield ten times as much over the entire life of building, in regards to the financial benefits of green building over twenty years the financial payback typically exceeds the additional cost of greening by a factor of 4-6 times.
- **Green Architecture's** Institutes and International frameworks and assessment tools are mentioned in chapter fourteen and fifteen.

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