Studying green architecture factors in order to achieving sustainable

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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 known as "sustainable architecture" or "green building," 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 building's construction, use and operation, as well as curtailing the harm done to the environment through the emission, pollution and waste of its components.

Green architecture usually symbolizes the sustainability of modern cities. While urban central areas are usually endowed with a multitude of green spaces, they are also the areas that are most prone to the undesirable effects of growth and urbanization. Planning of sustainable cities serves as a fundamental catalyst for change, improving environmental quality of the natural and built environments, and upgrading conditions for development of green architecture.

This paper is applied. The research method is "analytical- descriptive". In order to analyzing data, has been used SWOT technique. findings show, in Iran green architecture is moderate, although green architecture is expensive but one of the best ways for achieving sustainable city.

- Introduction

Planning of sustainable cities and the revitalization of green city areas contribute largely towards upgrading environmental quality as the vast umbrella, thus serving as a fundamental catalyst for change. Sustainable development projects taking place in green city areas tends to attract a variety of economic activity and competition, therefore encouraging both new inhabitants and visitors to revisit and rediscover these restored vicinities of their cities. Moreover, upgrading the physical built environment, social fabric and urban spaces within the historical urban structure all contribute towards increasing their adoption as places for public congregation and activity. This consequently increases social interaction and cohesion between citizens. Furthermore, Planning of sustainable cities and revitalization of green city areas tends to re-affirm residents' feelings of identity and sense of belonging. Furthermore, urban planning is often witnessed as an approach towards sustainability. According to Stren and Polese [1], one of the main aims of sustainable urban policy is to "bring people together, to weave parts of the city into a cohesive whole, and to increase accessibility (spatial and otherwise) to public services and employment [2]." In addition, sustainable areas are those which are created to support sustainable living, with a prime focus being placed on economic, social and environmental sustainability [3].

By the beginning of the 21st century the field of green architecture has changed its way in more complex issues under green urbanism works. Beyond the traditional approaches, green architecture theory and practice have enlarged its concerns with a multidisciplinary vision. The term green architecture has enlarged its boundaries and infrastructure, technology, ecology, art network systems are combined in one total vision.

Sustainable planning, as a set of ideas and frameworks - lays new ground for design and urbanity Practices: performance- based, research-oriented, logistics-focused, networked [4]. Green Urbanism is an emergent field of planning and design in which the dominant forces that influence urban design are landscape features and ecologies as opposed to architectural structures and

utilitarian infrastructure. Nowadays, the green architecture of the city becomes commoditized as a cultural product, ironically rendering many cities less and less distinguishable from one another. In place of regional and historical distinctions, many urban sites have long since lost most of their inhabitants to their decentralized suburban surroundings. In place of traditional, dense urban form most Iran spend their time in built environments characterized by decreased density, easy accommodation of the automobile and public realms characterized by extensive vegetation. In this horizontal field of urbanization, green architecture has a newfound relevance, offering a multivalent and manifold medium for the making of urban form ad in particular in the context of complex natural environments, post-industrial sites and public infrastructure [5].
In the context of sustainable planning, city sites become a major subject for designers with multivariable design lexicon, which includes the terms produced by the vocals of “re”: rehabilitation, renovation, restoration, reclamation, recovery, etc. include green structures and spaces between them. In these areas the land is covered by structures which are fundamental for green architecture. With their scale and materials, these structures have dominance on the land where they are located. Green areas have a different characteristics depend on the urban activity.

- Theoretical framework

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 [6].

Green Architecture and Green Design

Green architecture defines an understanding of environment-friendly architecture under all classifications, and contains some universal consent [7]; it may have many of these characteristics:

- Ventilation systems designed for efficient heating and cooling
- Energy-efficient lighting and appliances
- Water-saving plumbing fixtures
- Landscapes planned to maximize passive solar energy
- Minimal harm to the natural habitat
- 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 [8].

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 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 [9].
- 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 [10].

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 [11].

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 [12].

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 Greywater, 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 [13]. 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 in circulation. The use of non-sewage and greywater for on-site use such as site-irrigation will minimize demands on the local aquifer [14].

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 [15].

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.

In addition to relying on natural building materials, the emphasis on the architectural design is heightened. The orientation of a building, the utilization of local climate and site conditions, the emphasis 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 handling of energy acquisition, on-site water capture, alternate sewage treatment and water reuse [16].

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 [17].

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 [17].

Solar buildings are designed to keep environment comfortable in all seasons without much expenditure on electricity 30 to 40% savings with additional 5 to 10% cost towards passive features. Major Components: Orientation, double glazed windows, window overhangs, thermal storage walls roof, roof painting, Ventilation, evaporation, day lighting, construction material etc.

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

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 [18].

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 [19].

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 [19].

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 [21].

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 [2]. 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), improved aesthetics, improved 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 [22].

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 [13]. 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 [23].
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 [24]. (Horizontal Vegetated Complex Partitions).

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 [1].
According to Ken [25], 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 [4]. 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 [7].
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 [12].
3. Complicated design and planning considerations before a vertical system can come to place. It is also probably the most expensive green walls method [16].

Green building benefit

Green building is not a simple development trend; it is an approach to building suited to the demands of its time, whose relevance and importance will only continue to increase [25].

- Comfort. Because a well-designed passive solar home or building is highly energy efficient, it is free of drafts. Extra sunlight from the south windows makes it more cheerful and pleasant in the winter than a conventional house [14].
- 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 [22].
- Aesthetics. Passive solar buildings can have a conventional appearance on the outside, and the passive solar features 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 [25].

- Findings

Case study

In this section was introduced sample green building in Iran. Sample of developed green building in Iran

- Twin tower of Ardabil

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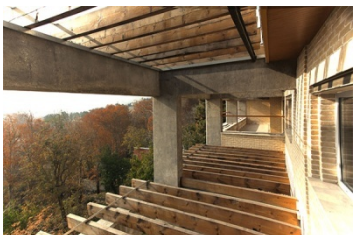
-Kowsar green building in Mashhad city



- Golab Dareh green complex in Teharn

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- Golab Dareh green complex in Teharn

Analyzing data

In previous sections, was reviewed literature. In continue was analyzed collected data by using SWOT technique. So, was classified data (strengthen, weakness, opportunities and threats).

Table (1): interior & outer factors of green building in Iran

strengthen	weakness	opportunities	Threats
There isn't environmental pollution	Excessive vertical development City	There are new materials in accordance With sustainable architecture in the region	There isn't attention to the form and skylight
There is appropriate environment for life	It does not conform implausible the earth	The use of sustainable architecture in the construction of old fabric	Lack of proper culture and encourage people to use Sustainable Architecture
Protection of energy	There is Short-term thinking and politics Non-coherent	There is native patterns	Changes in living conditions and the pattern Friendly society
Increasing durability of building	The absence of appropriate regulations Urban binding principles Sustainable Architecture	There is needed Infrastructure	Expanded advertise in pushing Non-indigenous people to design
Using of reproducible energy	Paying attention to the relationship Sustainable architecture and urban waste The fuel		

Preventing visual pollution	There is adaptively between current urban projects and sustainable architectures		
Return Material to natural cycle	Unfamiliarity of some managers		

Table 2: strengthen factors

	First Coefficients	Second Coefficients	Ranking	Final coefficients
There isn't environmental pollution	114	0.159	3.66	0.581
There is appropriate environment for life	102	0.142	3.66	0.519
Protection of energy	105	0.146	4.33	0.632
Increasing durability of building	104	0.145	4.66	0.675

Using of reproducible energy	104	0.145	4.33	0.627
Preventing visual pollution	96	0.134	4.33	0.580
Return Material to natural cycle	90	0.125	3.66	0.456
Total	715			4.070

Table 3: weakness factors

	First Coefficients	Second Coefficients	Ranking	Final coefficients
Excessive vertical development City	97	0.117	3.66	0.506
It does not conform implausible the earth	97	0.117	4.66	0.427
There is Short-term thinking and politics Non-coherent	114	0.137	4.33	0.637
The absence of appropriate regulations Urban binding principles Sustainable Architecture	111	0.134	3.66	0.580
Paying attention to the relationship Sustainable architecture and urban waste The fuel	107	0.129	4	0.471
There is adaptively between current urban projects and sustainable architectures	113	0.136	3	0.544
Unfamiliarity of some managers	106	0.128	3	0.300
Total	828			3.849

Table 4: opportunities factors

	First Coefficients	Second Coefficients	Ranking	Final coefficients
There are new materials in accordance With sustainable architecture in the region	98	0.212	4.33	0.917
The use of sustainable architecture in the construction of old fabric	93	0.201	4.33	0.870
There is native patterns	91	0.196	4.66	0.913
There is needed Infrastructure	86	0.186	3	0.558
Total	4.62			4.136

Table 5: threats factors

	First Coefficients	Second Coefficients	Ranking	Final coefficients
There isn't attention to the form and skylight	110	0.228	4.66	1.062
Lack of proper culture and encourage people to use Sustainable Architecture	107	0.475	4	1.900
Changes in living conditions and the pattern Friendly society	89	0.185	3.66	0.677
Expanded advertise in pushing Non-indigenous people to design	75	0.155	3.33	0.516

Total	481			4.912

Results and discussion

According tables (1-5) strengthen matrix is power than weakness matrix. So it is shows Iran is appropriate condition in mentioned subject (Strengthen = 4.070, weakness = 3.894).

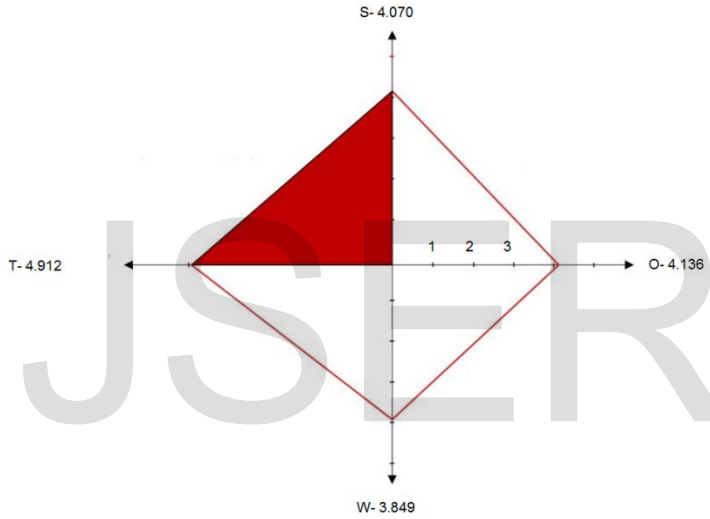

Figure (5): the graph of SWOT analyze

- Conclusion

Principles of Green Architecture are: Water features and their management; natural building design; passive solar design; green building materials; living Architecture. These principles are applied in a sustainable fashion to achieve an eco- friendly building.

- Any architect has the ability to change an entire building process by specifying materials with low carbon dioxide emissions.
- Green building standards are available for almost every type of building on a global basis and these standards are well developed and are regularly being updated; they cover all phases of a building's life cycle from design through demolition.

- Buildings that have been designed according to sustainability standards need to be operated and maintained according to these same standards.
- Buildings that were built prior to enacting these sustainability standards can also be upgraded to meet the standards that have subsequently been put in place.
- Green buildings must have a number of common components: these include a focus on energy efficiency and, in some cases, renewable energy; the efficient use of water; the use of environmentally desirable building materials and specifications; a minimization of the waste and toxic chemicals generated in the building's construction and operations; good indoor air quality; and an eye on so-called "smart" growth and sustainable development.
- 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.
- Traditional building materials are to be adapted to meet code-required standards for health and safety in contemporary buildings. Not only are they cost effective and environmentally friendly, but, when used correctly, these natural alternatives match the strength and durability of many mainstream construction materials.
- New building technologies, and in particular ICT automation and new materials, are to constantly be introduced to enhance the sustainable building process with the goal of reducing the impact of the building on the surrounding environment by using resources more efficiently (e.g. energy, water); enhancing and protecting the health and well-being of the occupants; and reducing any negative impacts.

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