

THE PRINCIPLES OF GREEN ARCHITECTURE IN HOT AND HUMID CLIMATIC ZONES

In the last decade, the industrial revolution has resulted in rapid development in human society as result of overpopulation. Generally, building construction sector and it is related in industries is the major consumer of natural resources as they are consuming about 60...70% of the world energy production. The contemporary buildings in the Arabian Gulf cities and in UAE have a modern luxurious architectural design styles with fully glazing elevations, which are unsuited to the hot humidity climate. The UAE government calls to start new architecture design strategies to apply the Green Architecture principles for the new coming buildings for reducing the consumption of energy in order to decrease the UAE's Carbon footprint.

Keywords: *Green Architecture Principles, Hot Humidity climatic, Thermal Comfort, Energy consumption*

The Green Architecture Principles:

The different definitions of Green Architecture focus on main three pillars, Environment, Economy and Human. (fig.1) in his book "Green Architecture", James Wines presents the principles upon which the contemporary environmental architecture is based as an ecological approach [1].

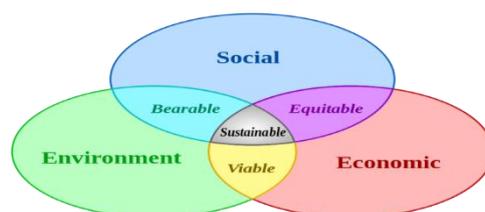


Fig. 1. Main Pillars of Green Architecture

Dr. Yahia Waziri defines Green Architecture as "The process of designing buildings in a manner, which respects the environment taking into account reducing energy and resources consumption and minimizing the effects of construction and usage on environment against maximizing the conformity with nature".

The Green Architecture has many principles which can be summed up in six main ones, which characterize the basics of Green Architecture in hot and hot humidity climate. These principles can be considered as a set of references and guidelines to the Architects and Designers containing some ideas and solutions towards of Green Architecture Design.

I-First principle: Conserving Resources:

An architect and designer should minimize the use of non-renewable materials in the process of building and construction through maintaining the necessary resources, where there is a continuous flow of natural and manufactured resources to and from a building throughout the building life span of the building in order to create an appropriate environment for human activities. In any ecosystem of a building, there is a constant flow of resources, i.e. there are inputs and outputs of the building and any resources, which enter the ecosystem of a building, will inevitably come out of it on the long run, this is known as the law of Resources Flow Conservation (fig.2).

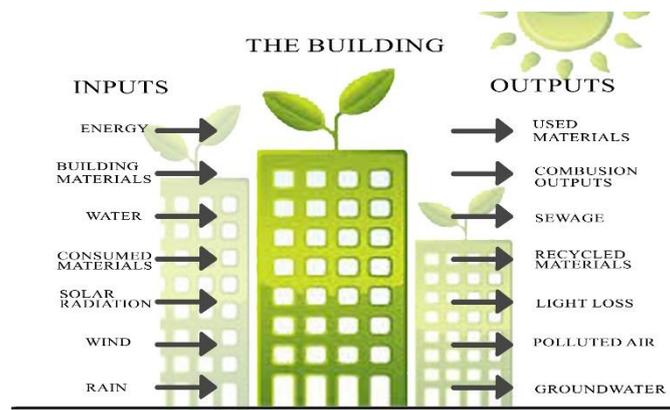


Fig. 2. Flow from Input and Output of Building Materials. [By Author]

I-1 Standards of Conserving Energy: The building should be designed and constructed in a way, which reduces the need for fossil fuels and widely relies on natural energies.

The use of the Green Architecture Principles in the designs which take the environment into account along with using available technology may reduce the consumption of energy by (50...70%) in the residential buildings (fig.3) [2].



Fig. 3. Standards of the principles of Conserving Resources [by Author]

Contemporary approaches, which focus on facing the limitation of the existing energy resources, are divided into: **first**, the approach of looking for alternative resources of energy which are preferred to be permanent and renewable, and **second**, the approach of dealing with the energy sources and our needs of energy in a scientific way to reduce the rates of depletion of existing resources [3].

In UAE, Hot arid area and hot humidity, one of the various measures adopted for reducing the use of energy is focusing on conserving the energy consumed in the buildings for the Cooling purposes. Here are some points that should be taken into account for reducing energy consumption in the buildings in hot and hot humidity zones:

- ✓ Focus on the buildings External Envelope Shelter, (External walls, Windows and Ceilings), by using of thermal insulation system. Dubai Municipality estimates that building power consumption can be reduced up to 40% by using of thermal insulation systems.
- ✓ Use of white and light colors painting on the facades and surfaces exposed to the direct solar radiation, as the white painting can reflect about 80% of the solar radiation effects of the direct sun rays falling.
- ✓ Extensive cultivation of trees to provide shading for neighboring buildings surfaces, and protect them from the effects of the direct sun rays falling in addition to that making air and the surrounding atmospheres healthier.
- ✓ Consumption of electricity can be reduced by using PV cells system which produces electricity from sunlight directly; further to a using the new integrated solar cells in semi-transparent glass windows that provide the place with filtered natural day light at the same time of generating electricity [4].

I-2 Standards of Conserving Water:

The Gulf Cooperation Council (GCC) as one of the areas affected by water scarcity in the world challenge in comparing to increasing population growth as well as significant economic and social development process taking place in the region and is the establishment of hundreds of infrastructure mega projects as well as steady demand for water for irrigation and agriculture. The "Desalination" main way to secure the needs of the UAE of fresh water, that means high energy that is consumed in drinking water and it is about 30% of greenhouse gas emissions in Abu Dhabi and is the second largest contributor to these emissions after manufacturing and construction. The quantity of 211,448 million Gallons from the treated water was provided in Emirates of Abu Dhabi in 2009 [5]. Among the strategies to meet the standards of conserving water are:

- Rationalization of water consumption.
- Collection of rainwater.
- Recycling of water

I-3 Standards of Conserving Materials:

Buildings in ancient civilizations were made of the building materials available in local natural environment such as stone, clay, wood and thatch. Burnt clay and bricks are of the most well-known and oldest construction materials used. The Babylonians had known (Glaze Clay Bricks), an Ancient Greeks and Romanians had lived in houses made of natural stone, clay and wood and such materials had use in Western Europe [6].

In the Arabian Peninsula, and Arabian Gulf countries the use of local building materials had prevailed in traditional buildings where local stone and sea stones were used as basic building material as well as clay and wood.

II-Second principle: Adapting with Climate:

A building should adapt with local climatic and its different weather elements. At the moment of the building is completed, it becomes a part of the environment and has exposed to the same effects of the weather elements such as, sun, rain or wind as anything else in the environment. If a building is able to face the pressures and climatic problems along with using all natural resources available in order to provide the comfort of human inside the building, then, it can be called climatically-balanced house.

Human was keen to include two main standards in its shelter, namely, protection from the climatic conditions and attempt to find an internal thermal comfort. Therefore; all of architectural natural styles have been used by human to resist the harshness of climate. These styles are an output of the interaction between two basic elements, **the Natural** wealth represented in raw materials and **the Climate** prevailing in the area [7]. In UAE, more than 60% of the energy used in the operation and construction of building is allocated for the production of internal artificial environment and thermal comfort (cooling and lighting), thus, the design that takes into account the climate may be the best method to minimize the negative environmental impact of most modern buildings [8]. The standards adopted for achievement of the principle of adapting with climate are in (fig. 4).

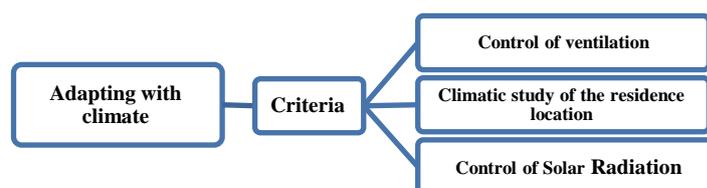


Fig.4. Standards of the Principle of Adapting with Climate [by Author]

III- Third principle: Respect for Users and Customers:

Green Architecture pays great attention to human as well as its needs which occupy the core of such attention, Green Architecture pays attention to the issue of conserving energy and resources in addition to the attention paid by the designers to the importance of respecting environment, where human safety and security are its top goals, the standards for achieving the Design for Human Comfort as the following:

III-1 Achieving physical Comfort, Physical Security & Safety:

Achievement of physical comfort is a part of achieving the psychological comfort for human inside a building, which can be pursued through the Climatic Comfort such as, (Thermal comfort, Quality of internal environment, Sound comfort and Light comfort). Achievement of physical security and safety is essential upon designing the building in general, this can be made through achieving security against the natural disasters such as earthquakes, hurricanes and fires, as well as achieving safety structural systems through using appropriate building materials along with suitable construction method systems emphasizing quality construction [9].

III-2- Achieving Psychological and Social Needs:

Achieving psychological and social needs aims at achievement of psychological comfort for the residents of a building, reflecting positively on the productivity of individuals, and a human architecture should be made in order to achieve psychological and social comfort through meeting habitation and shelter, security and safety, emotional and social needs.

IV- Fourth Principle: Respect for Site:

Green architecture design should respect the site and data of a site must be taken into account when making design-related decisions. The basic objective of this principle is to set a building in a manner and style which do not make substantial changes in a site. The Principle of Respect for Site is a call for the designers to use design methods and ideas that would make the least possible changes in the building site. The architectural character of a building should be harmonized with the environment in terms of historical and social aspects. In generally, architectural character of a house reflects the image of human civilization and affects the character of the community and poise of the individuals within it in both healthy and psychological aspects. Considering the contemporary architecture in UAE, we find that it lacks the architectural character reflecting its identity and heritage but it turned to follow what called "Architecture International Style" which dictated by western architects on the global community for the purpose of unifying the architectural and planning thought all over the world without taking into consideration the environmental, civilizational and cultural differences for each community.

V- Fifth Principle: Universal Design.

All the principles of green architecture must take into account in an integrated manner during the process of building design or master plan of the city, but may be difficult in practice to achieve all the above principles. Many of the buildings and houses in the heritage of local architecture in Gulf, for example, had given the forms and used architectural elements "green" and this was reflected in the use of natural materials available to the environment, or in the use of interior courtyards through the provision of shade during the day and stored for the cold air at night, and the air tower used to ventilate the rooms in the directly of prevailing winds or to ventilate the tunnels, but the use of wooden patterns elements helped to break the sun with the provision of privacy, all of these architectural elements and other former will still be able to use in our new modern buildings after developed in accordance with the requirements of and techniques of the times and the degree of progress, as well as the growing interest in the construction industry on human health

and the environment to give hope to the spread of thought and the principles of Green Architecture as a major tributary of the future architecture in the twenty one-century (fig.5).

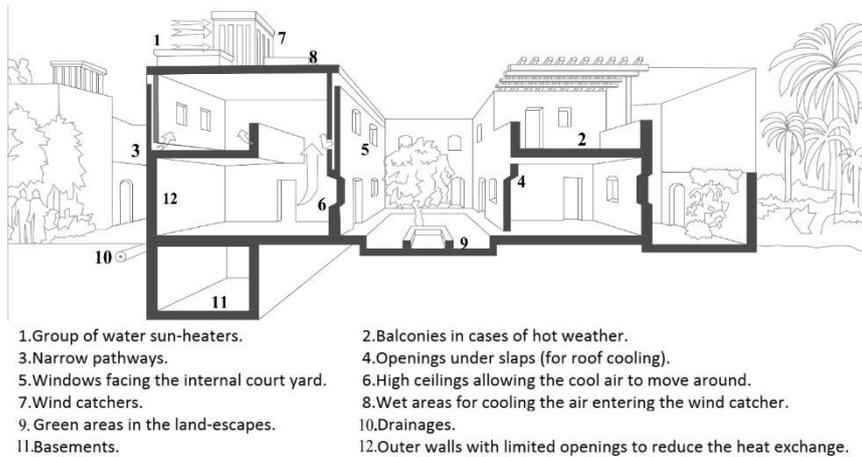


Fig. 5. Universal Design in Hot Humid Climate [By Author]

VI- Six Principle: Recycling & Reused:

Due to the rapid increase of population and constructions number, million tons of construction and demolition wastes are generated and such wastes are growing steadily and should be disposed, which can be reused or recycled, in accordance with the information provided by the National Association of Home Builders (NAHB), the rate of the funds spent for disposal of the wastes resulting from the construction of 100 houses is estimated by USD 50.000 [10].

Based on the above, it is necessary to develop an effective plan for management of the wastes using reduction and recycling options. Recycling Principle urges designers to minimize the use of new resources in the buildings they design and asks them to design and construct the buildings in a way that makes such buildings themselves or some of their elements, at the end of their life span, a source and resource for other buildings, this means that a designer should take into account, when taking design-related decisions particularly upon choosing the building materials, life cycle of these materials and how they will transfer after the end of the life span of the building as the traditional form of the life cycle of any building is a linear process consists of four main stages (fig.6).



Fig. 6. Regular form of the life cycle of a building.[By Author]

Among the methods followed to minimize the use of new resources, we mention the following:

Re-use of spaces and buildings for other functions and activities: On the regional level, we find that some of the old residential and archaeological buildings were reused as tourist restaurants or heritage hotels particularly in Dubai like Al Bastakiya, Qasr Al-Hosn in Abu Dhabi and Al Muwaiji Palace in Al Ain city, and as cultural and social centers.

Recycling materials, wastes and building remains:

Structural solid waste is defined as solid non-hazardous waste generated from the different activities of the buildings, demolition, construction, and the materials left at the sites include: asphalt, reinforced concrete, cement blocks, wood, glass, aluminum, pipes, boiler pipes insulators, wires and ceiling tiles ...etc.

The United States Environmental Protection Agency (EPA) estimated that (136) million tons of the solid waste of construction and demolition were generated in USA during 1996; the greatest part of such waste comes from demolition and renovation of buildings while the remaining part comes from new constructions, the total waste generated in Emirates of Abu Dhabi was 5,755,503 million tons in 2009, and in Dubai was 85 million tons in 2012 [11].

Recycling is an important method to minimize the use of resources and new materials where most of the debris resulting from industrial products and as inappropriate disposal of such debris is a serious environmental problem threatening the human safety

Focus on the use of recyclable materials:

Recycling contributes to preservation of environment and reduction of pollution through its role in achieving the following:

- Preservation of materials and energy resources.
- Minimizing the power consumption through recycling.
- Saving of energy by minimizing of production operations.
- Protection of environment from harmful and toxic substances resultant from manufacturing industries.

Conclusion:

- The Green Architecture principles applications in Hot and hot humidity zones aim for **Reducing** of power consumption **Decrease** the UAE's Carbon Footprint, **Providing** a comfortable and healthier internal environment for the building end users.
- Green Architecture is the process of designing building in a manner that respects the environment, taking into accounts the effects and use of the environment and maximizing the harmony with nature.
- The Green Architecture protects environment from harmful and toxic substances resultant from manufacturing industries and the Green Buildings promote the users healthier and increase employee productivity.
- The Green Architecture Design principles which take into account the local climate conditions may be the best method to minimize the negative environmental impact of the new modern buildings.

The UAE government calls to start new architecture design strategies to apply the Green Architecture principles for the new coming buildings for reducing the consumption of energy in order to decrease the UAE's Carbon footprint.

Չարֆյի Բասսամ

ԿԱՆԱԶ ԸԱՐՏԱՐԱՊԵՏՈՒԹՅԱՆ ՄԿԶԲՈՒՆՔՆԵՐԸ ՇՈՂ ԵՎ ԽՈՆԱՎ ԿԼԻՄԱՅԱԿԱՆ ԳՈՏԻՆԵՐՈՒՄ

Արդյունաբերական զարգացման տեմպերը, հասարակության և բնակավայրերի արագ զարգացումը հանգեցրել են տարածքների գերբնակեցմանը: Ընդհանրապես, շինարարության

դրություն է ընկնում համաշխարհային էներգետիկ արտադրության և բնական պաշարների սպառման շուրջ 60...70%: Պարսից ծոցի երկրների քաղաքներում և ԱՄԷ-ում ժամանակակից շենքերն ունեն շքեղ ճարտարապետական լուծումներ, ամբողջովին ապակեպատ են, ինչը նպատակահարմար չէ տաք, խոնավ կլիմայում արեգակնային ճառագայթման պայմաններում: Տեղանքի կլիմայական պայմանների հետ կապված, առավել շատ էներգիա է պահանջվում ապակեպատ շենքերի ներսում տաք օդը սառի վերածելու համար: Այլ երկրների հետ համեմատած ԱՄԷ-ն բնակելի տարածքներում առավել շատ էներգետիկ ռեսուրսներ օգտագործող երկրներից է՝ տոկոսային հարաբերությամբ շուրջ 70%: Դա է հիմնական պատճառը, որ ԱՄԷ-ի կառավարությունը կոչ է անում ստեղծել ճարտարապետության նախագծման նոր ռազմավարություն, այն է՝ շինարարության մեջ նոր կանաչ ճարտարապետության սկզբունքների կիրառումը, որն էլ կնվազեցնի էլեկտրաէներգիայի սպառումը, օդի աղտոտումը ԱՄԷ-ում, օդում ածխածնային գազերի պարունակությունը:

Առանցքային բառեր. ճարտարապետության կանաչապատման սկզբունքներ, խոնավ կլիմա, արեգակնային ճառագայթում, ջերմային հարմարավետություն, էներգիայի սպառում

Чарфли Бассам

ПРИНЦИПЫ ЗЕЛЕННОЙ АРХИТЕКТУРЫ В ЖАРКИХ И ВЛАЖНЫХ КЛИМАТИЧЕСКИХ ЗОНАХ

Промышленная революция привела к быстрому росту поселений и перенаселению. В целом, к строительному сектору относится около 60...70% потребления мирового производства энергии и природных ресурсов. Новые здания в городах стран Персидского залива и в ОАЭ создают их современный архитектурный стиль и роскошный образ, однако сплошное остекление домов не соответствует условиям жаркого климата, влажности и местным традициям и приводит к высокому потреблению энергии для обеспечения комфорта внутри зданий. В связи с этим, с целью сокращения потребления энергии и уменьшения выбросов углекислого газа правительство ОАЭ призывает к разработке новой стратегии строительства с разработкой и применением принципов зеленой архитектуры.

Ключевые слова: *принципы озеленения проектов, влажность, солнечная радиация, тепловой комфорт, потребление энергии*

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