



Evaluating Islamic Buildings According to Standard Sustainable Design

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ABSTRACT:

In the recent period of time, the concept of sustainable architecture dominated the design of buildings in general and buildings of an Islamic character in particular, as the Islamic faith calls for respect for the environment and man and the preservation of the economy, so many studies, scientific papers and architectural trends appeared that revolve around the same idea that is concerned with encouraging interaction between natural environments And built such as sustainable architecture, green architecture and environmental architecture. etc.

The problem was represented in the existence of a gap between environmental design trends and the preservation of the Arab-Islamic identity despite the presence of environmental pollution and increased energy consumption, and this is the opposite of the belief of Islam. To evaluate buildings of an Islamic nature and the extent to which they achieve sustainability in accordance with international evaluation systems for sustainable buildings for example (LEED- BREEM_ Green Pyramid) .

Keywords: Islamic Architecture; Sustainability; Green Building; Environmental Concept.

1 INTRODUCTION

The current direction toward environmentally friendly structures is a necessary aspect in bridging the gap between humans functional and physical needs and the harmony of natural world around him in a mood of peace. Sustainability becomes a crucial concern with the evolution of this century. As the result of the global warming issue, this idea is starting to gain popularity in the world of design. Environment suffers from a lot of problems. Like the issue of population growth which reduces the amount of green space that may be exploited to accommodate housing demands. Islamic Architecture is guided by set laws and a design philosophy that largely achieves ecological design goals. Consequently, we may gain from the Islamic ecological design concept [1-2].

1.1 Research problem:

- Gap between environmental design trends and the retention of the Arab Islamic identity.
- Rise of designs that lead to energy loss, environmental pollution and harmful effects on human health inside the buildings.
- The development of several building evaluation methods and the measurement of their sustainability in various nations throughout the world like LEED due to its inability to adapt to local conditions, it was not widely spread. Also, The National Center for Housing and Building Research's Green Pyramid System also made an appearance, although it wasn't deployed or turned on.

1.2 Research objective:

- Support environmental sustainability concept and a relationship and harmony between the environment.
- Keeping the Islamic value in the sustainable architecture design by incorporating Islamic Language and its elements for environmental treatments.
- Achieving the combination of sustainable design and its principles with Islamic architecture and its unique languages.

1.3 Research Methodology:

Descriptive analytic approaches are followed in the research. The descriptive method exemplifies the idea of sustainable design, its guiding principles as well as the global system or environmental design.

Also, the descriptive method to describe the Islamic architecture overview. Then the study examined how Islamic architecture and sustainable architecture relate to one another. The descriptive, analytical approach in order to describe, analyze case study Bayt Al-Suhaymi to find many principles of sustainable architecture exist on it.

2 Sustainable concept:

2.1 Sustainable development:

Since the 1970s of the 20th centuries, the idea of sustainability has grown and evolved. But in the 1990s, it became widespread and was used for construction, and it had a great effect on a variety of fields, including architectural design. All the countries all over the world paid great attention to the issue of sustainable development and its three axes (economic-social-environmental). Sustainable development is defined as: meeting the needs of current generations without harming the ability of future generations to meet their needs. The ideas center on economic growth, environmental preservation, decreased energy use, optimum use of natural resources, and dependence on renewable energy sources without neglecting the rights of future generations to the available resources [3].

2.2 Environmental sustainability:

Environment is ultimately determined by combination of physical, chemical, and biological variables that operate as one organism [4]. Environment is the collection of natural and artificial things in which the man can live in and which have a great effect on him, his health, his way of life and output [5]. God created the universe as a gift to humans, a symbol of his greatness and a place for sustenance of balanced life [6].

2.3 Sustainable Architecture & Sustainable design:

Sustainable architecture and environmental issues are now a part of the agenda for businesses, as well as local and international communities. Sustainable design mentioned that it is a design concept that aims to maximize the environment quality, while minimizing or avoiding the negative impacts on the environment from McLennan in Yudelson [7]. Also, sustainable design seeks to reduce the negative effects of people on the natural world's materials, resources, and processes [8]. And people can't get enough of it. The word "sustainability" and the expression "sustainable architecture" are spreading in the world of design and architecture for two main reasons: functional and formal. There are many principles for sustainable design criteria [9]:

- Site respect.
- Energy conservation.
- Adapt to the climate.
- Reducing the use of natural resources.
- Efficient use of resources.
- Achieve energy efficiency.

- Preventing pollution, achieving internal environmental quality and ensuring a healthy environment.



Fig. 1. The UN's Sustainable Development Goals include challenges related to environmental, social, and economic components of sustainability. Source: Open source by the UN. (1)

2.4 International systems for environmental design:

They started to design evaluation methods for environmental buildings as a result of the increased global interest in the environment and the conception of environmental buildings, that involves: BREEAM, LEED, GPRS [10].

2.4.1 BREEM (Building Research Establishment Environmental Assessment Methodology):

The United Kingdom is where BREEM was created. It is the oldest environmental classification of buildings. On a level of pass which is 36%, Good, 48% Very Good, 57%, 68% Excellent and outstanding buildings are graded and certified [11]. As shown in table 1

BREEM points of evaluation and standards	
Standards	Evaluation
Energy and carbon dioxide emissions	19%
<ul style="list-style-type: none"> • The rate of emission in the house • Effect of building material on energy • Environmental-friendly classified goods • Low power source consumption 	
Water	6%
<ul style="list-style-type: none"> • Water consumption inside the house • Water use outside the house 	
Materials	12.5%
<ul style="list-style-type: none"> • Environmental impact of materials • Sources of materials for secondary elements • Sources of materials for basic 	
Waste	7.5%
<ul style="list-style-type: none"> • Warehouse for recyclable waste 	

<ul style="list-style-type: none"> • Management of waste generated by construction 	
Pollution	10%
<ul style="list-style-type: none"> • Influence in global warming • Nitrogen oxide emissions 	
Health& Wellbeing	15%
<ul style="list-style-type: none"> • Daylighting • Special space • Sound insulation • Age of the house 	
Management	12%
<ul style="list-style-type: none"> • Home User Guide • Effects of construction • Security • Consider the plans of contractors 	
Ecology	10%
<ul style="list-style-type: none"> • The environmental value of the site • Protection of environmental features • Effects of construction on the environment Additions and environmental improvements	
Transport	8%
<ul style="list-style-type: none"> • Connected to public transport network • Maximum parking space • Convenient transportation 	

Table 1. BREEAM Points of evaluation and standards.

2.4.2 LEED (Leadership in Energy and Environment Design):

The most popular green building grading system is LEED. The purpose of it is to help building owners and stakeholder to sets his sights on Environmental responsibility and using resources efficiently. According to a scale with four levels, buildings are assessed and certified. Certified with a score of 40 to 49, Silver 50-59 points, Gold 60-79 points, Platinum 80 points and above [12]. As shown in table2

LEED points of evaluation and standards (V4 edition):	
Standards	Evaluation points
Transportation means& Location	16
Non-Pollution means of transport and protection of land	
Sustainable Sites	10
Ecological Sites& design strategies	
Water Efficiency	11
Water use reduction	
Energy and Atmosphere	33
Improve energy efficiency for entire building	
Materials and Resources	13

Waste management& ecological materials	
Indoor Environmental Quality	6
Management of and improvements to indoor air quality, Low-emitting materials, sunlight benefit	
Innovation in Design	6
Creativity in design, Cultural awareness, impacts and challenges, historical or heritage awareness	
Regional priority	4
Total points	100

Table 2. LEED Points of evaluation and standards.

2.4.3 GPRS (Green Pyramid Rating System Levels):

The Egyptian Council for Green Building created the Green Pyramid Evaluation System in 2009. The Egyptian Green Pyramid was developed using international techniques, such as the LEED rating system. It was created in accordance with Egyptian Laws of construction and the combination between all the criteria and methodologies that have been effective in using the environmental concept. According to the Egyptian categorization system for green architecture, there are different degrees of green building certification: Certified, which receives 40-49% of the possible points, Silver Pyramid (50-59%), Golden Pyramid (60-79%), and Green Pyramid (80% or more) [13].

GPRS certification category points		
Categories	points	credits
Sustainable Site, Accessibility, Ecology	10	15%
<ul style="list-style-type: none"> - Desert area development - Informal area redevelopment - Compatibility with National Development Plan 	<ul style="list-style-type: none"> - Transport infrastructure connection - Catering for remote sites - Alternative methods of transport 	<ul style="list-style-type: none"> - Protection of habitat - Respect for sites of historic or cultural interest - Minimizing Pollution during construction
Energy efficiency	50	25%
<ul style="list-style-type: none"> - Energy Efficiency Improvement - Passive External Heat Gain Reduction - Energy Efficient Appliance - Vertical Transportation Systems 	<ul style="list-style-type: none"> - Peak Load Reduction - Renewable Energy Sources - Environmental Impact - Operation and Maintenance 	<ul style="list-style-type: none"> - Optimized balance of Energy and Performance - Energy and Carbon Inventories
Water efficiency	50	30%
<ul style="list-style-type: none"> - Indoor Water Efficiency Improvement - Outdoor Water Efficiency Improvement 	<ul style="list-style-type: none"> - Water Feature Efficiency - Water Leakage Detection - Efficient Water uses during construction 	<ul style="list-style-type: none"> - Waste water management - Sanitary Used Pip - Efficiency of Water-based Cooling

Materials and Resources		20	10%
- Regionally procured materials - Materials fabricated on site - use of readily renewable materials	- Use of salvaged materials - Use of recycled materials	- Use of lightweight materials - Use of higher durability materials - Use of prefabricated elements	
Indoor Environmental quality		20	10%
- Optimized Ventilation - Visual Comfort	- Thermal Comfort - Acoustics Comfort	- Controlling emissions from building materials	
Management		20	10%
- Containers for materials waste - Employing waste recycling workers on site - Access for lorries, Plant and equipment - Identified and separated storage areas	- Project Waste Management Plan - Engaging a company specialized in recycling - Protecting water sources from pollution - Waste from mixing equipment	- Control of emissions and pollutants - providing a Building User Guide - Providing a Periodic Maintenance Schedule	
Innovation a and Added Value		10	Extra
- Cultural Heritage	-Exceeding Benchmarks	- Innovation	

Table 3. GPRS certification category points.

3 ISLAMIC VALUE AND OVERVIEW [14]:

The more we learn about Islamic architecture, the more it becomes clear that the purpose of the Islamic content is to give the structure a unique identity. In the buildings built in various Muslim nations. Even if there are many different approaches, the unique quality and familiarity of the environment, including the weather, building materials and designer ideas are preserved. The most important characteristic of Islamic architecture all over the worlds that it has the same characteristics which respect the rights and traditions of the surrounding in where they live in.

The major element of Islamic architecture is that it's form and function are both shaped by Islam.

Islamic conceptions of God, man, nature, life, death, and the afterlife are the only one that can guide the development of Islamic architecture. Islamic Architecture reflects Islamic culture and civilization, showing both the level of Muslim aesthetic and creative knowledge and cultural identity. Sustainability must always be main concept of Islamic architecture. Building should be constructed to meet the needs of society's citizens without disregarding their culture of identity.

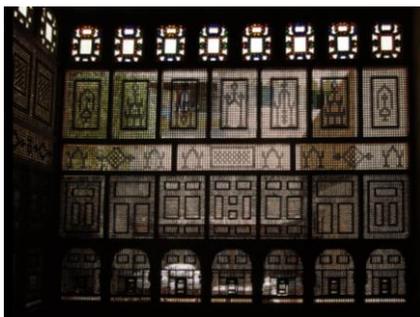
3.1 Function:

When an architect seeks to design or build an Islamic building whether it is a mosque, school, house, he makes a great effort to create a new construction a good purpose. All components and building materials utilized in construction are borrowed from nature [5-6].

3.2 Form:

Humans must live harmoniously with nature. The natural environment acts as both a barrier and a support, and architects work to both seek its assistance and fight its intrusions. The structure and shape of buildings in relation to their location, along with the layout of their places, may very easily be transformed into a tool for controlling natural light, ventilation, heating, cooling, insulation, acoustics, Through Islamic synonyms, such as skin Islamic facade, courtyards, the use of water sources for cooling, and other treatments that indicate Islamic identity. etc[13].

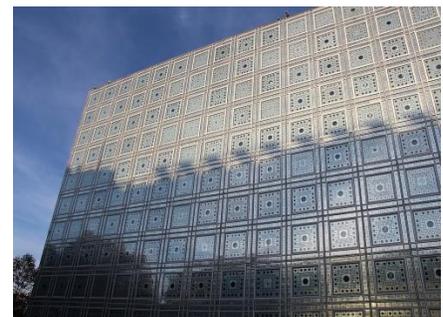
A **mashrabiya** is an architectural element which is characteristic of traditional architecture in the Islamic world and beyond [14]. It is a type of projecting oriel window enclosed with carved wood latticework located on the upper floors of a building, sometimes enhanced with stained glass. It was traditionally used to catch wind and for passive cooling. Jars and basins of water could be placed in it to cause evaporative cooling [14].



Bayt al-Suhaymi, Cairo, Egypt



Bayt al-Kritliya,
now the Gayer-
Anderson Museum,
Cairo



Institute du Monde Arabe
mashrabiya

Figure 2. types of mashrabiya

The **courtyard** is an open space surrounded by walls. It can be defined as an area of land space located inside or outside the building and overlooked by some windows of the rooms. It is used as an architectural element in the design of the building to moderate the temperature inside the rooms and to light and ventilate them. Trees are planted in it and a water fountain is provided. Depending on whether the courtyard is surrounded by four or three walls, the courtyard is called closed or open [15].



Figure 3. example of courtyard

A **wind catcher** is a chimney-like structure made of clay, wood, or bricks, constructed on the rooftop of houses, mosques, or storage rooms to harness the cool breeze and direct it downwards towards the interior space. The way these towers work is by directing cool wind that is circulating at higher levels downwards through vertical openings with oblique sides (also known as directional openings) by leaving only the shaft opposite of the incoming wind open. Once the cool air enters the space, the warm air circulating inside the interior space is pushed out through openings created on the opposite side of the windcatcher. In areas without cool breeze, windcatchers act as chimneys and push warm air upwards and out through the openings of the tower, regulating the interior environment of the home[16].

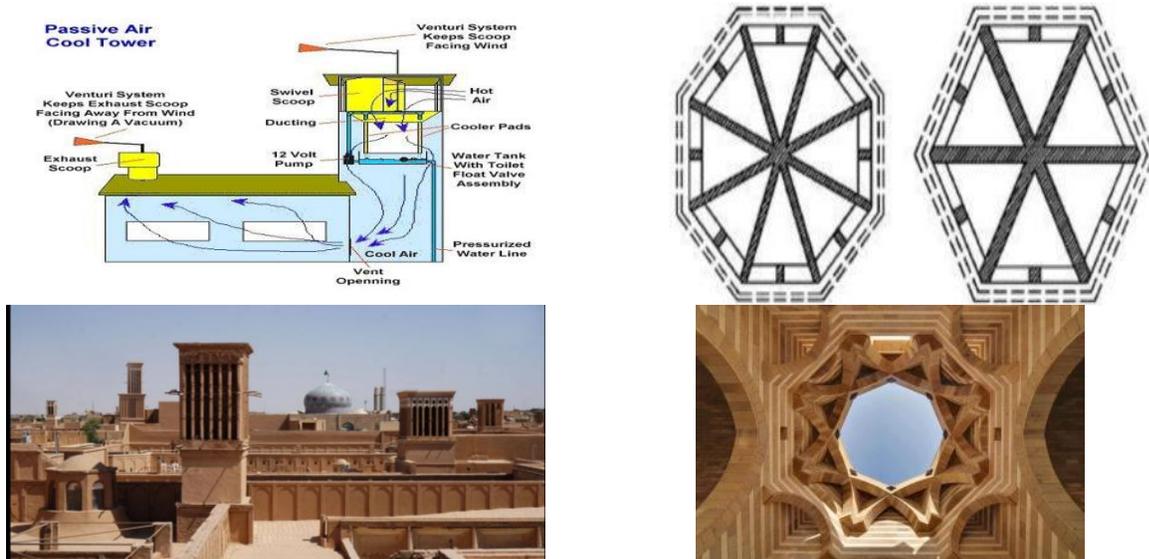


Figure 4. example of wind catcher

3.3 Islamic point view& Environment [11-12]:

Human is totally depended on the nature to survive. Man's awareness to his spiritual mission on earth occurs in the context of nature. Man is vital element of the whole natural environment. Man is nature himself, thus preserving nature means preserving himself, and destroying nature means destroying his chances of achieving civilizational success in the future. Islam places a high value on the environment, laying out man's rights towards its and his duties towards it in great detail. There should be compatibility of man with the environment whenever possible.

4 Analytical study

From the previous theoretical study of Islamic architecture and the extent to which its formal and functional equivalents have been achieved for sustainability, and the study of some evaluation systems for sustainable buildings, the most important evaluation points have been deduced for each system, then these points will be taken to evaluate the most important architectural buildings with Islamic synonyms in a comparative analysis method using relative weights.

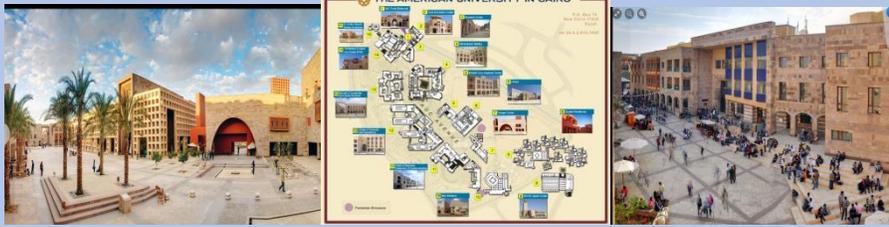
Samples are selected in terms of several points:

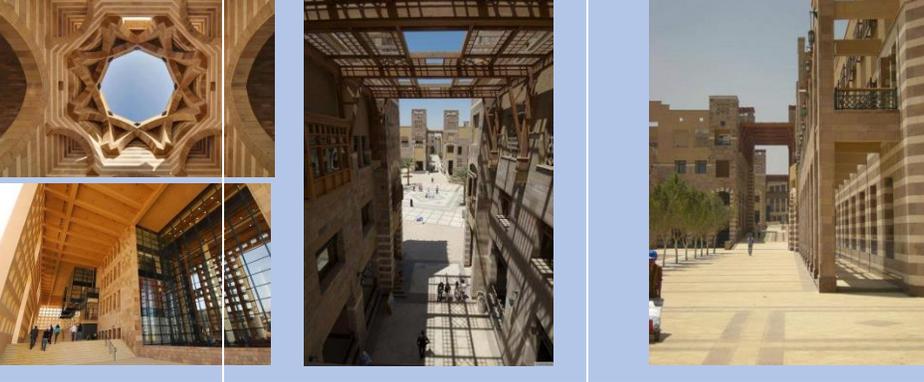
- 1- Its apparent formal features are linked to Islamic architecture.
- 2- That the buildings achieve the principles of sustainable architecture.
- 3- Processors use digital technology.
- 4- Project samples shall be at the local and international levels.

Study samples:

- 1- The American University in Cairo building [17].
- 2- The Arab World Building in France [18].

The first project: – The American University building

<p>Project photos</p>	
<p>Project definition</p>	<p>It is a leading American educational institution that provides an outstanding education in the English language. In September 2008, the university moved to the new campus in New Cairo.</p> <p>AUC's new campus is an affirmation of desert-friendly architectural and landscape design and innovative environmental measures to make the new campus a model for responsible development.</p>
<p>designer</p>	<p>Abdul Halim Ibrahim</p> <p>Its first president is Charles Watson, who remained its president for 25 years, and who was born in Cairo</p>
<p>Type</p>	<p>Educational bulding</p>
<p>Site</p>	<p>It was established in Tahrir Square in the center of the Egyptian capital, Cairo, and its current headquarters has become in New Cairo</p>
<p>Date created</p>	<p>1919</p>
<p>Structural system study</p>	<p>The walls of the buildings have been constructed according to energy management systems that reduce the costs of using air conditioning and heating equipment by at least 50%. About 80% of the outer walls of the sanctuary were made of sandstone, which helps keep the rooms cool during the day and warm during the night.</p>
<p style="text-align: center;">Project analysis</p>	
<p>Site study</p>	<p>Adapting to changing conditions so that land uses are distributed in proportion to the nature of the site.</p>
<p>Study the building for the site</p>	<p>Flexibility in design for the possibility of future extension</p>
<p>Building</p>	<p>Construction of building walls according to energy management</p>

systems study	systems, which reduce the costs of using air conditioning and heating equipment by at least 50%.	
Design Study (form)	Islamic skin façade were used in modern ways for shading - with the use of the idea of courtyards to ventilate the spaces - and the use of water elements for cooling.	
		
Design study (environmentally)	Resource efficiency (material and energy)	<ul style="list-style-type: none"> -In order to reduce waste, the sandstone remaining from the construction has been recycled and used in the construction of the double Wall that surrounds the courtyard. -The university uses 100 percent treated water for irrigation on campus.
		

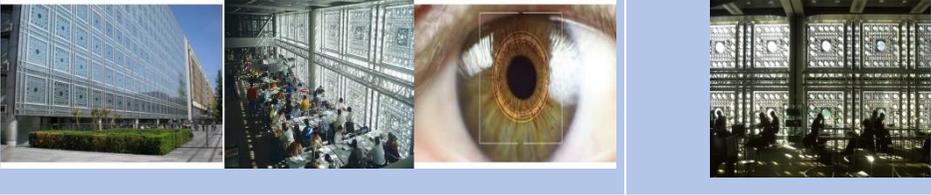
	<p>Adapting to changing conditions appropriately on dynamic contexts</p>	<p>The idea of the courtyard, courtyard, or enclosed space, the open space was used to be a vital and positive characteristic.</p> <ul style="list-style-type: none"> -The courtyards and entrances between the buildings on the university campus are all built towards the northeastern winds and towards the university garden. -water and green spaces, they contribute to cooling the air when it moves to the top to replace the warmer rising air in the middle of the campus, and this design reduces energy and maintenance costs in the long run (.The presence of gardens helps to intensify the cold air that gathers during the night and ventilates the entire sanctuary during the day. -In total, the new campus contains 1,216 palm trees, 6,970 trees and 27 fountains. All trees and plants in the new campus have been planted and grown. -A 1.6-kilometer underground utility tunnel runs underground through the campus to transport supplies through electric vehicles.
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Table 6 . Analyses The American University building

The second project: – The Arab World Building in France

<p>Project photos</p>	
<p>Project definition</p>	<p>The design of the Institute of the Arab World was completely inspired by Islamic architecture, but with the integration of Western technologies. The facade of the institute overlooking the Seine River looks like a curved arc, to appear parallel to the arc of the river, and on the other side, the facade is rectangular in shape as if it were a giant and flat TV screen. It contains decorations and colors, but if we approach the building, we will find that its external structure is a glass layer covered with a perforated metal layer of aluminum, and its function is to control the passage of light into the building,</p>

	<p>in addition to controlling the ventilation process, just like the principle of the work of the mashrabiya that were previously designed in homes Old Arabic.</p> <p>- When the light is intense, they are closed, and when the light recedes, they are opened, so that their work is filtered and filtered by sunlight, in addition to that the design of the Institute of the Arab World inside was not different in creativity from the external structure, as the stairs connecting its floors were decorated in the same way and style in The decoration of the external structure, as well as the water and air-conditioning installations, are also lacy and visible, giving a wonderful artistic impression at the moment of crossing into the Arab World Institute.</p>
designer	جان نوفال “Jean Nouvel”
Type	Arab cultural center
Site	The banks of the Seine River next to Notre Dame Cathedral in the center of the French capital, Paris
Date created	In 1981, to open its doors to visitors in 1989.
Structural system study	<p>The skin facade is a layer of glass covered with a perforated metal layer of aluminum, and from the inside it was not different in creativity from the outer structure, as the stairs connecting its floors were decorated in the same way and style in the decoration of the outer structure, as well as the water and air-conditioning extensions are also lacy and visible.</p> 
Project analysis	
Site study	Adapting to changing conditions so that land uses are distributed in proportion to the nature of the site.
Study the building for the site	Flexibility in design, the ability to enable future expansion

<p>Building systems study</p>	<p>Islamic skin façade is a layer of glass covered with a perforated metal layer of aluminum, whose function is to control the passage of light into the building, in addition to controlling the ventilation process, just as the principle of the work of the Islamic skin façade that were previously designed in the old Arab houses.</p> <p>- When the light is intense, they are closed, and when the light recedes, they are opened, so that their work is to filter and filter the sunlight.</p> <p>Rationalization of solar energy consumption, Use of building materials compatible with nature.</p> 	
<p>Design Study (form)</p>	<p>The building simulates the shape of the cornea of the eye. When the light is intense, the openings are closed, and when the light is confined, they are opened to allow light and air to enter, borrowing the idea of Islamic skin facade.</p> 	
<p>Design study environmental</p>	<p>Resource efficiency (material and energy)</p>	<p>The building uses low-energy processes (reducing energy consumption by reducing the required temperatures and required lighting by using natural lighting throughout the day, thus reducing energy consumption by 30%.</p>

	Adapting to changing conditions appropriately on dynamic contexts	<p>The idea of the building embodies the ability to adapt through repetition, as the cornea was repeated on the entire facade to provide sufficient lighting and energy for the operation of the building.</p> <p>The idea of Islamic skin façade (Mashrabiya) was done in a modern technology way so that it opens and closes with the light - there is interaction and integration between the building and the surrounding environment - energy efficiency - adaptation to changing conditions - efficient use of resources - it works to recycle materials - it needs continuous major maintenance.</p>
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Table 7. Analyses The Arab World Building in France

After each project has been analyzed and studied separately from the design and environmental point of view, a comparative analysis must be made to be applied to the applied table resulting from what was concluded from the theoretical and analytical part in order to reach general results of the study. A comparative analysis, the method of relative weights has been followed in evaluating projects in terms of the elicited principles as follows:

Measurement standards derived from the theoretical part	The American University building	The Arab World Building in France	
LEED points of evaluation and standards (V4 edition):			
Transportation means& Location: Non-Pollution means of transport and protection of land	*	-	16
Sustainable Sites: Ecological Sites& design strategies	*	*	10
Water Efficiency: Water use reduction	*	-	11
Energy and Atmosphere: Improve energy efficiency for entire building	*	*	33
Materials and Resources: Waste management& ecological materials	*	-	13
Indoor Environmental Quality: Management of and improvements to indoor air quality, Low-emitting materials, sunlight benefit	*	*	6
Innovation in Design: Creativity in design, Cultural	*	*	7

awareness, impacts and challenges, historical or heritage			
Regional priority	*	*	4
Percentage of the presence of the indicator for each project	100	60	100
BREEM points of evaluation and standards			
Energy and carbon dioxide emissions: The rate of emission in the house Effect of building material on energy Environmental-friendly classified goods Low power source consumption	*	*	19
Water: Water consumption inside the house Water use outside the house	*	-	6
Materials Environmental impact of materials Sources of materials for secondary elements Sources of materials for basic	*	*	12.5
Waste Warehouse for recyclable waste Management of waste generated by construction	*	-	7.5
Pollution Influence in global warming Nitrogen oxide emissions	*	*	10
Health& Wellbeing Daylighting - Special space-Sound insulation Age of the house	*	*	15
Management Home User Guide- Effects of construction Security- Consider the plans of contractors	*	*	12
Ecology The environmental value of the site Protection of environmental features Effects of construction on the environment Additions and environmental improvements	*	*	10
Transport Connected to public transport network Maximum parking space Convenient transportation	*	-	8
Percentage of the presence of the indicator for each project	100	78.5	100

5. Results and Conclusions:

As a result of the comparative analysis of the American University project and the Arab World building in France in terms of the LEED evaluation points and the **BREEM** evaluation points, it was found that:

- ✓ In terms of **LEED** points, the American University building achieved 100%, while the Arab World building in France achieved 60%.
- ✓ In terms of **BREEM** points, the American University building achieved 100%, while the Arab World building in France achieved a rate of 78.5%.

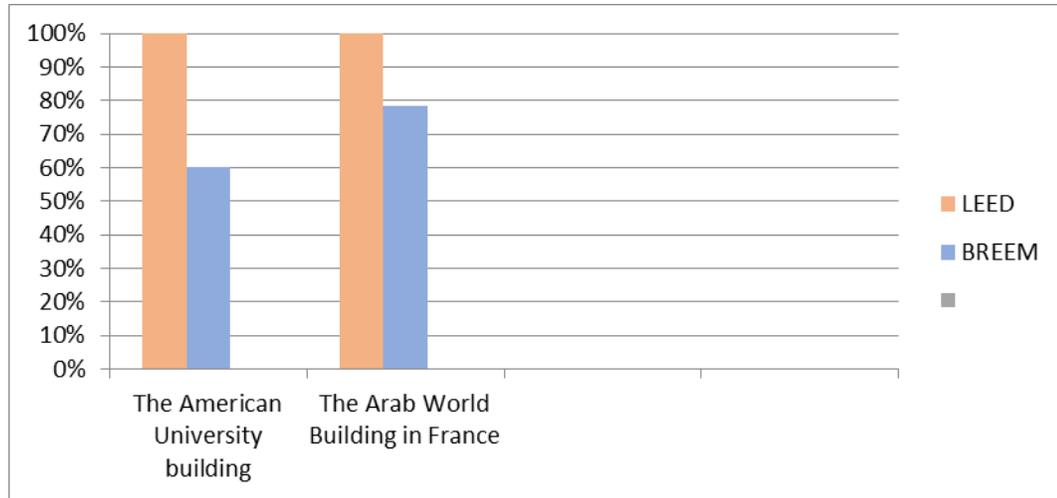


Figure 5. result of the comparative analysis of the LEED, BREEM evaluation Percentage

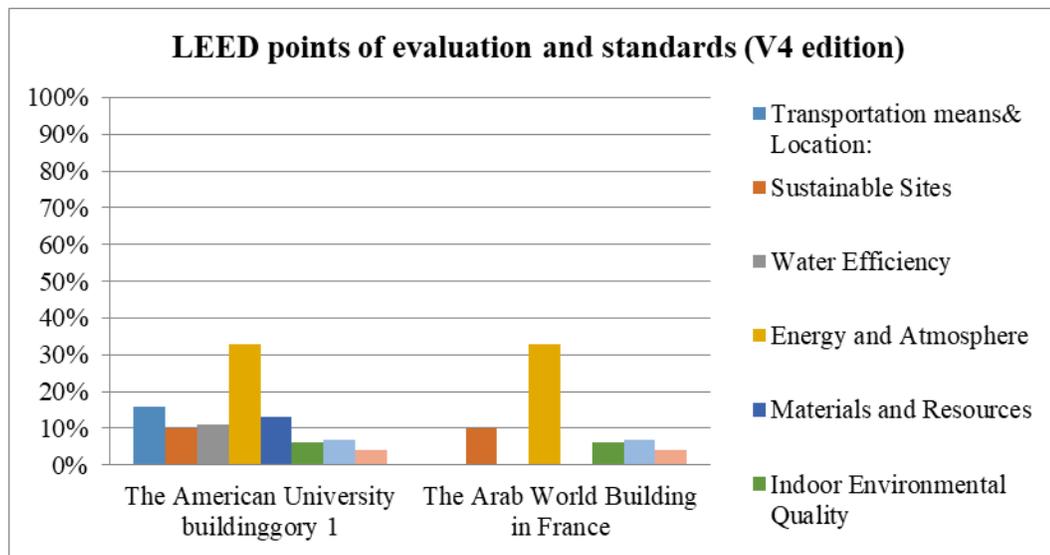


Figure 6. result of the comparative analysis of the LEED evaluation point

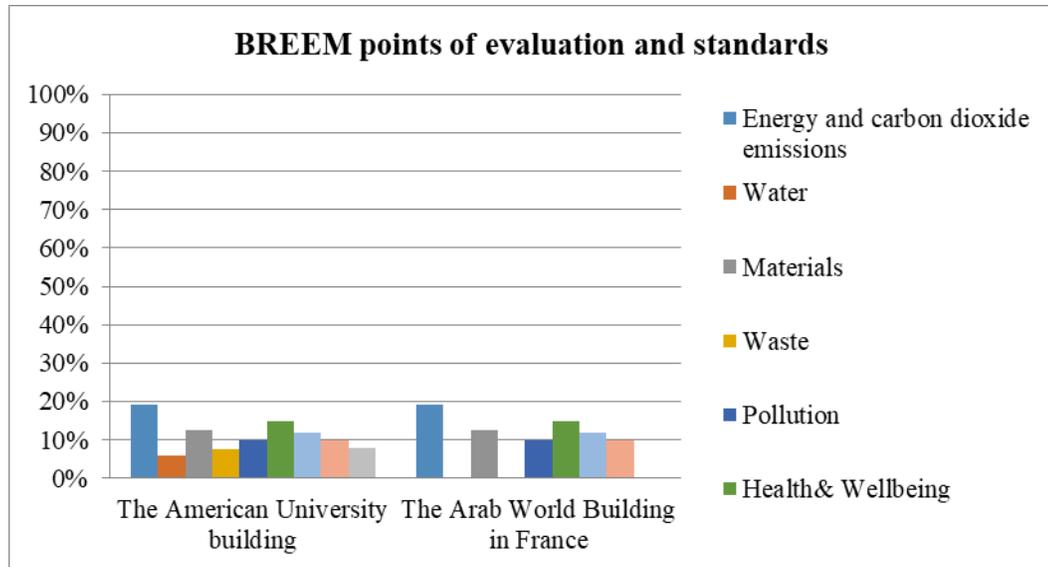


Figure 7. result of the comparative analysis of the BREEM evaluation points

5 CONCLUSION

Finally, the study comes to the further conclusion that sustainable buildings involve a collection of values, including aesthetic, ecological, social, political and ethical values, and those values should be integrated in order to satisfy requirements. Islamic traditional architecture shows the defined sustainability principles of Islam and has proven to be effective in terms of comfort and quality of built and natural environment as it in the following:

- The ability for attaining integration and union between Islamic and sustainable architectural styles in order to preserve identity throughout construction and produce environmentally friendly buildings.
- Activating Islamic architectural features like the courtyard, Mashrabiya, Malqaf and shokhshikha, shading elements and natural lighting control, thermal insulation methods using local building materials.
- The purpose of sustainable design is to lessen the negative effects of the built environment and the natural environment, as well as to consume less energy and nonrenewable resources.
- Interest in Islamic culture and knowledge of its ecological, cultural, and social elements are expressed by the architect.
- The state's responsibility in discovering ways to reduce environmental pollution and establishing growth of eco friendly architecture and housing without a loss of character, particularly in new cities this is one of the lots.

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