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Role of Historic Architectural Elements in Approach to Green Architecture in Private Homes and High-Rise Buildings in the United Arab Emirates (UAE) and Egypt

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Abstract—: This examination paper reveals insight into how to animate the part of ancient design components in Egypt and the UAE as a rule to apply green engineering standards. The paper proceeds to calling attention to the natural components and ideas highlighted in compositional outline and how they are implemented in the proposed residential building design proposal. The paper shows that the design arrangements utilized as a part of memorable structures constitute essential components supporting the utilization of green engineering standards in private development.

Keywords— heritage inspiration, Islamic elements, residential tower, UAE's weather, hanging garden, shading system, energy efficiency

I. INTRODUCTION

It has been discovered that many green engineering outline standards were connected, in different behavior and shapes, in ancient structures. Islamic engineering is one of the memorable compositional plans that joins green design standards and components the most (openings, forms, materials, orientation, etc). The utilization of Islamic design components in applying green engineering standards requires expanding upon Islamic compositional arrangements effectively utilized as a part of residential structures. Comparing these with green design hypotheses enables us to recognize Islamic compositional components and Islamic engineering that are suited to the utilization of the green engineering standards.

The paper expect that the utilization of Islamic structural components can contribute specifically to the development of sustainable structures and the use of green design standards in these structures. And on the other hand, the paper as well talks about an implemented design proposal of a building to be situated in a new upcoming part of the city of Ajman in the United Arab Emirates. The proposed design has taken into consideration the local climate condition and of how modernism and decontructivism would take place in the UAE.

Moreover, there is another look over of how it would go along if it is to be built in Egypt based on the huge difference in climate condition between both the countries.

II. METHODS

So how do Green Architecture and Buildings take place in Egypt and UAE? Various investigations and papers giving point by point research and examination of green engineering, its standards and norms have been distributed. They serve to recognize the most critical standards of green structural plan, which we will use here to break down ancient engineering. The most critical green architectural plan standards are noted out underneath:

A. First its included in the building's architectural design/engineering: form, orientation.

- Its orientation: Orientation influences a space's warm solace level, ventilation and regular lighting. A northward introduction is the most reasonable; it isn't presented to coordinate daylight and takes into consideration a relentless level of common light. The East and West-confronting sides of structures are not helpful for good common lighting as well as southward façade. Therefore, sun rays enter the south façade horizontally and enter through the east and west façade vertically.
- Its form: The more prominent the height of the structure, the more compelling is ventilation and the breeze's impact in decreasing warm radiation levels, therefore we can add wind towers through shafts for example in Egypt since the weather is quite pleasant. But in the meanwhile, in UAE, wind towers are recommended to be used, not only private homes, but also in buildings due to the heat. This would add a bit of coolness to the building due to its height. Natural light ought to enter more than 3 meters into the building; the more profound

the light enters, the weaker the lighting moves. Therefore, a second layer can be added on the façade to block most of the heat. Past a separation of more than 7 meters, artificial lighting is required. The auxiliary plan of the building coalition ought to limit outer surface and rooftop regions presented to the sun's beams. The perfect frame is an essential one. It can be squared, circular.

Figure 1: South Façade of the Residential Building

B. Secondly its included in the building's design in its envelope: roofs, walls and openings.

- Its roofs: Heat protection materials (lightweight block) and warmth deflective light-shaded materials ought to be utilized and if better if they are local materials.
- Its walls and openings: Suitable construction materials ought to be utilized to lessen warm conduction from outside to inside but instead in Egypt they use sand/mud burnt (red) bricks which with time will bring up problems due to the weather. It is usually used since its cheap unlike concrete blocks in Egypt are quite expensive. On the other hand, in UAE, concrete blocks are of different types and it is what is being used in construction mainly. At both the vertical and flat levels, dividers ought to be tilted to take into consideration the edge of the sun's beams. This is where we get to add louvres (fixed or mechanical), mashrabiyas to protect from the outer heat. Moreover, using openwork divider structures, upper openings and sky facing window for allowable amount of sunlight at necessary areas and close at private areas. This can be done in the second layer of the façade. Narrow openings in hot zones; they need to be shaded and outfitted with sunscreens. In both the countries openings confronting the north are the most appropriate for lighting and ventilation. The more prominent the width and tallness of the openings, the more normal light infiltrates and spreads in building insides. But that's a different case in UAE for the temperature is higher. Therefore, other categories need to be studied such as the window layers if they are glazed/reflective or not. This is where modern technology comes in. Openings ought to be introduced on a few dividers and upper openings ought to be utilized also.

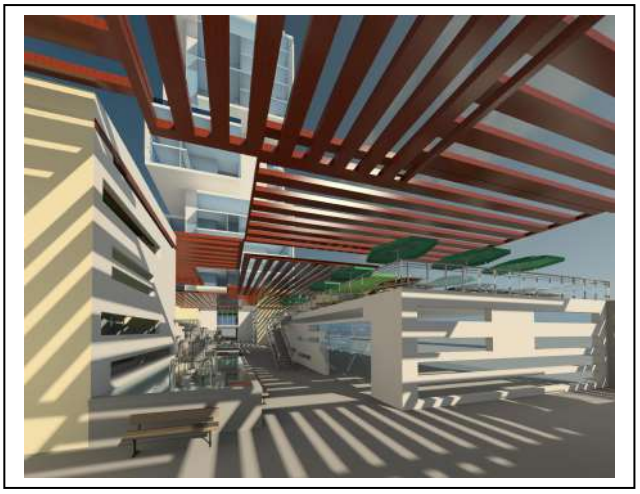

Figure 2: Openings and shades in the shops

C. Thirdly, its included in the use of materials in the design.

- Natural and inexhaustible development materials that are reasonable to the building site and the encompassing condition ought to be utilized. Light shading, low warmth conductivity materials with coarse surfaces to avoid radiation and warmth ought to be utilized. Durability, vitality effective development materials ought to be utilized.

III. VIEWPOINTS

What is the viewpoint of Islamic architecture from a green architecture perspective? In an Islamic home, there are green architecture: Numerous examinations and references have noticed that the Islamic home is agreeably incorporated into its regular habitat, and that it gives security against the impacts of common components, natural and climatic conditions. Since they utilize inexhaustible regular vitality sources, for example, wind and sun power. Islamic private design fuses many standards of green architectural engineering, including:

1. The efficiency of using suitable materials: The warm execution of building envelopes in Islamic homes depend on applying heat transmission opposition and warmth pick up decrease standards to connect with and adjust to the earth. This is accomplished by utilizing locally accessible material, for example, gypsum, block, etc. The generous thickness and high warm limit of these materials backs off warmth transmission and give lasting protection from outside components.

2. The ability to user's will into consideration: Islamic social traditions, customs and culture are reflected in the plan's satisfaction of the requirement for protection and regard of neighbors' privacy and respect. This is showed in the internal introduction of homes, the detachment amongst salamlik and haremlik. And the seclusion of the whole home from bystanders in the road, which is acknowledged by constraining the quantity of openings and utilizing mashrabeyas for privacy and as well as for heat.
3. The ability to adapt to climatic conditions: In spite of the little size and number of windows on outside exteriors, Islamic home plan is splendidly adjusted to climatic conditions since it utilizes creative ventilation strategies which mainly works in Egypt due to the pleasant climate conditions. But in the UAE, it has to be thought about more deeply since there is a huge difference in temperature. The utilization of locally accessible normal assets and development materials and different structural arrangements, for example, mashrabeyas of any type of material and shokhshekhas (little sky facing windows) resolve all atmosphere related issues.
4. The ability to bring up a hand in hand design: The structural outline of Islamic homes endeavors to apply the standards and cohesiveness of green design. It makes utilization of common development materials accessible in the neighborhood condition, utilizes inward yards, space introduction and shading to control temperatures, windcatchers to ventilate spaces that don't confront north, shokhshekhas to finish the cycle of air development, and mashrabeyas to weaken solid daylight, to manage normal ventilation and give security.
5. The ability to conserve energy: The Islamic home is an ideal case of environmental engineering plan. Plan standards, development materials and ecological arrangements make utilization of regular assets and vitality sources (wind, sun, materials, etc.) to give an inside situation that is both agreeable and in concordance with social qualities and culture.

The above rundown introduction of green design standards highlighted in Islamic engineering demonstrates the degree to which Islamic engineering connects with the neighborhood condition and how it makes utilization of assets accessible in the earth to manufacture homes that both guarantee the solace of their clients and safeguard normal assets.

Credit Section	Maximum Credit Points
IDP - Integrated Development Process	13
NS - Natural Systems	12
LB - Livable Buildings	37*
PW - Precious Water	43*
RE - Resourceful Energy	44
SM - Stewarding Materials	28
IP - Innovating Practice	3
TOTAL	177*

* LB : Maximum of 36 credit points available for Offices and 30 credit points for Retail.
PW : Maximum of 45 credit points available for Schools.

IV. Green Building Rating System

1) ESTIDAMA, Pearl Building Rating System (United Arab Emirates) Figure 3.

2) THE EGYPTIAN GREEN PYRAMID RATING SYSTEM (Egypt)

The Green Pyramid rating system's in Egypt scores: Strong for 70% - Medium for 50% - Weak for 50%.

- Energy efficiency
- Water efficiency
- Site sustainability
- Indoor environment quality
- Resources and construction materials
- Reduction of pollution and recycling of waste
- Innovation and flexibility of management and maintenance

V. Discussions

So, what does Islamic architecture take into consideration?

1. **Natural Lighting**

- The issue is that windows are a noteworthy wellspring of warmth inside the building, which made conventional Islamic engineering to create answers for regular light and square direct daylight. The most vital of these are the mashrabiya, which is a compositional component that enables wind to enter and keeps the sun, these for the most part cover the outside of windows and galleries.
- Mashrabiya control light, wind current and outside privacy. That made mashrabiya a solid security component for its thin cartel, which used to be made of wood cones and now and again of non-wood materials, for example, marble, mortar and metal. Mashrabiya first showed up in Egypt, then at that point exchange to the next Arab nations.

2. **Building Underground**

- Using the soil potential is one of the standards which manageable outline relies upon to profit by characteristic assets. Building underground relies upon limiting or deciding the impact of outside climatic conditions on the inside space, by exploiting the warm stockpiling capability of the mass of soils.

3. **Natural Ventilation**

- Common ventilation is a standout amongst the most essential standards of reasonably in a customary Islamic house, as the velocity increment the rate of warmth exchange from the body to condition, it additionally disposes of dampness, and cool the building.
- The malqaf is the most critical machine to get and enter the breeze into a house. It is additionally viewed as a standout amongst the most essential components of the Islamic structures. The malqaf

characterized as: a design component that used to ventilate the building.

- The malqaf then again makes diverse weight zones amongst inside and outside. The air enters in the wake of purging and saturated, at that point been pushed out openings. During the evening this procedure is switched. The malqaf additionally diminish residue and sand, which been conveyed by hot dry breeze, where it in the long run rests at the base of the malqaf.
- There are a few sorts of malqaf: the most critical are the rooftop malqaf and the well-malqaf which are one-way, following the general breezes heading. At that point kashtil or wind towers which are multi-directional. Additionally, there are other straightforward sorts of malqaf, for example, the twofold divider, and badqash. At long last, there is an exceptional sort of malqaf called Badgir, which was produced in the Arabian Gulf, it is a pole opened from above from the four sides (here and there on just two), it has two corners to corner stripes inside that catch the breeze from any heading.

4. **Thermal Comfort**

- The primary idea of planning the conventional Islamic house was the Courtyard, utilizing patio as a main issue to accomplish the rule of self-observer, which was the lung of the house.
- The considerable contrast between the temperatures amongst day and night made it goes about as a warm controller, by making diverse weight regions between the limited shaded roads and the yard in activity called night flushing.
- As a rule, the patio (courtyard) was regularly focused by a wellspring or salsabil notwithstanding organic product trees. These components cooperated to saturate the dry air and decrease its temperature. A few alterations were done to the yard to guarantee keeping the stream of air which drove including more design component, for example, Iwan, maqaad and numerous others.

5. **Building Material**

- The materials are critical to shield the working from outside conditions, for that determination materials are exceptionally delicate stage because of physical properties concerns: optical reflectivity, warm conductivity resistivity and transmissions. Additionally, in light of the fact that it is capable of warmth move into and out of the building.
- Mud (clay) is the best regular building material, since it can give warm segregation. It likewise decreases the consumption of imperative common assets and carbon outflows. Mud has been generally utilized in Islamic world all through the ages.
- Concerning Brick, it is a standout amongst the most critical building materials utilized in Islamic design, particularly in Egypt, Iraq and Morocco (where wood and stone are uncommon). Block was utilized to construct bearing dividers, bars and arches. Because of giving great warm confinement to inside spaces, on the off chance that it was worked in an extensive thickness.

VI. DESIGN PROJECT

As mentioned before, the paper as well mentions the discussion of a proposed project in which it tries to implement the ancient Islamic architectural aspects as a way to approach green architecture in the modern era. Not only in private homes, but as well in high-rise residential/office buildings. The project is a proposal of a residential tower (2 Underground Parking + Ground Floor + 2 Mezzanine Floors + 20 Floors + Commercial Center) in the middle of an upcoming part of Ajman, United Arab Emirates. Due to UAE's harsh weather, there are many proposed ideas from ancient Islamic elements implemented in this Residential Tower proposal, but these ideas can be used in Egypt to improve the pleasant weather condition acting upon the building.

The tower uses the concept of 'Deconstructivism' in which the tower has been designed of 8 block masses (2 on the same level but on opposite sides) being applied onto 4 main rigid cores in the tower which helps in the green architecture concept of design to minimize surface and roof areas exposed to the direct sun's rays. Those cores can play a big role in terms of natural ventilation as they can be used as shafts to ventilate the entire building. Every block mass has several floors (1st and 3rd masses have 5 floors each, while 2nd and 4th masses have 3 floors each) and a penthouse on top of the 4th mass. The floors consist of different distributions (studios, 1-2-3 Bedroom Apartments, Duplex). On top of every level of two same level block masses, exists a floor for service. Those floors are to be used as hanging gardens since people living in the UAE in high rise towers might feel abandoned from the nature and even to cool down the tower since the façade area is huge and will be directly facing the sun. These hanging gardens can be used to cool down the roofs of the blocks which can also be extend along the second layer of façade (which is the mashrabiya) and can absorb the heat before acting against the curtain walls of the blocks. Let's take the place of Egypt, in such country the amount of wind is huge. Therefore, wind turbines can be fixed on each of the block masses outside the service floor. The commercial center is as well designed to fit in and to play a huge role with the tower's concept and shading system and hanging gardens. Two different cores join the two-floor parking with the commercial center. The circulation of the commercial center to the tower is planned in modules aligning with the ground parking structure columns.

Figure 3: East Façade of the Residential Building

The tower's façade is a triple glazed reflective curtain wall-based system for maximum natural lighting and it has been studied based on the solar study of the region where the East, South and West facades have been covered by an outer second layer that acts as a shading layer where its strips pattern are based upon each apartment's function and its privacy as it is solid at areas needing most privacy which can as well be used to fix PV panels on three facades to help with the electricity consumption. For example, in UAE, the amount of solar power that can be used if PV were to be fixed, is large enough to provide power for the whole residential building. The shading layer then holds fixed louvers that are based on the pattern design on the second layer to prevent direct heat passing onto the tower The East and west façade has taken their pattern vertically while in the south façade horizontally. Moreover, the second layer can be designed as a mashrabiya to follow the Islamic home concept to provide privacy.

In UAE, since the temperatures are high most of the year, heat in the sand can be used to produce electricity using modern technology. Energy can be concentrated into one receiver and then used when the sun sets. The plant is a concentrated solar power, or CSP system, which uses mirrors to focus sunlight to heat sand. In UAE sand is already hot enough, but this method can be used in Egypt where the heat is not that high. The hot sand then produces steam which can run turbines and generate electricity. This might be an expensive operation to fix but would help in energy production/consumption in the future. Geothermal system can also be used in Egypt for example to cool water and in UAE to heat up the water without using power from the grid. Such aspects can save a lot of energy being consumed.

VII. Results

Figure 4: Area and human occupation in an apartment section

Outdoor Temperature:	Max: 40°C/Min: 14°C
Floor Area:	578 m²
Exterior Wall Area:	81 m²
Average Lighting Power:	4.94 W / m²
People:	5 people
Exterior Window Ratio:	0.66

Figure 5: Energy Intensity of an apartment section

Electricity EUI:	119 kWh / sm / yr
Fuel EUI:	35 MJ / sm / yr
Total EUI:	463 MJ / sm / yr

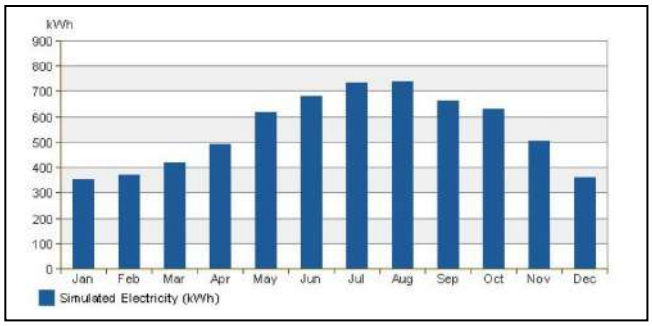

Figure 6: Annual Electricity Consumption of the whole Residential Building

VIII. Conclusion

With such ancient Islamic elements that were used in the past and the modern technology that might have not been there in decades can be a part of making modern private homes or high-rise buildings become part of what we call now "Green Architecture". Residential Buildings are more efficient in terms of energy loss. As for single family houses are more efficient in terms of solar power. But if the building has a huge area for solar panels then this would make it more efficient and generate more power. Materials might cost a lot if we add (10cm concrete, 15cm rigid insulation, 2cm water, 10 cm concrete), but it would be the most efficient. The overall façade system was estimated to reduce cooling loads by 20% providing efficient energy saving air conditioning system. It is estimated that the design resulted in a 40% saving in carbon emissions from the tower beside reduces cooling loads by 20% and between 20-50% reductions in solar heat gain compared with other traditional curtain wall buildings.

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