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## TRADITIONAL SPATIAL AND ENVIRONMENTAL PARAMETERS INFLUENCING INNOVATIVE ARCHITECTURAL INTERVENTIONS: CASE STUDY OF DARIYAH GOVERNORATE

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## Abstract

Traditional and vernacular architecture have always been responsive and sensitive to spatially and functionally socio-cultural and environmental conditions. Spatial configuration of architectural elements served a purpose such as alleviate harsh environmental conditions, respect concept of privacy, and accommodates e sociocommunal activities. The evolving contemporary architecture has grown far from the traditional architecture leaving behind sensitive design solutions that enhanced the spatial and environmental experience. The aim of this paper is to learn from traditional vernacular spatial production, notably the Saudi Najd architecture, in order to enhance contemporary architectural practices and experience. The paper aims to discuss the use of innovative technologies inspired from traditional and vernacular spatial and functional practices in contemporary architecture interventions. The research will investigate: (1) Elements of the Najdi traditional vernacular architecture that improves the spatial and environmental conditions of the architectural space; (2) The use of SMART technologies and innovative design method such as parametric design, smart façade, and innovative construction materials to reinterpret vernacular architecture heritage elements and environmental approaches to provide a spatial environmental heritage rooted design solutions.

## Keywords

Traditional vs contemporary, vernacular, space production, responsive design, najdi, cultural heritage

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**ABSTRACT:** *Traditional and vernacular architecture have always been responsive and*

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## 2. VERNACULAR NAJDI ARCHITECTURE

“Vernacular architecture is the architecture of the local” (Nisha & Jayasudha, 2016). It is built by the local community and reflects the needs, function, their culture, geographical location, historical context etc. responding to the dominant climate of that region. It is thus an expression of the interrelation between man and nature, an expression that has evolved in line with the environmental conditions, developed given available natural materials within its locations and the limitations of resources and construction techniques in ways that were most efficient out of necessity (King 1998 in Gharib & Mohamad, 2015). Additionally, the vernacular architecture shares religious doctrine and social values that helps mitigating several environmental problems by introducing designs that answers to the social needs and behaviors in these harsh conditions. According to Safwaa, vernacular architecture has proven that both its technical methods and structural systems are energy efficient and easy to be applied. Hence, every landscape is characterized with a distinct vernacular architecture that is climate environment, and culture responsive.

To further investigate the environmental and cultural response of vernacular architecture, the emphasis of this research is on Najdi vernacular architecture. Born in the central desert of the Arabian Peninsula, the Najdi vernacular architecture is specific to the Arabian costumes, Islamic beliefs and harsh hot arid environment of the desert. The harsh environmental conditions and the costumes and habits of the Najd community have influenced construction material, division of space, façade treatments etc. and consequently, the Najdi Architecture has been proven to be among sustainable environmental architecture styles (Gharib & Mohamad, 2015).

### 2.1 The triangular shape- openings:

Geometry plays a significant role in the Arabic spatial pattern. The triangular shape, known as “Al-Mukhramat”, is one of the traditional elements of the Najdi architectures, it as a geometrical

element used to articulate openings in the façade of the built structure for esthetic or functional purpose. According to Gharib, the two most common triangular forms used in architecture are equilateral and isosceles, and . Triangles are effective tools for architecture and are used in the design of buildings and other structures as they provide strength and stability.

From a technical point of view, the mud, as construction material, is known for its fast deterioration, however with reduced edges the triangular openings is least susceptible to deterioration in adobe construction. Additionally, the importance of the triangle as a two- dimensional geometrical shape, consisting of three heads joining three sides, is characterized by its balance in terms of engineering and forces over a given body. Equilateral and isosceles triangles symmetry aids in distributing weight.

From a functional point of view these triangular patterns, located at a respectively high level of the façade, served as opening for natural light in during the day, circulating of air and allowing view from inside while preserving privacy. Over time this shape gained a cultural significance and was passed on through generations as a visual inheritance. The triangle by tradition is a symbol of human consciousness and the principle of harmony.

From an aesthetic point of view, the simple geometrical ornaments are used in elevations of houses and buildings and varies in term of vertical and horizontal repetition of pattern and openings. Different colors for decoration of doors, windows and ceilings are used to add character to the surrounding environment and to the internal scheme (Gharib & Mohamad, 2015).

## 2.2 Building material:

Unlike Gulf coastal regions, lime stone is not found the Najd central Plateau, the main construction material had to made out of soil or silt collected from the dry riverbeds after seasonal rain. People of Najd produced their building block by mixing this mud with water and straw that solidify once exposed to the sun. The mud bricks were thereafter laid in horizontal layers forming the walls of the buildings, with a thickness that range from 450–

750 mm (Gharib & Mohamad, 2015). The walls are then covered with mud plaster to protect the bricks from erosion and provided the building with a decorative surface.

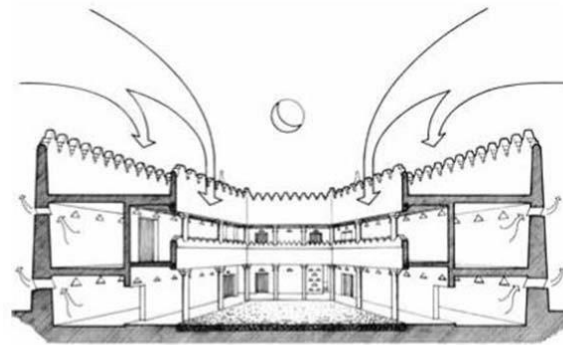
The thick walls and the constituting material add an environmental dimension to this architectural. The thickness of the walls allows for natural insolation, a cooler indoor environment in summer and warmer in winter. Moreover, this method requires no technical complication since it does not require construction of thresholds during the construction process, it is fairly simple and made of relatively renewable environmental material.

Tree and Palms are also an important structural element in the Najdi Architecture, they are used as beams forming the ceiling and the palm-leavess are used as the roof carpet.

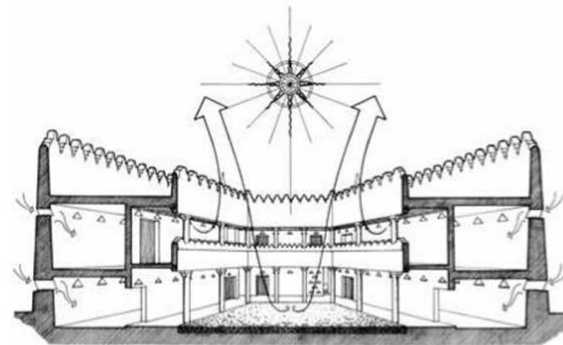
## 2.3 Internal courtyard and ventilation towers:

Given the harsh arid hot environment and dust storms, Najd architecture managed to provide a pleasant and sheltered open space in the form of courtyard at the center of residence. “Al-Finaa” is an inner open planted courtyard exposed to the sky and surrounded by room that protects it from wind and dusty environment. According to Hassan Fathy, the “typical courtyard house, open space is closed entirely to nature at ground level, which is necessary to shelter from heat and glare...we also know, according to aerodynamics, that wind blowing above the house will not enter the courtyard, but will pass over and create eddies inside (Figure 1). Thus, the courtyard will retain cool air that has settled there and will seep into the rooms and walls, cooling the house” (1978).

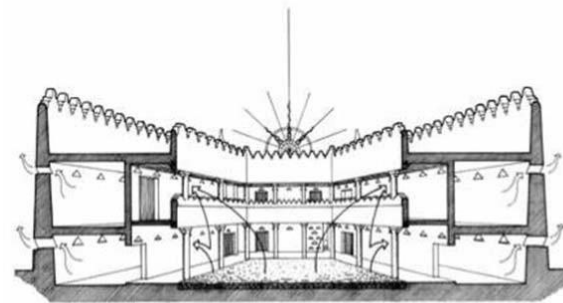
**Night:** courtyard and roof act as cool air sink.



**Day:** sun heats the courtyard, warm air rises creating chimney effect and pulls breeze through rooms.



**Evening:** courtyard and building retain heat then give it off as night air cools.



*Opposite* The great city wall of Hā'il northern Najd, in 1914.

Figure 1: Najdi Architecture Internal Courtyard – Source: Dar Al Omran

This provides a sheltered and relaxing environment to the building's inhabitants and forms in the Islamic Architecture and the Arabian civilization a convenient social space between inside and outside responding to environmental aspects (Gharib & Mohamad, 2015).

Additionally, ventilation towers built next to the vertical circulation inside the building are used as a natural cooling device.

#### 2.4 Architectural special structure:

The Typical Najdi houses are shaped as a response to the Najdi social practices and Islamic religious values. Segregation in space between public part of the house (reception or Majlis) and the most private section of the house for the women of the family is a key factor (figure 2). Entrance to the house is always indirect, sometime there is two entrances and separate circulation and sanitary blocks. Transitional circulation is ensured by inclusion of gallery with colonnade around the courtyard which has an environmental benefit of alleviating glare and providing outdoor shaded areas.



Figure 2: Segregation between public & private spaces of the house – Source: Dar Al Omran

External openings are minimal, usually located on the upper part of walls and are narrow in addition to openings for external view over the main entrances (General Authority for Tourism and Antiquities 2010). The openings have (a) structural intent to fulfill the openings or perforations with mud without depending on the use of lintels, (b) environmental intent: Is to create openings with the largest width in base within the least area possible; (c) a social intent of maintaining maximum privacy through limitation of sight passing through narrow openings; and (d) an economical intent responsiveness to the use of cheerful colored ornaments by integration of shapes without adding new building materials. Hence, we can see that the Najdi vernacular is one of the ecological, social, culture and economic responsive traditional architecture and the challenge lies on how we can re-use and rethink the benefits of the Najdi architectural elements in modern design.

### 3. A VERNACULAR AND TECHNOLOGICAL FUSION FOR SUSTAINABLE DEIGN

For the purpose of testing and understanding the application of vernacular inspired architectural design ways to use the traditional vernacular language to construct the future, the paper will study Al-Diriyah Governorate building design by Dar Al-Omran, of which the author is the General Manager and lead designer in partnership with Arch. Rasem Badran.

Al-Diriyah Governorate building is located at the gates of the historic core of Al-Diriyah, northwestern outskirts of Riyadh and is surrounded by many cultural heritage sites such as Imam Mohammad bin Abdelwahhab memorial, Imam Mohammad bin Saud Mosque, Eid prayer plaza, Bujiri site, Turaif city, and the Saudi flag pole (Figure 3). The building was inaugurated in 2016.

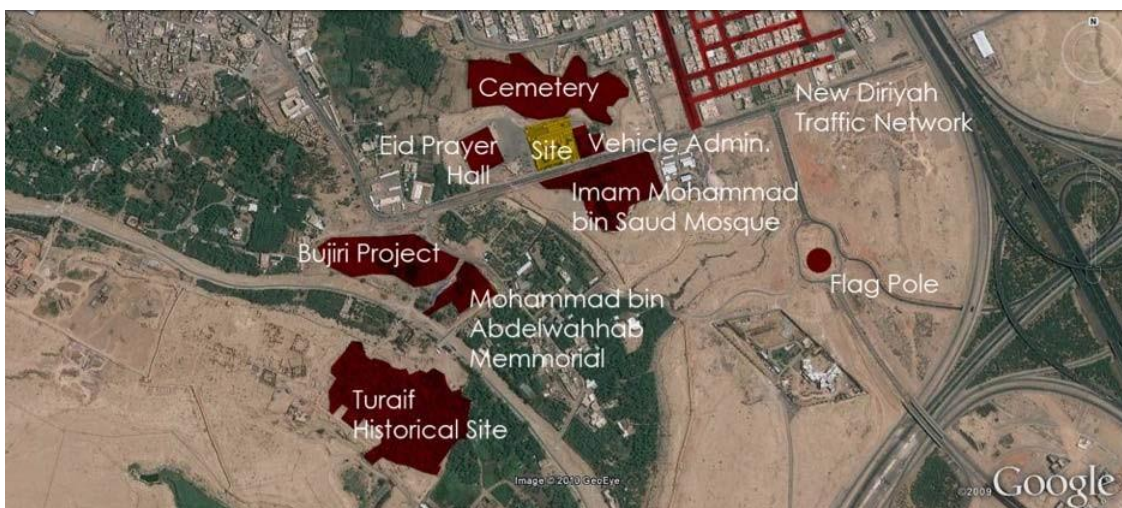


Figure 3: Al-Diriyah Governorate location map

From the onset, the aim is to respect the historic setting and recognize the civic significance of the building by a design concept that respond to the particularity of the site.

The nature of the building as a governmental institution implies an image of dignity, grandeur sublime. The design concept evolved from two simple interlocking rectangles into a building emerging from the land and surrounded by a wall, offering a modern reinterpretation of traditional designs, of the new embracing the old. Al-Diriyah Governorate building constitute a smart modern interpretation of heritage, and represented through its design elements (Figure 4).



Figure 4: Al-Diriyah Governorate Building 3D Model – Source: Dar Al-Omran

#### Reference to heritage:

Aim is to respect the historic setting and recognize the civic significance of the building by a design concept that respond to the particularity of the site. This creates a dynamic building which takes cues from its surroundings (Figure 5).

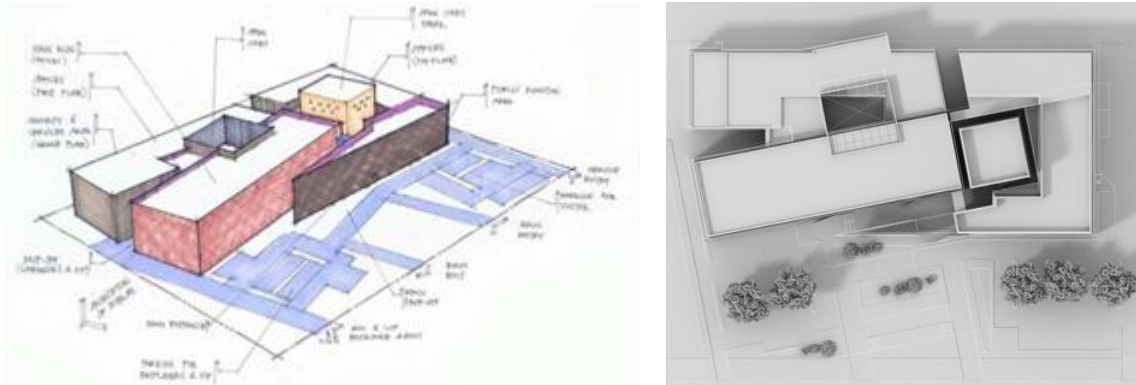


Figure 5: Dominant Building axis – Source: Dar Al Omran

to respect the historic setting and recognize the civic significance of the building by a design concept that respond to the particularity of the site. This creates a dynamic building which takes cues from its surroundings (Figure 5).

The heritage axis translated into a grid system that guided the division of the interior spaces (Figure 6). In fact, the grid system proves to be the most successful criteria for utilizing space with a grid module of 10mX8m (to fit two standard 5X8m offices) is adopted. The grid following the Qibla

direction is composed of 11.00 tilted modular intersection (10\*8m) and circular column preferred in centers and cores, rectangular section near office areas to be embedded in walls.

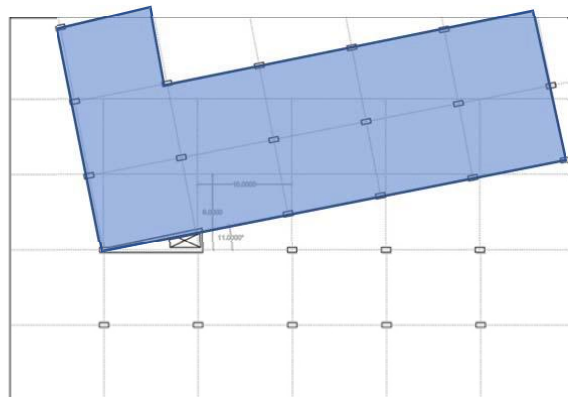


Figure 6: Al-Qibla Grid – Source: Dar Al Omran

Across Al-Qibla-Turaif Grid provides a visual connection with Abdelwahhab memorial located 200m west of the site and providing a powerful sight axis towards the historic city. The Turaif city is set on a hill overlooking the valley, it is the most significant

visual attraction, the design assured that is perceived from exterior plaza, even if that requires elevating the plaza's level, and the Governor's office.

Across the second axis, the proposed building will have a strong visual connection from the interior spaces (offices and the entrance hall) with Imam Mohammad bin Saud Mosque, contiguous to the site form the southern border, and its dominating structure with high minarets. And from the ceremonial halls, the Saudi flag pole is the main visual feature.

#### **Adopting the vernacular:**

The building design adopted many of the features of the vernacular architecture and when possible reinterpreted them with innovative technological approaches.

The spatial division of the building adopts the traditional idea of a courtyard, featuring an earth tower, around which ceremonial halls are organized. The courtyard was employed as a planted core in response to the hot climate to provide a shaded relaxing environment for the users. (Figure 7). Also, the use of courtyard inside the building shaded

by high parapets to provide light and the natural ventilation through the building by creating a positive and negative pressure between the inside and outside, the design intent is to use sensors in the building where it operate according to wind direction and temperature controls so it will open certain windows across the building in order to provide the natural ventilation.

The building also adopts the traditional idea of a courtyard featuring a rammed earth tower as a prominent element. It forms a focal point around which the ceremonial halls are orientated.



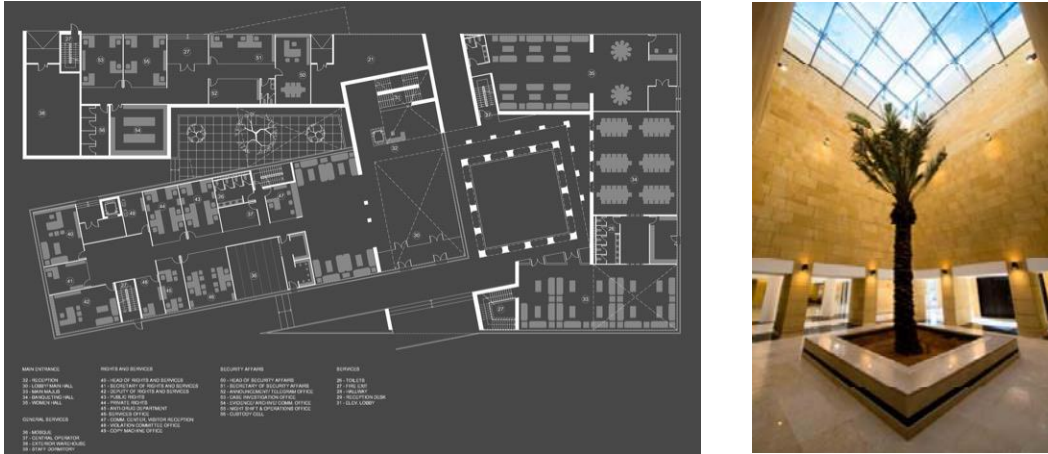


Figure 7: Ground Floor Plan of the Al-Diriyah Governorate – Source: Dar Al-Omran

### Hierarchy in spaces and element of surprise:

Like in the old city, people walk through the building on a journey and have the spaces revealed to them. Like traditional Diriyah houses, the beauty of the building lies in the inner spaces. These spaces unfold in time each evoking different feeling to the visitor. When the building comes in view upon your arrival to it, you instantly feel its imposing presence and authority which commands respect. The interior, though respectful of tradition, is uninhibitedly contemporary. The movement throughout the building is from public to increasingly private areas. As you enter the main hall you are taken aback by the sheer scale of it and you suddenly feel small and humble. Then the spaces start to come down to human scale to become more intimate and inviting. The movement throughout the building moves from the public gradually to the private areas. Lobbies end with small halls to articulate the space as means of orientation. They create moments in architecture forming gathering spaces encouraging socialization.

### More than a triangular motif:

The traditional triangle motif was a main source of inspiration for the design of the façade, however it was not applied as a superficial imitation that can be removed, the designer's intent focused on reconceptualizing that form to create an intricate facade, enhance the shape environmental function and aesthetic values (Figure 8). The concept design started from the form of direct triangle of the Najdi architecture to shape facade that provide a shading screen but yet transparent to the main functions behind it.



Figure 8: The use of the triangular motif – Source: Dar Al-Omran

The use of triangular shape for inspiration to create an environmental façade required a parametric articulation of the shape size, distribution, density in relation to the interior lighting distribution, shade and framed views. The form became an integral part of the design as a whole, this elaboration allowed the treatment of each component to form a coherent narrative and it is implemented throughout the building façade as in a poetic expression varying in size like sand particles blown and swept by the wind. (Figure 9).

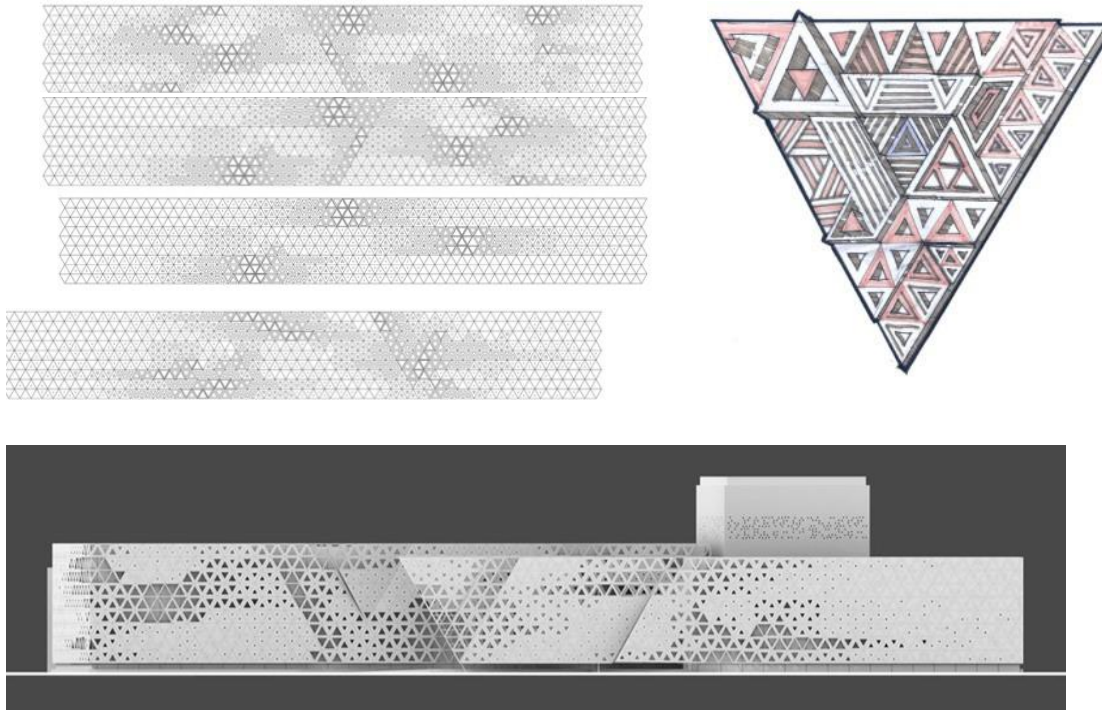


Figure 9: An intricate façade – Source: Dar Al-Omran

The hierarchical arrangement of the shape allows to reduce the glare, filter natural light and allowing it to flood into the building and reduces the amount of heat transmitted through the building. The interesting and changing play of shadow and light, throughout the day, across various building surfaces, making interior place alive (Figure 10).

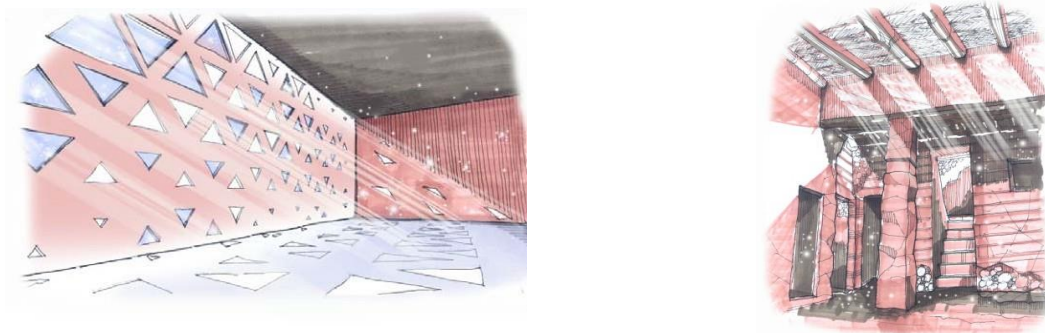


Figure 10: Play of light – Source: Dar Al-Omran

Hence, the parametric interpretation of the triangular pattern suggests a remarkable amount of freedom in its repetition and complexity. The elaborate details on the facade reflect both our heritage as well as current technological advancements.

#### Applying new technologies:

Additionally, innovative technological elements were used to improve environmental conditions. The exterior façade is designed as double skin to reduce the heat transmission to the building. Using the eco-mesh, a modern material serving as an insulator, a shading device to prevent solar glare and overheating.

The use of concrete, rammed earth and glass (curtain wall) were used to add unique qualities to the design. This selection of materials represents a modern adaptation to the harsh climatic conditions which resulted in an ecological responsive design (Figure 11). Concrete is a genuinely environmentally friendly material. It has qualities that make it a sustainable material of choice such as excellent sound and fire protection and high thermal mass. The thermal capacity of concrete enables it to absorb, store and later radiate heat which in turn reduces internal temperatures. Concrete also offers stability, durability and design flexibility.

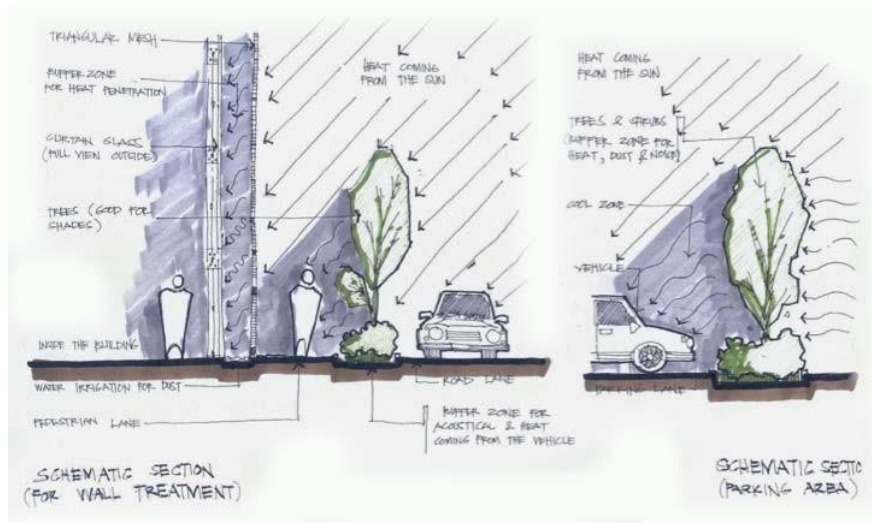


Figure 11: Façade wall treatment – Source: Dar Al-Omran

#### 4. CONCLUSION

In brief, the intention was to create a building responsive to the unique location, climate and culture of Al-Diryah that serves as a symbolic landmark while avoiding superficial adaptation of heritage elements.

The architect aspired to achieve a synergy between old and new and evoke feelings of wonder, admiration and pride. The design and choice of material convey a sense of the past as well as aspirations to the future. This theme guides the elaboration of each distinct component throughout the building to form a coherent narrative. The use of triangular motif is adopted as the main visual element because of its traditional value, applied as an integral part of the design and implemented in a thoughtful manner rather than a superficial imitation. The elaborate details of the facade reflect both Al-Diryah heritage as well as current technological advancements. The smart choice of construction materials focused on responsive to the environmental conditions and inspired from the vernacular architecture notably the rammed earth reflects the influence of adobe construction for the exterior walls.

The uniqueness in design idea which appeared in the experimentation mechanism in the application of the multiple design motivations using the triangle (Environmental— Structural—Social— Economic) helped to develop the building and upgraded the environmental standards to verify the concept of sustainability and also reflect contemporary architecture associated with the local culture of the region of Najdi Architecture without reflowing in the formal traditions features only.

Finally, the case study of Al-Dariyah governorate whereby spatial and functional elements the traditional and vernacular Najdi architecture were interpreted and transformed to be used in an intelligent manner as a design and functional element to improve the spatial and environmental experience within a modern architectural intervention.

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