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Utilizing Sustainability Principles in Administrative Buildings: A Case Study of the New Nineveh Governorate Building

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Abstract

The interaction between sustainable principles and architectural design leads to a balance between the generation's needs and the natural resources of the environment. In relation to our responsibility to conserve resources for future generations, Hence, the importance of the term "sustainability" and its application in architectural buildings. This research presents a case study that attempts to reveal the extent of employing the architectural sustainability principles in reconstruction projects in Nineveh governorate. The theoretical framework was built by reviewing the literature and previous studies related to the subject to extract the most important principles of architectural sustainability for administrative buildings. The research methodology is based on conducting qualitative analysis through interviews with experts as well as morphological analysis of the case study building in order to reveal the extent of employing the architectural sustainability principles, to provide the architectural practice with recommendations, which enhance the sustainable performance of administrative buildings, making the reconstruction process more sophisticated and advanced.

Discipline: Architecture, Sustainability.

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1 Introduction

The definition of sustainable development is described as "Meeting the needs of current generations without compromising the ability of future generations to meet their own needs."

(Orabi et al., 2015). The intersection of urban sustainability principles and architectural design necessitates a profound comprehension of sustainability philosophy to successfully execute urban projects that fulfill the criteria of a sustainable urban environment. Sustainability comprises three fundamental dimensions: social, economic, and environmental. (Hassan et al., 2020). These dimensions must be considered throughout the various phases of urban projects, starting from the ideation and preparation for development, through planning and design, followed by construction, occupancy, maintenance, and ultimately, decommissioning and demolition. Each phase must directly engage with natural resources, including energy consumption, water usage, materials employed, land designated for the project, and the management of waste produced. Regarding sustainability principles, the conservation of resources, the reuse and recycling of materials, and the utilization of high-quality, environmentally friendly materials, when applied with expertise and skill, will undoubtedly result in the successful realization of physical projects that address the social, economic, and environmental dimensions of sustainability approaches (Orabi, 2015). Sustainability spans economic, social, and environmental dimensions across various sectors, particularly emphasizing the built environment. There is an increasing agreement on the importance of developing this environment as an integrated system that corresponds with the distinct local characteristics of each area, which vary in climate, geography, and societal structure (Al-Hayali & Al Dohaji, 2011). It is crucial to define what a building entails; Frank Duffy emphasizes that the notion of a building is not uniform, and the proposed design of a building consists of various layers of constructed components. He identifies six layers: the site, which encompasses the geographical and urban locations, the legally defined site that persists for generations, and the structure, which includes foundations and heavy load-bearing elements that are expensive and hazardous to modify, typically ranging from 30 to 300 years old, although few buildings surpass 60 years. Services comprise telecommunications wiring, electrical wiring, heating and cooling systems, and moving parts that require replacement every 15 to 17 years. The space plan involves interior design, where the arrangement of walls, ceilings, floors, and doors in residences can change approximately every 30 years. Lastly, furniture includes items such as chairs, desks, photographs, and phones (Tiesdell, 2007, pp.302-306). The significance of ongoing sustainability assessments during the design phase of office buildings lies in the reduction of energy consumption. Inefficient recycling, coupled with a lack of attention to the cost implications of sustainable design, can result in resource wastage and increased energy consumption, which is an entirely undesirable outcome (EL-Etriby, 2019).

For the purpose of achieving sustainable administrative buildings, each layer of the building, which is represented by the site, structure, engineering services, building skin, space plan and furniture, must be designed in conformity with the principles of responsive sustainability of natural resources at the stage of architectural design, which will reflect the efficient performance of the administrative building after its completion and occupancy.

The objectives of this study are as follows: 1) to assess the design of administrative buildings in Nineveh Governorate in accordance with the principles of architectural sustainability, with a particular focus on the Diwan building of Nineveh Governorate, which serves as the primary administrative structure, 2) to improve the designer's sustainable design strategy throughout the design process, ensuring the creation of a building that fulfills the criteria of architectural sustainability.

2 Literature Review

2.1 Environment Aspect

The environmental aspect focuses on water quality, air quality and providing visual, acoustics and thermal comfort (Debizet & Symes, 2008). Conserve the environment by reducing carbon dioxide emissions and energy consumption by properly guiding buildings and using environmentally responsive architectural processors to control the building's internal loads (Kumar, 2016). It is important to use environmentally friendly materials that are in harmony with the surrounding context (Orabi et al., 2015). The utilization of local construction materials plays a pivotal role in shaping the distinct attributes of regional architecture, based on their formal, physical, and mechanical properties (e.g. heat capacity, thermal resistance, thermal conductivity coefficient, flexibility, formability, texture, and material shape) and the factors that impact them throughout the lifecycle - from extraction to construction, operation, eventual disappearance, and degradation, aiming towards recyclability. The natural materials like stones, alabaster, plaster, clay, and bricks stand out as top choices for sustainable building practices (Al-Hayali & Al Dohaji, 2011). The process of identifying the most suitable form of repurposing remains a subjective process dependent on the expertise, capabilities, and circumstances of the particular situation, requiring comprehensive research to increase the chances of success and extend the lifespan of the structure. The criteria cover a wide range of factors such as architectural design and arrangement, building materials and composition, functionality and intent, historical background and approaches, geographical location and environment, as well as other aspects related to artistic, historical, social, and scientific domains (Al-Allaf and Huyale, 2019). Traditional architectural principles provide a distinct encounter with sustainable architectural practices by employing design strategies that address the specific climatic conditions through the utilization of elements such as wind towers, vaulted ceilings, courtyard gardens, afforestation, and the transition between seasonal spaces. Additionally, the incorporation of roofed structures and covered walkways contributes to effective shading within the architectural design approach (Esmaeili & Litkouhi, 2013). The use of modern technology in an environmentally responsive manner offers enormous potential for architectural sustainability through simulation programs at the design stage and the use of smart solar nuts, reflective glass types and plant insulation, as well as the development of local building materials (Rifaat, 2018). Several building design strategies address the environmental aspect of architectural design, such as passive cooling systems, natural light, thin conglomerate strategy, Trombe Wall, and evaporative cooling systems (D.C) (Kumar, 2016).

2.2 Economic Aspect

The economic aspect is achieved through, inter alia, extending the life of the building using sustainable building materials, identifying an easy location for accessibility and transportation of materials, flexible design to change usage during the lifetime of the building, reuse and recycle of various materials, as well as through optimization of interior space and proximity to support services (Orabi, 2015). Rationalize energy consumption, reduce the use of new resources, design according to society's actual needs and respond to geographical and climatic location characteristics, all of which support the economic aspect (Esmaeili & Litkouhi, 2013). Materials used are more sustainable as they are more durable, reusable, recyclable and do not require a high cost of onsite transportation and cost of extracting, manufacturing, installing and maintaining relatively low (Kumar, 2016). Principles of good governance and value added based on innovation serve to strengthen the economic aspect of the building (Rifaat, 2018).

Adapted buildings responsive to user behaviour gain additional economic value, especially if they are based on the principles of Simplicity, Density, Durability, Adaptation, Locality, Mutuality and Comprehensibility (Fauth and Pieper, 2022).

2.3 Social Aspect

Social values take precedence in design over rigid engineering principles, directly influencing the attainment of architectural sustainability. Community values dictate a unique design approach tailored to each specific spatial context (Winkelman, 2013).

Social factors play a crucial role in the architectural decision-making process, as achieving sustainable buildings necessitates social justice and equitable access to public services for all community members, alongside ensuring user satisfaction with the services rendered (Orabi, 2015).

Traditional architecture embodies a unique social aspect through the concept of privacy, which is reflected in the distinctive features of mashrabiya (shanashil/takhrima/barmaqli), winding entrances, and orientation towards courtyards (Esmaeili & Litkouhi, 2013).

The social dimension also influences the interior design of administrative offices by determining the type of workspace and its effects on employee behavior and performance. Various types include: Open plan offices, Office Landscapes, Structuralist offices, Cubicles, Hot Desking, Casual offices, Eco-friendly design offices, Coworking Spaces, and Digital Workplaces (Hassan et al., 2020).

The factors examined that affect perceptions of sustainable architecture and stakeholder engagement in green building design highlight the interplay between technology and architecture. The focus has been on exploring how technological innovation impacts social perceptions of sustainable design, as well as analyzing the factors that influence perceptions of sustainable architecture and stakeholder involvement in building projects (Poon, 2021).

3 Research Methodology

The research methodology relies on performing qualitative analysis through interviews with

experts, alongside a morphological analysis of the case study building. This approach aims to uncover the degree to which architectural sustainability principles are applied, ultimately providing architectural practice with recommendations that improve the sustainable performance of administrative buildings, thereby rendering the reconstruction process more sophisticated and advanced. Table 1 gives a checklist based on sustainability principles in the design process.

Table 1: Checklist of the application of sustainability principles in the design process

Design stage	Resources Management	Sustainability principles				
		Reuse	Recycle	Eco-friendly	Preservation of resources	Quality
Site	energy	•	•	✔	✔	✔
	water	✔	•	•	•	•
	materials	✔	✔	✔	✔	✔
	land	•	•	✔	•	✔
Structure	energy	•	•	•	•	•
	water	•	•	•	•	•
	materials	•	•	•	•	•
	land	•	•	•	•	•
Envelope or skin	energy	✔	✔	✔	✔	✔
	water	•	•	•	•	•
	materials	✔	✔	✔	✔	✔
	land	✔	✔	✔	✔	✔
Engineering services	energy	•	•	•	•	•
	water	•	•	•	•	•
	materials	•	•	•	•	•
	land	•	•	•	•	•
Space plan	energy	✔	✔	✔	✔	✔
	water	✔	✔	✔	✔	✔
	materials	✔	✔	✔	✔	✔
	land	•	•	•	•	•
Stuff/ furniture	energy	•	•	•	•	•
	water	•	•	•	•	•
	materials	•	•	•	•	•
	land	•	•	•	•	•

4 Case Study

Nineveh Governorate's new office building represents the largest administrative building implemented in Mosul City, with an area of 44506 square meters, which includes the main governorate building, the hospitality house building, guard buildings, protection, workshops for maintenance, generator rooms, and the constructed area of the 9080 square meters building. The building consists of six floors and a basement. The building is divided into five items based on the general criteria for the design of administrative buildings (buildings combining symbolic character and administrative work) to determine the design and materials required for each classification:

1 . Mr. Governor's Office (Class A).

2. Office of Deputy and Assistant Governor (Class B).

3. Departmental Directors' Offices (Class C).

4. Offices of People's Heads and Staff (Class D).
5. Public spaces.

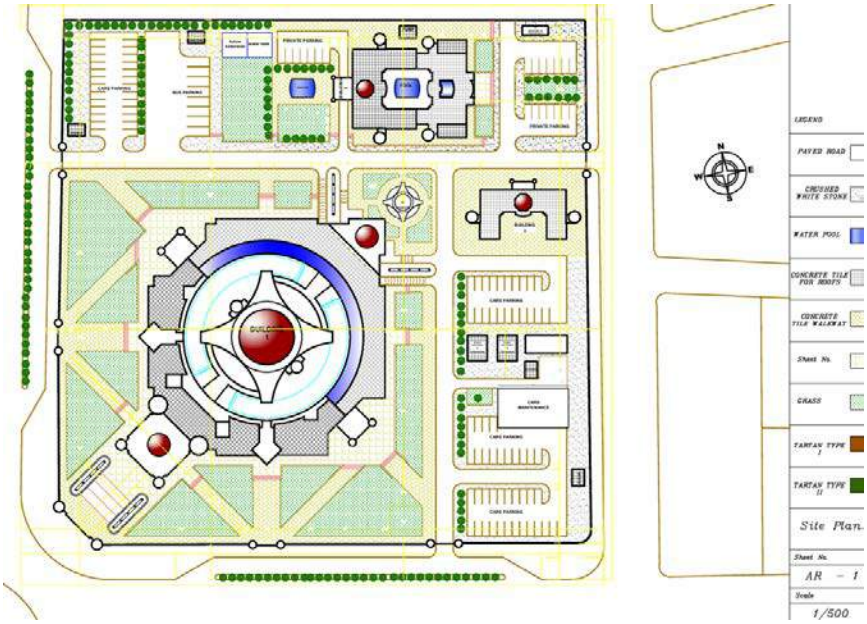

Figure 1: Design of the Nineveh Governorate's new office building

Public spaces are the main entrance, secondary entrances and waiting areas spread across the building's floors. The main entrance is located on the North West Side with an area of 400 square meters to receive staff, reviewers and visitors. It is characterized by the presence of representatives of each collaborator and a section of the governorate and wide queries sufficient to meet the needs of the auditors. The symbolic standard has been weighted in the design of this space and the adoption of elements and details of Assyrian civilization to mimic the design of its exterior mass. The natural corridor material has been adopted for the packaging of walls and floors, with the grafting of wood materials and gypsum board for murals and sculptures. The secondary entrances are located on the South West and North East sides, with an area of 100 square meters. The waiting room is located in the central part of the ground floor. It is the space between the main entrance and the governor's entrance. It is 1250 square meters and provides sufficient space to wait.

5 Discussion

5.1 Experts Interview

A number of experts supervising the building’s implementation were interviewed in order to obtain qualitative information about the extent to which sustainability principles were applied in the building’s design. Sustainability principles were discussed according to the following building design stages:

5.1.1 Site Selection

The site's orientation is characterized by a circular shape, providing a balanced orientation and equal solar exposure to the building spaces. It is essential to consider the architectural perspective in order to finalize the site's details and accurately represent the architectural components, thus aiding in resource conservation. The design of the site, including green areas and water features, plays a significant role in regulating the environmental conditions. Situating the building in close proximity to the Tigris River has facilitated the conservation of natural water reservoirs by enabling the utilization of groundwater through well drilling, reducing reliance on river water and thereby safeguarding the water resources for the ecosystem.

5.1.2 Structure and Envelope of the Building

In relation to the architectural design of the new governorate building, a modification was made in the external finishing material, transitioning from Bitoban to Halan. This alteration introduced two significant elements. The first element pertains to the aesthetic dimension, as the Halan stone aligns with the traditional architectural style observed in the city of Mosul. The second element highlights its function as a heat-insulating material, previously utilized in indigenous architectural practices, thus playing a crucial role in energy conservation and promoting environmental sustainability. Furthermore, the potential for material reusability not only aids in resource preservation but also underscores the environmentally friendly nature of the building. The prospect of repurposing the marble material employed in the building's facades further emphasizes the commitment to environmental conservation. The utilization of the natural stone, Halan stone, as an organic insulating medium reinforces the sustainable approach towards resource conservation. The architectural strategy incorporated the use of graded building blocks, resulting in the creation of shadows that contribute to energy preservation efforts within the environment. Additionally, the application of insulating materials such as foam and al kasha on the building surfaces serves the purpose of thermal insulation and reduction of energy consumption, thus playing a pivotal role in safeguarding energy resources for environmental sustainability.

5.1.3 Engineering Services

The utilization of the inclined wall within the architectural layout serves as a strategic location for the installation of solar panels, harnessing solar energy to power the building sustainably. This feature demonstrates foresight, as the glass panels are designed for potential conversion to solar cells, owing to the wall's optimal inclination angle of 53 degrees. The building, constructed in 2019, lacks a crucial water filtration system, an essential component of contemporary designs focused on water recycling and resource conservation. Furthermore, the building's window design facilitates natural ventilation, enhancing the overall environmental efficiency of the structure. To address potential issues related to high groundwater levels, a well was excavated in the basement for continuous water level monitoring and automatic drainage into

the city sewage system. Additionally, the building is equipped with an automated fire suppression system, specifically designed to safeguard important documents. The basement houses water tanks and a drainage system shielded from direct sunlight exposure, effectively contributing to energy preservation efforts.

5.1.4 Architectural Plan and Traditional Architectural Elements

In relation to the architectural design of the building, the central courtyard feature was inspired by traditional architectural practices in Mosul to mitigate harsh climatic conditions. By integrating greenery and fountain basins within the courtyard, this environmental strategy was implemented to combat heat. The strategic placement of internal windows facing the courtyard is thought to reduce the building's energy consumption, thus contributing to energy conservation efforts. External facades of the building function as a traditional method of providing shade, especially on higher levels, to enhance thermal insulation against the summer sun and shield from winter rainfall. Additionally, the traditional architectural element of shanashil (mashrabiya/takhrima/barmaqli) is included as a sustainable solution for climate control, further aiding in energy preservation. The incorporation of dome elements from Mosul's traditional architecture not only adds engineering value in terms of thermal insulation but also offers the potential to increase the building's roof height.

5.2 Morphological Analysis

Assessment of the application of sustainability principles in the new governorate building according to the design stages.

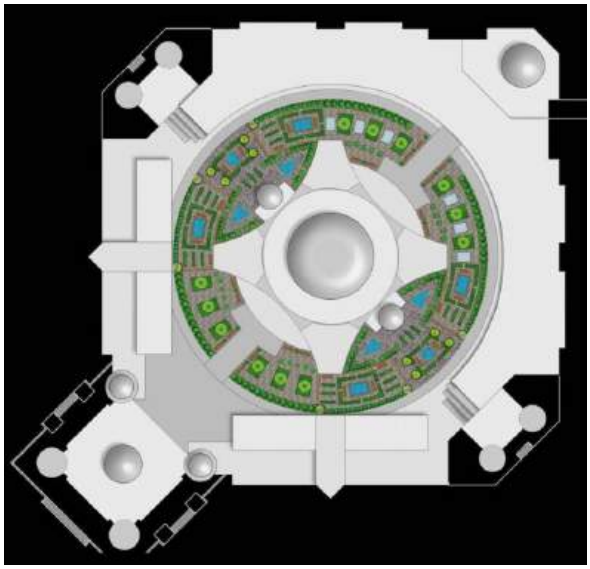

Figure 2: Use the indoor garden element of Nineveh Governorate's new office building

5.2.1 Site Selection and Design Phase

The chosen site is situated near the Tigris River, centrally located within the city and easily reachable from the government circles complex, adjacent to the Liberty Bridge. Expansive outdoor gardens and several fountains have been created to alleviate the hot, arid summer climate, in

addition to incorporating the indoor garden feature within the courtyard (Figure 2) or the open circular interior of the sky, allowing for natural light to penetrate through it for the crypt (Figure 3).

5.2.2 Structural Structure Phase

The approved structural system consists of pillars and armed concretized bridges that have been overstated in terms of the number of pillars and the large quantity of weaponization that could have been designed more economically and met the building's construction needs. Also, concrete material cannot be reused or recycled and is a non-environmentally friendly material during its entire life cycle from extraction to transport and production, and then blending and forming in the molds, but it has the flexibility and ease of forming, and the domes were used for roofing important spaces such as the listed hall and main entrance. The dome's shape mitigates the temperature gained from the roof and thus reduces cooling loads and energy consumption.

5.2.3 Building Envelop

Processed at the architectural formation level and at the material level used, the architectural formation is defined by the incorporation of a square shape within the circular courtyard, which is framed by a substantial central block that generates a broad and open circular area between it and the primary square shape. This area is designed as a network of gardens and fountains, fostering an indoor environment that enhances the atmosphere and imparts an indoor aesthetic to the adjacent hallway, while also allowing for ceiling illumination for the crypt. The building is distinguished by the implementation of the hallway element from various sections to ensure adequate shading and to obstruct the direct penetration of sunlight into neighboring architectural spaces. The Shanashelle element was used for the upper floors for the same purpose as well as the realization of the symbolism and local architectural identity. Local (Halan) Stone has been used in the packaging of facades, which is a natural, reusable and recyclable material and provides employment opportunities for local labour from extraction to production, installation, maintenance and subsequent maintenance.

Figure 3: The 3D circular courtyard of Nineveh Governorate's new office building

5.2.4 Engineering Services

Electrical and mechanical systems have been fully relied upon, and negative systems and methods have not been taken from the exploitation of refrigerated water, passive cooling, or solar energy, despite the existence of appropriate flats, especially the slash wall, with an area of 580 square meters for the fifth and sixth floors facing the south and south-east.

5.2.5 Space Plan

The use of the open square shape of the interior towards the central space with central mass and the generation of space between the two spaces, as well as the side-to-the-outside and the inside, enabled the achievement of the thin scheme (Thinner), which provides the inside and outside view enhanced lighting, and natural ventilation.

5.2.6 Furniture

The open workspace of each section was used to distribute furniture (Figure 4). It was possible to think about modern informal workspaces or the system of administrative booths that provide the kind of privacy that Eastern communities desired while giving priority to job work.

Figure 4: Modern open workspace.

6 Conclusion

Achieving a sustainable architectural environment poses a major challenge for planners, architects, and construction professionals, along with their technical and logistical services. However, it is a crucial process for conserving resources for future generations. This approach must be implemented in the reconstruction projects within the Nineveh governorate to contribute to the rationalization and preservation of natural resources.

The design of the new governorate building has essentially overlooked the application of the principles of sustainability despite the architectural attempts to respond to the local environment through the use of the central courtyard, the side hallway and the architectural schnachel element in the facades and packaging of local materials, but it has not reached the design level of passive cooling systems either using the principle of aerobic movement based on the development of wind towers or exploit groundwater and near the river to design the evaporative cooling system or the area cooling system (D.C.), solar energy was not employed despite the great opportunity in terms of geographical location and sunny local climate as well as the building's shape, especially the slash wall of the fifth and sixth floors facing the south and south-east with an area of approximately 580 square meters.

The research recommends the adoption of the principles of architectural sustainability in the design of new buildings and for all stages of the project and the use of building information modeling techniques from the planning phase of the project to the design, implementation and then works and maintenance.

It also recommends that buildings completed for rehabilitation be reconsidered in accordance with the principles of sustainable architecture to minimize the loss of natural resources and to achieve a healthy and secure environment for present and subsequent generations.

7 Availability of Data and Materials

All information is included in this work.

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