Sustainability of Sovereign Buildings in Mesopotamian Civilization

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Abstract. The pattern of sovereign buildings has emerged within the course of the history of architecture around the world and through the succession of civilizations since ancient times. The planning and designing foundations of these buildings were mainly affected by the diverse ruling authorities and differed according to the successive systems of government. The main thing that distinguishes most of the designs of this style of building is their sustainability through the materials used in its construction as a means of perpetuation throughout the ages, constantly marking the eternity of its rulers. The lack of knowledge in previous literature in the field of Architecture about the role of materials and technologies in achieving sustainable sovereign buildings in Mesopotamian civilization, constitutes the main research problem. The aim of the present paper is thus defined as arriving at the establishment of a theoretical framework by which are determined the main principles and mechanisms of materials' choice and techniques utilized in different eras of ancient Iraqi architecture, to finally benefit from the past experiences to attain sustainable sovereign buildings today and in the future.

The research results confirm the role of the ruling authority (priests and rulers) in the choice of materials and techniques, as a prominent contribution in achieving sustainability and eternity in sovereign buildings of Mesopotamian civilization.

Keywords: sustainability; sovereign buildings; building materials; eternity

1. Introduction

Mesopotamia, as it was named by Greek historians, is regarded as one of the first emerging civilization’s centres of the world, where the remnants of its architecture are still standing (as those of the Sumerians, Assyrians, and Babylonians). Over thousands of years, the world had witnessed the creativity and artistry of the ancient Iraqi workers in building and construction, in a way that aroused ever-lasting interest and admiration.

In Mesopotamian civilizations, a clear pattern of building had emerged, represented by the sovereign buildings (temples and palaces), in which the authorities had had a say in choosing their locations, their materials and hence their longevity. It had been through the intentional use of highly durable materials with special technologies that ensured the long survivability and sustainability of such buildings over thousands of years, reflecting the dominance and power of the rulers of ancient civilizations.
The lack of knowledge in the previous literature in the field of architecture, about the role of materials and technologies used in attaining sustainable sovereign buildings in the Mesopotamian civilization, constitutes the main research problem. The present paper assumes that the choice of materials and technologies by the ruling authorities in Mesopotamia had an impact on the durability and immortality of the sovereign buildings throughout history.

With this perspective in mind, the paper tackles the problem through three main axes: the first axis introduces the definitions of the main concepts of the research including concepts of sovereignty, immortality and sustainability. The second axis explores the role of materials and technologies used in the sovereign buildings in ancient Iraqi architecture (from the Early Dynastic Period dated 2800 BC, until the fall of Babylon in 539 BC), including the Sumerian civilization, Assyrian civilization, and the modern Babylonian civilization.

Finally, data analysis, discussion and conclusions are presented in the third axis.

2. Sovereignty, Immortality and Sustainability Concepts

2.1. Sovereignty and Immortality Concepts

Sovereignty is described in the dictionary as “the status, dominion, power, or authority of a sovereign; royal rank or position; royalty. Or supreme and independent power or authority in government as possessed or claimed by a state or community [1]. It is also defined as “a supreme lord or ruler; one who possesses the highest authority without control. Some earthly princes, kings and emperors are sovereigns in their dominions” [2].

There are several meanings and senses of the word ‘sovereign’. Some describe it as "the supreme and the highest power on its territory and what is found on it or in it." [3], or as "a certain political reality that lies in the ability to unilaterally issue a political decision within the state, and the actual capacity for legal monopoly of the instruments of domestic repression and non-compliance with foreign powers, as well as the actual capacity to achieving political independence, that is, free will in the international arena” [4].

According to what is mentioned above, the word sovereignty seems to indicate, or is associated with the concepts of authority, domination, independence, and the power of a supreme body over its dependents. Its meaning may differ according to context (social, political, economic, etc.). Sovereignty is related to the type and foundation of the ruling power, be it of a democratic, totalitarian or any other type.

As for Immortality, it is one of the concepts related to sovereignty. It is, according to Ibn Mandhour, the permanence of survival, or the lasting forever. Furthermore, it also means a kind of continuous presence that is not affected by time [5], and it is “time that never ends or that has no limits” [6].

2.2. The Concept of Sustainability

The New Webster International Dictionary notes that the word "sustainable" is derived from the word " sustainability": which is "... to cause to continue", or the causing for continuous- without interruption or ending- of something; or meaning "... to keep up", i.e. to preserve and to continue, sustainability and continuity [7].

As for its customary meaning, the concept of sustainability has had many conventional usages, one of which is given by Phillip Sutton. He states that sustainability connotes the preservation of something and supplying it with its provisions of survivability and permanence. It is not limited to the complimentary environmental, social and economic issues, or to the improvement of the quality of life, per se, alone [8]. This means that the idea of sustainability is connoting preservation and continuity.

Although sustainability as a meaning has been around for a very long time, sustainability as a clear and agreed concept clearly emerged among the various development trends during the second half of the twentieth century, and began to impose itself strongly at the beginning of the twenty-first century. It does not only mean the economy in the exploitation of resources within the permissible limits, as its concept goes beyond that to include the optimal exploitation of it [9].
The concept of sustainability includes the following basic principles:

- Conserving resources, and frugal exploitation.
- Continuity, durability and renewal.

It is a concept with a comprehensive meaning and wholly linked to the concept of conservation and permanence of resources, seeking to preserve life and improve its quality [8]. This concept differs according to the field in which the research is carried out. For example, when searching in the field of the environment the term environmental sustainability is used. When researching in the field of economics the term economic sustainability is used and so on. Therefore, there are many classes of the concept of sustainability including (environmental, economic, social, etc ...)

2.2.1. Features of sustainable building materials

Sustainable building materials are characterized by several features as follows: [10]

- Pollution prevention measures in manufacturing: Pollution prevention measures taken during the manufacturing process can contribute significantly to environmental sustainability. Therefore, the materials that produce the least amount of pollution are the best materials.
- Use of natural materials: Natural materials usually require less processing, less damage to the environment, and less production of toxic substances. When natural materials are incorporated into building products, the products become more sustainable.
- Local materials: Using locally produced materials shortens transportation, also, it is the most suitable material for climatic conditions.
- Longer life: Materials with a longer life, that is, durable materials, require fewer raw materials. The durability of the materials is an important factor in analysing the life cycle costs of the building, as well as materials that require the least amount of maintenance.
- Reusability: Reusability is a function of the age and durability of a material. Very durable materials may have many useful years of service left when the building in which they are installed is decommissioned, and may be easily extracted and reinstalled in a new site., such as windows, doors, bricks and wood.

2.2.2. The degree of durability of building materials

Each building material has structural properties that distinguish it from the rest of the materials, and these properties differ in terms of permanence and durability. The immortality and durability of buildings are related, in many aspects, to the materials and techniques used, and one of the patterns of association between them is the degree of permanence, which is classified into two types:

- High materials permanence:
  Studies refer to the necessity of the building materials to have the durability needed to resist the stress they are exposed to, and thus attain the durability of the building that was previously planned.
  The Campbell study refers that the choice of building materials has cultural and political dimensions, in addition to the fact that materials with high durability are often economically expensive (such as marble and gold), [11].

- Low material permanence:
  Despite the premonition of immortality and love of survival and permanence in humans, this did not prevent them from using materials with low permanence, Alexander in his book entitled "The Timeless Way of Building" states that despite the human attempts to preserve the building in its present state forever by building it from high durability materials, but it is still necessary to build some parts of the building with materials that show the progression of time and extinction, because the properties of nature do not emerge without the presence of death and awareness of the fact that things disappear, and this is the timeless way of construction [12].

3. Sovereignty buildings' materials and techniques used in Mesopotamian civilization

The Mesopotamian civilization is regarded as one of the oldest civilizations, that is comprised of several dynasties, the most important of which are the Early Dynastic Period, the Sumerian era, the
Assyrian era, and the Babylonian era. In these civilizations there were buildings that could be considered as sovereign buildings, according to the above-mentioned procedural definition. These buildings varied between temples, ziggurats, palaces and even royal cemeteries, in which the dominant authority (priests or rulers) had had a major role in designing them; selecting their sites as well as selecting the materials and techniques used in building them to be of permanence and immortality nature, so as to perpetuate their names and civilizations. The priests and rulers in ancient Mesopotamia, and for the most of historical eras, were keen on immortalizing their accomplishments in various ways and means. This reached the level where some kings wrote their names on building materials, such as King Ornamo who enveloped the outside of the ziggurat with burnt bricks and put a seal with his name inscribed on some of them. The same with Kings Sholki and Amersen's writings on the bricks used in the royal cemetery [13].

The materials and techniques had a great role in achieving the desire of the ruling and dominant authority, and consequently the survival of the buildings for a long time.

A group of buildings which were considered sovereign buildings through the history of Mesopotamian civilizations, will be selected to explore the concept of sustainability of materials and technologies and their role in the immortality of these buildings, as follows:

3.1. The Early Dynastic Period (2700 BC-2300 BC)
This era extends from the end of the “Gamda Nasr phase” to the beginning of the establishment of the “Akkadian Dynasty”. In this era the main role of architecture was directed to the service of religion, which helped priests and rulers to achieve emphasis on the legality of their authority. This period was marked by the role of the temple’s sovereignty, which created a special social system represented by the presence of priests in the temple, conducting their direct supervision in all aspects of political, social and economic life [14].

One of the most important sovereign buildings of this era was the Oval Temple, located in the city of Khafragha, near the temple (Sun), and was built using materials and technology of sustainable quality, that made it durable. It was called the Oval Temple due to oval shape of the outer wall (Figure 1), and it was believed that this temple was for the worship of the mother goddess (In -Ana), as her name appeared on the head of a stone pin discovered there. Only the foundations of the temple’s podium and the walls of its oval fence had survived, and one could notice its distinctive architectural layout, being surrounded by an oval fence. The Oval Temple was built of flat convex adobe, which could be seen in floor plans of the rooms and fences. The whole building was built on top of pure-white-sand-filled hole, up to a depth of (8) m. The temple was built by a distinctive method, whereby a big hole (some 64000 cubic meters) was dug to get rid of clay and replace it with pure white-sand, prior to foundations setting [15]. This method became one of the distinctive techniques of constructing sacred buildings, separating them immediately from the surroundings. Among other techniques used in the construction of the oval temple was to install foundations or piles at the corners of the building, in the form of statues called the foundations statues. These have pointed, long and thin end implanted in Earth. Despite the effect of elements over the long period of time since it was built, the remains still exist (Figure 2).

![Figure 1. The Oval Temple in Khafagah (Perspective and Plan). [16]](image)
Through the analysis of the Early Dynastic Period and its architectural products, one finds out that the temples represented the prime sovereign buildings of that era, and that the controlling and the swaying power were represented by priests. Also, one notices that the prime materials used then were restricted to clay and its products of bricks and adobe, on top of the other available materials such as reed and tar, where they were the primary materials in the south of Iraq. Furthermore, the existent religious beliefs had had an important role in the choice of materials (such as clay and pure sand), in addition to their durability and immortality characteristics.

3.2. Sumerian Era (2300 BC-2003 BC)
The Third Dynasty of Ur is regarded as the most important during the Sumerian Era. The city, Ur, is thought to be the first religious and civilization centre for the Sumerian people. The design plan for the city is oval-shaped, not exceeding 96 miles at its major axis. It is surrounded by an external wall, as shown in (Figure 3). The main dominant part of the city is the religious complex. This could be thought of as the sovereignty centre, due to its location. It includes an inner surrounding wall and court, as well as three temples and the Ziggurat of Ur. The presence of a royal cemetery in the city, and the way it was built, suggested the aspiration of immortality. Accordingly, the present paper will shed light on the Ziggurat of Ur, together with the Ornamo cemetery, to explore the use of construction materials and technology that made them durable relics.
3.2.1. Ziggurat of Ur
The Ziggurat is regarded as the start for the emergence of this pattern of new construction method in the Mesopotamian civilization. This pattern was represented by ziggurats that rise above ground in stories, starting with three in Ur, and ending in nine in Babylon. The design was that of a solid-inside, and having a top on which the god descended on. Ziggurat of Ur was mentioned in the cuneiform writings as (E.LU GAL-GAGI-SI-SA), which literally means (the house of the king who holds justice) [19] (Figure 4). King Orniamo had built his Ur Ziggurat on the relics of ancient temples, that were thought to go back to the early dynastic period. He had made its internal structure out of adobe, then covered it from outside with a layer of baked bricks, on some of which was inscribed the name, King Orniamo. The thickness of this layer was about 2.4 m, and tar was used as a bonding material [15]. One of the techniques used in building the Ur Ziggurat was what was referred to as the ‘weeping eyes’. These were a group of holes scattered inside the external walls of the Ziggurat, organized in a special manner. The primary job of these holes was to let air through, to the inside of the Ziggurat body, so as to ensure their continual dryness, and the prevention of dampness within them. Moreover, they allow the rain-water that fall on the top of the Ziggurat, and absorbed by the Ziggurat body to be pulled out through these holes. The four walls had had the characteristic of bending outwards by 11cm for every 10m. That is to say that the line from the tip of the summit bended a little downwards, (Figure 5). It is likely that this technique was used to give straight walls, which suffer from a convex-shaped-illusion, an overall straight look [16].

The way the materials were used to construct and cover the Ur Ziggurat, as well as the drying methods for the mud inside it, and the drainage of the collected rain water, in addition to the techniques in building its walls, all had a great impact on the survival of the remains of the Ziggurat to the present.

3.2.2. Ur Royal Cemetery
One of the structural patterns that emerged in the third Ur dynasty was the royal tombs that were known as Shabaad or Orniamo. It was located in the south of the city of Ur and, created under the ground by using sustainable building methods and techniques that enabled the cemetery to survive despite the harsh environmental conditions.
The cemetery contained 16 earth tombs and more than 1800 ordinary ones, and it forms the largest part of the overall cemetery of the city of Ur, which is located to the east area of the city (Figure 6). The cemetery contained strange remains and unrivaled golden art treasures the construction of these graves was by using the bricks that held the writings of Kings (Shulky) and (Emerson), and the walls were of regular and strong ends, constructed with bitumen mortar that indicated the importance of the buildings. The rooms of the graves and stairs were constructed with pointed brick arches [22]. What distinguished the cemetery was that it witnessed the first attempts of the Iraqi architecture to use the techniques of the semi-circular shape in the roofing of Iraqi buildings in general and the tombs in particular.

**Figure 6. The Royal Cemetery of Ur, [16]**

In addition to what was used of materials and techniques that could be considered sustainable in the Sumerian Era in its sovereign buildings, the building was reinforced with small pottery nails that were stacked in the walls, and performed the support function, which contributed to the permanence of the buildings (Figure 7).

**Figure 7. The Pottery Cone Used to Reinforce the Walls, [22]**
Through the analysis and tracking of the Third Ur dynasty within the Sumerian era, it appeared that the temples were still the main sovereign buildings in this era with the emergence of the ziggurat as a new building pattern that rose in the skyline of the city, as well as the emergence of royal cemetery underground. The influential and controlling authority at that time was represented by the priests with the emergence of the ruler as a supportive but less effective power. The primary materials used in buildings were confined to clay and its products like brick, as well as other available materials like reeds and bitumen, with the use of pottery nails for consolidation and the semi-circular arch in the roofing. The growing importance of the temples, ziggurat, and royal cemetery had a role in the direction towards sustainable materials and technologies in order to attain the permanence and immortality of these buildings.

3.3. The New Assyrian Era (911 BC- 612 BC)

The Assyrian era appeared in Mesopotamia in alternating periods of the history of Mesopotamian civilization, but the peak of its power and its emergence was by the end of the (Keshi) occupation. Its main cities and capitals were in northern Iraq, which was characterized by the presence of stone as an important primary material. Through the study of the city of Assyria (Figure 8) and other Assyrian cities, such as Khorsabad, it could be concluded that there was a great interest in palace buildings alongside the temples and ziggurats, and the emergence of a new style represented by the palace of the crown prince at that time. Thus, power was divided between the priests and rulers.

In this section, the paper will shed light on a sovereign building in the Assyrian era represented by the complex of Sarjoun Palace in the city of Khorsabad, which contained the main palace, and a group of other palaces, together with temples and a ziggurat.

Figure 8. Plan of Assyrian city which showed various palaces [23]

3.3.1. Sargon Palace in the city of Khorsabad

This complex represented the pinnacle of the development of sovereign buildings in the Assyrian era due to its large size, multiplicity, and the importance of its buildings. The palace was built in the north of the city and included the main palace with approximately 200 rooms and 30 yards (Figure 9). In fact, it was a military center that stored in its room the many spoils that were obtained during the victorious military campaigns. Limestone, and alabaster were used to cover the huge walls and to make bases, crowns and some columns, as well as door sills. The stone was also used in paving the
halls in important buildings, while hard stones were used to carve statues and panels with prominent images [22]. The materials used in this complex as well as the techniques applied in its construction, had a great role in the permanence and continuity of the building, where the use of the stone in the construction and covering of buildings had a great impact.

![Figure 9. Plan and model of Sarjon palace complex in Khorsbad](image)

Through the analysis and tracking of the modern Assyrian era, it became clear that the palaces had replaced the temples as representatives of the sovereign buildings. This showed the growing authority of the ruler over the role of the priest. The latter had less influence, and accordingly less attention was given to temples, which became attached to palaces as evident in the palace of King Sargon. The availability of stone as a raw material in northern Iraq had a role in the immortality and permanence of the sovereign buildings.

3.4. The Modern Babylonian Era (626 BC - 539 BC)
The modern Babylonian era is the last era of Mesopotamian civilization, before the time of successive occupations and the fall of Babylon at its end. Its architecture represented the culmination of what the old Iraq architecture reached with the growing role of the ruling authority and the prosperity of architecture and city planning. This was evident in the city of Babylon (Figure 10), with its geometric planning and the great Procession Street (Mawkeb Street), around which the main buildings were distributed. Nebuchadnezzar Palace appeared as an influential sovereign architecture in the city, located to the north, besides the Ishtar Gate. In addition to the development of sustainable technologies and materials that were used in this palace, especially in the hanging gardens located on the northern side of it, there were also new treatments that appeared in this era. The most important innovations of the new Babylonians in dealing with building materials and their techniques was the apparent awareness of limestone. As a strong material, they used it like mortar to bind the brick pieces, which gained new advantages by adding the powder to them [25].

3.4.1. Nebuchadnezzar Southern Palace
The palace architecture including the materials used in it, the design prepared for it, as well as its location, show the importance of the palaces as sovereign buildings, that enhanced the glory of Babylon's Procession Street (Figure 11).

The sustainable technologies used in the hanging gardens show the evolution that took place during that era, where these gardens were chosen as one of the Seven Wonders of the World in a specific period.

Through analyzing and tracing the modern Babylonian era, it becomes clear that the palaces there had become the only architectural pattern that represented the sovereign buildings, while the temples were set aside. This indicated the absolute power of the ruler, Nebuchadnezzar, and his totalitarianism concerning the religious and worldly authority, as well as his intervention in the choice of materials.
and sites of buildings. The most important contribution of the Babylonians was the adoption of a technique that merged between two types of brick processing techniques, the first chosen from the ancient Babylonian heritage and the second from the Assyrians, so as to create a unique sculpting technique with glazing technology. The new method contributed in the prominence and the immortality of the materials used in the sovereign buildings (the palaces).

4. Conclusions

By revealing the main concepts of sovereignty, immortality, permanence and sustainability, and exploring them in examples elected from different eras of the Mesopotamian civilization, the following conclusions were drawn:

- The sovereign buildings of the Mesopotamian civilization varied between temples, ziggurats and palaces with the succession of the Mesopotamian eras. The architecture produced was evidently influenced by the ruling authority in the design and implementation of buildings, as well as the choice of the site, materials and techniques, to satisfy the ruler's desire in attaining immortal buildings with high permanence and continuity.

- The materials and techniques used in the sovereign buildings varied, depending on their presence on the site and their suitability for the purpose for which they were intended, as a structural material or for covering purposes. The main materials used were bricks, stone, and clay, as well as other materials. Innovative technologies emerged in different eras, which together led to the permanence and immortality of these buildings.

- The choice of sustainable materials and technologies in the sovereign buildings throughout the various eras, had a great role in the immortality and permanence of buildings despite their exposure to harsh environmental and climatic conditions throughout history, as well as the challenges resulting from the continuous wars and successive occupations of the Mesopotamian cities.

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**Figure 10.** Babylon city plan [26]

**Figure 11.** Nebuchadnezzar Palace and the hanging Garden in the City of Babylon. [27]
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