

Sewerage network of pipes in Light of Recent Archaeological Excavations

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قنوات الصرف الصحي في ضوء نتائج التنقيبات الأثرية الحديثة

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Introduction

Sewerage network of pipes represents one of the civilizational features of the Islamic city. Archaeological excavations at Islamic archaeological sites have revealed many of them, clearly demonstrating the community's concern for cleanliness and purity as a fundamental principle of our religion. Despite the importance of this architectural and service element, studies and research have not addressed it directly, often mentioning it only marginally within discussions of house and palace architecture. No dedicated study has been devoted to it despite its vital function. Due to the material and examples of sanitation channels we have gathered from recent excavations at Islamic archaeological sites, we felt it beneficial to write a research paper on the subject, hoping it will be a successful starting point for future studies undertaken by archaeologists and those interested in history and architectural infrastructure.

The research is divided into several sections: **The first section:** The Islamic perspective on cleanliness, which is a fundamental and primary position in Islam, mentioned in numerous verses of the Holy Quran and Prophet's quotes and traditions. To understand the origins of sewage systems, we dedicated a **second section** to discuss their historical roots, examining important pre-Islamic models from ancient Iraqi cities. **A third section** explored sewage systems in Islamic archaeological sites, including archaeological discoveries that confirmed the existence of such systems in the homes and streets of these ancient Islamic cities. This is followed by an introduction and a conclusion. We hope we have succeeded in this endeavor... and success comes from God.

Keywords: Excavations - Al-Hashimiyah - Maskan - Harbi - Al-Atishi – Basra

المخلص

أظهرت نتائج التنقيبات الأثرية أن أنظمة تصريف المياه في مدن العراق القديم كانت متقدمة من الناحية الهندسية، إذ يعود أقدم دليل أثري عليها إلى ما يقارب أربعة آلاف سنة قبل الميلاد، مما يعكس وعياً مبكراً بأهمية تنظيم الصرف الصحي والمحافظة على البيئة العمرانية.

بينت الأدلة الأثرية أن قنوات التصريف شُيّدت بمواد متنوعة، شملت الحجر والاجر والفخار، واختيرت هذه المواد بما ينسجم مع طبيعة الموقع والغرض الوظيفي للقناة، الأمر الذي أسهم في إطالة عمرها وكفاءة أدائها وكانت على نوعين الانابيب المغلقة، والانابيب المفتوحة أو المكشوفة التي تعمل عمل السواقي نفذت بمواد محلية منها الحجرية، والاجرية، والفخارية و بعدت طرق، منها التوصيل بالتعشيق والمركبة المتدرجة على بعضها البعض باختلاف مستويات ارتفاعها حتى تحقق الانسيابية المطلوبة لجريانها.

كشفت الدراسة عن تنوع أساليب تغطيتها بين التغطية المستوية والسنامية، وهو ما يدل على تطور الحلول الهندسية باختلاف الأزمنة والبيئات العمرانية.

أوضحت نتائج التنقيبات أن القنوات لم تقتصر وظيفتها على تصريف مياه الصرف الصحي، بل استُخدمت أيضاً لتصريف مياه الأمطار وتوصيل المياه النظيفة، مما يعكس وجود نظام متكامل لإدارة المياه داخل المدن القديمة والاسلامية .

أثبتت اللقى الأثرية أن تصميم القنوات اعتمد على الانحدار المدروس لضمان انسيابية جريان المياه ومنع ركودها، وهو ما يكشف معرفة دقيقة بالمبادئ الهندسية والهيدروليكية.

بينت الدراسة أن القنوات كانت ترتبط بأحواض أو مستودعات لتجميع المياه، وهو ما يشير إلى وجود تخطيط مسبق لشبكات التصريف داخل الأحياء السكنية والمنشآت العامة.

أظهرت نتائج المقارنة بين المواقع الأثرية وجود تشابه في أساليب تنفيذ شبكات التصريف بين مدن العراق القديم، مع اختلافات فرضتها طبيعة كل مدينة وظروفها الجغرافية والعمرانية.

كشفت التنقيبات في مدينة آشور عن وجود شبكتين منفصلتين؛ الأولى خصصت لتصريف مياه الأمطار والمياه النظيفة نحو نهر دجلة، والثانية لنقل المياه الآسنة إلى أحواض تجميع، وهو ما يعكس مستوى متقدماً من التنظيم في إدارة الموارد المائية.

أوضحت نتائج التنقيبات في مدينة مسكن استمرار استخدام المبادئ نفسها في تنفيذ شبكات التصريف، مع إدخال بعض التعديلات في أساليب البناء، بما يؤكد توارث الخبرات الهندسية واستمرارها عبر العصور

أثبتت الدراسة أن تنفيذ شبكات الصرف الصحي لم يكن عملاً عشوائياً، بل جاء ضمن تخطيط عمراني متكامل أخذ بنظر الاعتبار توزيع الشوارع والمنازل والمرافق العامة، بما يحقق سهولة تصريف المياه ويحافظ على سلامة المنشآت.

أظهرت النتائج أن شبكات التصريف أسهمت بصورة مباشرة في تحسين الظروف الصحية والحفاظ على البيئة داخل المدن القديمة واستمر إلى العصور الإسلامية، من خلال الحد من تجمع المياه والفضلات وتقليل آثارها السلبية على السكان.

بينت الدراسة أن العديد من المفردات المرتبطة بشبكات المياه والتصريف استمرت في الاستعمال عبر العصور، ومن ذلك ورود لفظة "بيب" في النصوص المسمارية الآشورية الحديثة بوصفها مرادفاً لكلمة "بايب" العربية، الأمر الذي يعكس جانباً من الاستمرار اللغوي والحضاري.

تؤكد نتائج البحث أن ما توصلت إليه التنقيبات الأثرية الحديثة يعيد تقييم مستوى التطور الحضاري في مدن العراق القديم، ويبرهن أن أنظمة الصرف الصحي كانت جزءاً أساسياً من التخطيط العمراني، وأسهمت في تحقيق بيئة حضرية أكثر استدامة واستقراراً.

الكلمات المفتاحية: التنقيبات - الهاشمية - مسكن - حربي - العطيشي - البصرة

The First Section: The Islamic religion's stance on cleanliness:

Islamic civilizations were built on Human and society development alongside the development of architecture and urban life. Among the pillars of this was attention to social and economic life; striving to achieve aspirations for stability and prosperity, and harnessing the human and natural resources of the nation; To serve that noble endeavor, cleanliness, and its related preliminaries and outcomes, had an important aspect of the priorities of building the Islamic society, based on the Holy Qur'an. In the Holy Qur'anic verse, we read: "In the name of God, the Most Gracious, the Most Merciful: O you who have believed, when you rise to [perform] prayer, wash your faces and your forearms to the elbows and wipe over your heads and wash your feet to the ankles¹". "In the name of God, the Most Gracious, the Most Merciful: O you who believe, do not approach prayer while you are intoxicated until you know what you are saying".²

As for the necessity of purity of clothing, there is no clearer or more eloquent command than that revealed to our noble Prophet Muhammad, peace and blessings be upon him, in the words of God Almighty: "In the name of God, the Most Gracious, the Most Merciful: O you enveloped in garments, Arise and warn,. And magnify your Lord, And purify your garments."

The Prophet's biography is replete with exhortations to cleanliness and attention to it through the noble Sunnah, in deed, hadith, and tacit approval, as mentioned in the noble Prophetic hadiths that deepen the values of cleanliness and purity brought by the Wise Reminder, including: "God is good and loves goodness, clean and loves cleanliness, generous and loves generosity, munificent and loves munificence, so clean your courtyards and do not imitate the Jews"³ and his saying: "Cleanliness is half of faith"⁴, and his saying: "Cleanse your teeth, for it is cleanliness, and cleanliness leads to faith, and faith is with its possessor in Paradise ".⁵

Second Section: Historical Roots

We glean from cuneiform texts that walls were equipped with openings or water waterways dug at their summits, then pierced through their structure to reach their base. These were used to drain moisture and rainwater so that they would not negatively affect the wall's structure, causing it to swell and expand, which would ultimately lead to its cracking and collapse. These openings and water channels were called "bibu"⁶ from the Middle Assyrian period onwards, a word similar in Arabic to "bib," meaning a water channel to a basin or gutter.⁷

Excavations at Iraqi archaeological sites have revealed an important aspect of the ancient Iraqis' concern for cleanliness and purity, namely.

This seems self-evident to researchers of Mesopotamian affairs, given the society's connection to the temple at that time and the associated religious rituals, which necessitated attention to individual cleanliness, both physical and spiritual. This was reflected in the city and its architectural details, including temples, houses, neighborhoods, and alleyways.

The problem of drainage from daily use, rainwater runoff, and sewage has preoccupied the minds of Iraqis since ancient times. Archaeological excavations in the fourth layer of Tell Hassuna⁸ revealed a man-made stone channel constructed by the inhabitants of those civilizations to dispose of accumulated water in their dwellings. This is considered the oldest stone-paved drainage channel in Iraq⁹. Large earthenware jars were also used as reservoirs for collecting wastewater¹⁰.

In the city of Ur, that important Sumerian capital, water drainage channels were discovered dating back to before 4000 BC. These were interlocking pottery pipes that extended horizontally to wider channels, from which liquids were to be drained into special reservoirs. They were designed in a distinctive engineering and artistic way to perform their function without any obstacles. They consisted of a group of pipes that were connected to each other by interlocking, forming a closed pottery pipe made up of several connected pipe pieces. The maximum length of each piece was (90) cm, and the diameter was (50) cm. They were connected to each other until the horizontal extension of the

pottery channel, after interlocking the pieces, reached approximately (40-60) meters. The Sumerians surrounded this drainage network on both sides with pottery shards to create pores capable of absorbing seepage from the canals without causing damage to the pavement of public streets, as well as temple courtyards and residential buildings¹¹. (Figure No .1)

During the excavations of the city of Ashur, conducted between 1999 and 2002, details of the drainage channels in the Assyrian residential quarters located south of the ziggurat at the site known as "al-Majannah¹²" were revealed. These channels were constructed of brick and covered with a layer of brick as well, extending beneath the floors of alleys and streets. They branched out to reach the storage reservoir. It is worth noting that these discovered channels were of two types: one for draining rainwater, as well as clean water, which flowed directly to the Tigris River near the city, and the other section of the channels for wastewater to reservoirs prepared for this purpose.¹³ (Figure No . 2).

The cities of Iraq continued throughout their successive civilizations continued to render this aspect considerable attention. The living evidence revealed by the excavations is proof of this. Islamic architecture inherited and developed this technique in the Islamic cities it established, given that Islam is a religion of cleanliness and purification, and faith has been linked to cleanliness on more than one occasion.

In the city of Maskin¹⁴, which dates back to the Parthian era¹⁵, located in the Al-Dujail district of Salah al-Din Governorate, 65 km north of Baghdad and about 1.5 km Southwest of the district center, the site covers an area of 175 dunams. Its archaeological significance was announced in the Official Gazette, Al-Waqai' al-Iraqiya, issue number 2053, dated October 10, 1942.¹⁶

A drainage of wastewater canal was unearthed, at the first point, located near the public street in square 1.10; Dimensions of (10m x 10m) at a depth of (75cm) of the first layer, it extends horizontally and branches into two: one heading east and the other west. The first branch is covered with a layer of triangular brick halves laid successively and level, and with a relatively thick layer of plaster as a binding material. In the horizontally extended section, (2.50m) of it extends from north to south¹⁷, then it turns at an obtuse angle greater than (90°) to achieve easier flow as it turns southward, since the obtuse angle is wider, which achieves a faster flow rate. At the bend, the channel is covered with brick halves divided into two right-angled triangles laid successively to cover the exposed canal opening, alternately place them at the obtuse angle of the canal's extension without leaving any exposed gaps.

While the bricks were laid vertically and floppingly on both sides of the canal along its straight course to achieve complete coverage, with the right brick resting on the left brick and meeting at the top to form a pyramid shape. The

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binding material between them was clay, in small proportions in this particular part. The variation in the shape of the canal covering in this part after the bend takes two forms, sometimes flat and sometimes pyramidal. This is attributed to the fact that this part of the canal is the visible part, while the flat part in terms of covering, its course extended under the floor tiles of the first layer, and ended to flow into a circular storage tank with a diameter of (75) cm, and at a level deeper than the floor level ¹⁸.(Figure No .3)

The different pattern of covering the channel in this section facilitates continuous maintenance in case of any blockage when it accumulates in its final channel before the outlet in the warehouse. It also protects it from being affected by external factors, taking advantage of the ease of lifting the bricks laid in a pyramid shape as a result of some of them leaning on each other, for maintenance purposes when necessary. In contrast, in terms of purpose, in the first section, which ran under the floor tiles of the building, the triangular brick halves were laid in a level, compact, and interconnected manner, and in an opposite order of paving

The binding material was plaster, with a relatively thick thickness, in order to seal the pores, as well as prevent seepage and the resulting continuous moisture inside the approaches of the channel, while maintaining a level position and tight covering, since it forms part of the floor of the building, and avoiding an obstacle for the residents of the house during their normal daily movement, in addition to environmental factors, such as reducing the emission of unpleasant odors from it. Not to mention its unsightly appearance.

The storage area was exposed and lower than ground level. The expedition was unable to explore it during its first season, as it was more than a meter deep and may extend to older layers, which were outside the expedition's excavation plan for its first season in 2008. Therefore, the excavation results did not reveal the depth at this point. This discrepancy in depth is explained by the need to achieve the required flow of waste, allowing for hygienic and safe storage, as well as maintaining the environmental balance by disposing of waste away from the dwelling and reducing the resulting odors. The expedition's final report indicated the total length of the channel, estimated at 13 meters, with a width of 40 centimeters. The dimensions of the used mat were 25 x 25 x 7 centimeters, and the diameter of the storage area was 75 centimeters. (Figure No .4)

By comparing the results of excavations conducted to determine the historical period of the layer, the mission concluded that it dates back to the Parthian period (137 BC - 226 AD). This conclusion was drawn from excavations at Tal Aswad between 1970 and 1976 AD, the results of which were published in the book "7 Years at Tal Aswad" ¹⁹.(Plate No 1)

Fragments of pottery channels with an open irrigation system, lined with bitumen, were also uncovered (Figure No. 5).

At the second point, located in the center of the site, the remains of a latrine were revealed in square J.K.5. It was constructed from a single piece of pottery in the form of an open circular basin with a diameter of approximately 40 cm. From this basin, a closed pottery pipe connected directly to it for waste disposal began. This pipe was distinguished by its wide circular opening, which gradually narrowed to form a closed pipe. It is highly probable that it was connected to other pipes by interlocking them. The storage area where waste was disposed of; however, the damage caused by the pressure of the upper layers on this structural layer and its proximity to the surface prevented the mission from tracing the path of this channel; it is likely that this model of latrines and their associated channels is a common system in the houses of this layer at the Maskan site.²⁰

At point four G.9 on the contour map of the Tal Maskan site, which is one of the four most important points selected by the mission as excavation points for its first season in 2008; The excavations there revealed a fence wall considered one of the most complete ancient city walls discovered in recent excavations. It encircles the city in a semi-circular shape, punctuated by several relatively wide, penetrating gates that appeared as openings piercing the wall's structure. It was reinforced by identical, solid, semi-cylindrical towers, as the expedition reported in its final report²¹. The exploration of the wall's structure, between the first tower and the second tower (17.5 m), revealed the tower in its entirety, from base to top, showing a similarity to the first tower in both layout and construction. The wall's surface, which was flat and approximately 1.5 m wide, was designed for the guards to walk upon, monitoring for anyone who might attempt to raid the city and endanger it, thus detecting them before they approached the wall. (plan No. 1).

Therefore, the wall's surface was equipped with a rainwater drainage system. So that it would not accumulate on the surface and cause damage to its architectural structure when it flowed through the body of the wall; given that it was built entirely of square bricks measuring (40×40×8) cm, and this conclusion was reached when several parts of open pottery gutters were found between the sides of the wall²², indicating that they were used to drain seasonal rainwater when it collected on the surface of the wall.

The gutters were made of thick pottery (5) cm, and they were not in one piece; rather, parts of them were found scattered in distant places at the edge of the wall. One of them was a piece representing the middle part of the gutter, and it was open at the top. As for the part that was intended for the flow of rainwater from the back of the wall, it was perforated with two circular holes, each with a diameter of (2) cm, penetrating the flat, open body of the gutter. Each hole was made on one side; in order to fix it to the floor of the surface of the wall,

perhaps fixed with pottery nails or of some metal. However, the results of the excavations did not indicate this. In addition to the possibility of it being swept away by heavy rains.

The channel is bordered on both sides by a relatively thick rim, rising by 4 cm, forming a barrier to prevent water from flowing from either side. There is also a section of the end of the gutter, which was also open at the top, forming an exposed, semi-tubular, boat-shaped earthenware gutter ending in an arched spout. The spout slopes slightly at its edge to facilitate the flow of water before it collects on the wall's surface, thus fulfilling its function. The combined length of the sections before they were scattered into several pieces was estimated at 50 cm. Therefore, it's believed that they were fixed at the middle of the wall's surface to direct rainwater away from it before it accumulated. (Figure No . 7-8-9)

The Third Section: Sewage systems in Islamic archaeological sites in light of modern archaeological excavations.

When the Muslim Arab resolved to conquer North Africa and establish an Islamic capital in Egypt on the ruins of the Byzantine state, and this was accomplished in the year (21 AH/641 AD). The modern archaeological excavations of the city of Fustat revealed a city plan similar to the cities of Basra and Kufa, with tribal plans in which the mosque was the main axis. The city was interspersed with narrow roads branching off from each other in winding paths, the most prominent features of which were irregularity and randomness, as they did not adhere to an engineering system. Moreover, its civil buildings, in their various styles, the method of their construction did not receive due attention, unlike military architecture. However, they were subject to care, organization, and sewage systems. Not to mention the distribution channel for potable water, which was made up of interlocking earthenware pipes.²³

From the city of Harbi, which is considered one of the Islamic sites declared in the Official Gazette, Al-Waqai' Al-Iraqiya, issue number 1872, dated February 3, 1941²⁴, located 90 km north of Baghdad, 30 km South of Samarra, and 5 km West of Balad²⁵. Archaeological excavations within the city's houses revealed three systems for draining wastewater from daily use, as well as for disposing of heavy waste. The excavations uncovered channels constructed of brick beneath the floors of bathrooms and latrine. Specifically, in the second excavation area, house number 1, and in the third excavation area, houses number 5 and 9.²⁶

These channels were also covered with brick to prevent waste and dirt from falling into them, which would lead to blockages and the resulting environmental damage. Under the floor of the layer, some houses also had another type of channel, which is an open channel in the form of a half-open pipe made of pottery, and they are of different lengths, one pouring into the

other, until they reach a storage facility for the water collected in the open courtyard, which is located outside the house, in addition to the use of pottery pipes in which the diameter of the opening of the first is less than the other, and they are connected in it by interlocking; so the pipe is inserted into the other to become a single continuous channel, transporting wastewater and refuse to its designated place. The architect used this system in the two houses marked (6-7), Excavation Zone 3. (figure-2-3)

As for the third system, the architect used a system of open earthenware water channels of varying lengths, installed in a stepped fashion, one on top of the other, thus ensuring a smooth flow of water to transport the refuse to its designated place. This system was found in House No. (2), Excavation Zone 8.²⁷

Among the recent excavations at **Tal al-Atishi**, which is considered an Islamic site, its archaeological significance was announced in the Official Gazette, Al-Waqai' al-Iraqiya, Issue No. 2120, dated (11/10/1943).²⁸ It is located Northeast of the city of Karbala, at a distance of (11) km from the Al-Husayniya district in (District 34/Abu Zart/Plot 11). It is considered an Islamic site as the site forms the western edge of the Al-Husayniya district.²⁹

The excavations of the first season, excavation point No. (2) in square (L10), at a depth close to the soil surface estimated at (20) cm, revealed two drainage channels. The first was two courses high of bricks with dimensions of (30×30×10) cm, widening as it descended and flowed smoothly towards the East where the open courtyard of the site was located, with an extension of (4.6) m, and a width of (15) cm, emptying into a basin that was covered with gypsum mortar from the outside to prevent seepage and the resulting environmental damage. What remained of it was a semi-circular base to meet another channel in the open courtyard of the building, whose floor was covered with gypsum. These two channels achieved smooth flow through the slope, in addition to the difference in the dimensions of the height levels of one of them from the other, which was (90) cm, with the difference in the dimensions of the bricks in the second channel, as it was (27×27×10) cm, which indicates that the courtyard and the two channels were used in successive periods of time. As for the reasons for the slope, it is to create a smooth flow because the ground on which it was built is level. (figure No.10)

From Hashimiyah al-Anbar, which is located (5) km Northwest of the city of Fallujah, near the eastern bank of the Euphrates River³⁰, where the survey work determined that it is within (Plot 8, District 18, Azraqiyah), and it occupies an area of land with a circumference of (6) km, and in fact it represents several archaeological mounds that were surrounded by a mud-brick wall.³¹

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The highest point in the archaeological Hashimiyah al-Anbar was revealed according to the contour map of the site, which was a height of (13) m; The excavations in this neighborhood included squares (J9 K9. .H10) within the established site map, which resulted in two building layers dating back to the Abbasid era. The discovered residential house plans exceeded six houses, in which the sewage system invented by the inhabitants of the Tigris and Euphrates Valley was followed. The excavations revealed one of these systems, which was a system of closed pipes consisting of several parts interlocked with each other, which extended under the floors of the residential houses, which in turn led to reservoirs that were located at the middle of the open courtyard of each of the six discovered houses.

Each reservoir had a visible hole in one of its bricks to drain the water that collected in the open courtyard, which floor was paved with bricks in all the floors of the six residential houses.³² Islamic jurisprudence considers foul odors a harm that necessitates the removal of their source. Scholars have ordered the covering of sewage pipes and similar structures to prevent the emission of odors from harming the inhabitants of the house, as well as those in neighboring properties.³³

Among the recent, unpublished excavations from the ancient city of Basra³⁴, specifically in District 52, Al-Shuaiba Al-Sharqiya, Basra Governorate, southern Iraq, conducted in 2023, in square (Q.39.2) of chamber (number 150), which measured (2.50 x 2.50) meters, and had a floor of compacted earth at a level of (4.35) meters.(figure No.11).

Another brick-paved floor measuring (5×18×18) m was also uncovered on the Northern side, of which (3.70×2.90 m) remains, while, the other parts had been removed.³⁵

On the same side of the floor, a water channel extending northward was uncovered, constructed of bricks with dimensions of (13×13×3) cm. (1.70) m remains of its length, with a width of (20) cm, is (8) cm above the floor of the chamber on which the channel extended was at a level of (4.80) m above the surface of the hill.³⁶ (figure No.12)

A water channel located on the Southern side of the square was also uncovered, extending southward. It was constructed of rammed earth, with (180) cm remaining of its length, and a height of (16) cm. It is at a level of (4.70) m.³⁷

To the east of it is another channel extending eastward. The remaining dimensions of this channel 2.90×14 cm, constructed of bricks measuring (10×28×6) cm, clay was used as a binding material. The remaining height is (20) cm, and it is at a level of (67) m.³⁸

Conclusions

Archaeological excavations have revealed that the drainage systems in ancient Iraqi cities were highly sophisticated in terms of engineering. The earliest archaeological evidence dates back to approximately 4000 BC, reflecting an early awareness of the importance of water management and preserving the urban environment.

Archaeological evidence showed that drainage channels were constructed using a variety of materials, including stone, brick, and pottery. These materials were chosen to suit the site's characteristics and the channel's function, contributing to their longevity and efficiency. The channels were of two types: closed pipes and open or exposed pipes, which functioned as irrigation ditches. These open pipes were constructed using local materials such as stone, brick, and pottery, employing various methods, including interlocking connections and stepped systems with varying heights to achieve the required flow. The study also revealed a variety of covering methods, ranging from flat to ridged, demonstrating the evolution of engineering solutions across different eras and urban environments.

The excavations revealed that the canals were not only used for sewage drainage, but also for rainwater and clean water, reflecting an integrated water management system within ancient cities. Archaeological finds demonstrated that the canals' design relied on carefully planned slopes to ensure smooth water flow and prevent stagnation, revealing a precise understanding of engineering and hydraulic principles.

The study showed that the canals were connected to basins or reservoirs for water collection, indicating pre-planned drainage networks within residential areas and public facilities. Comparative analysis of archaeological sites revealed similarities in the methods used to implement drainage networks in ancient Iraqi cities, with variations dictated by each city's nature and its geographical and urban conditions.

Excavations in the city of Ashur uncovered two separate networks; The first channel was dedicated to draining rainwater and clean water into the Tigris River, while the second was for transferring wastewater to collection basins. This reflects a high level of organization in water resource management. While excavations in the city of Maskan revealed the continued use of the same principles in implementing drainage networks, with some modifications in construction methods. This confirms the inheritance and continuity of engineering expertise across the ages.

The study further demonstrated that the implementation of sewage networks was not haphazard, but rather part of a comprehensive urban plan that considered the distribution of streets, houses, and public facilities to ensure easy drainage and maintain the integrity of structures. The results showed that

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drainage networks directly contributed to improving health conditions and preserving the environment within ancient cities, a practice that continued into the Islamic era, by reducing the accumulation of water and waste and mitigating their negative impacts on the population.

The study revealed that many terms related to water and drainage networks continued to be used throughout history. For example, the word "bib" appears in Neo-Assyrian cuneiform texts as a synonym for the Arabic word "bayb," reflecting a degree of linguistic and cultural continuity.

The research findings confirm that recent archaeological excavations reassess the level of urban development in ancient Iraqi cities, demonstrating that drainage systems were an essential part of urban planning and contributed to a more sustainable and stable urban environment.



figure No. 1



figure No. 2



figure No. 3



figure No. 4



figure No. 5



figure No. 6

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figure No. 7



figure No. 8



figure No. 9



figure No. 10



Figure No. 11



Figure No. 12

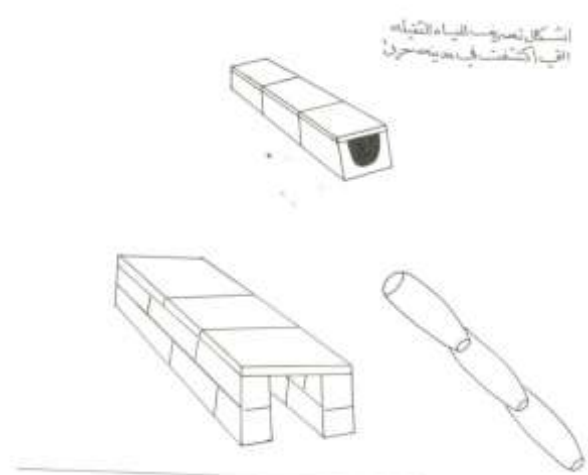


Figure no. 2

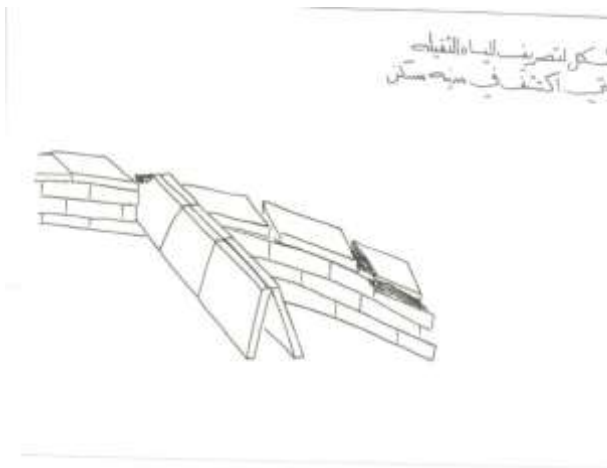


Figure no. 1

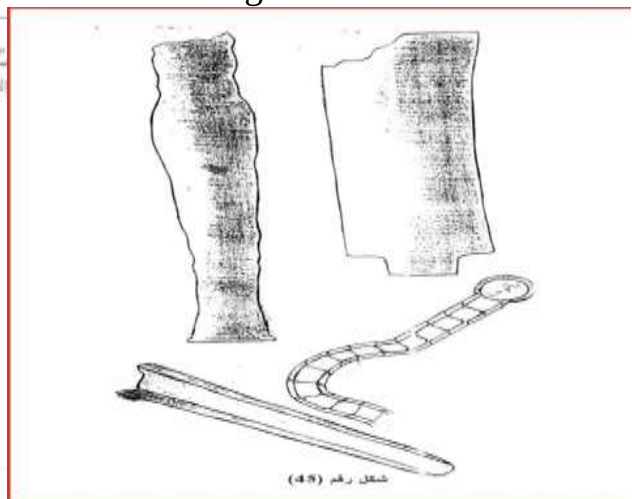
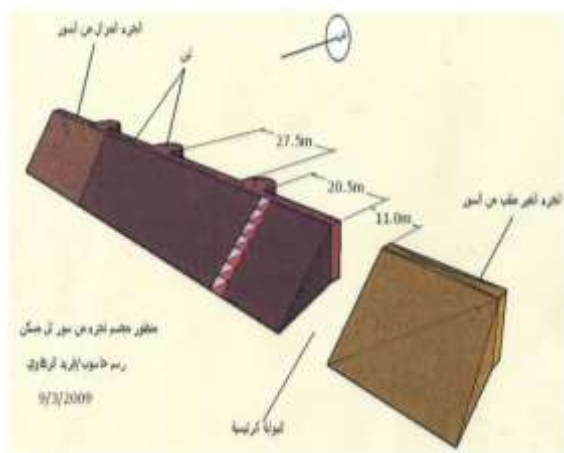


Figure no. 3



plan No. 1

References

1. Al-Azami Muhammad Taha, Defensive Walls and Fortifications in Ancient Iraqi Architecture, PhD thesis submitted to the Council of the College of Arts - Department of Archeology - University of Baghdad, 1992, p. 157.
2. Al-Nawawi, Abu Zakariya Muhyi al-Din ibn Sharaf al-Nawawi (d. 676 AH), Al-Majmu', Dar al-Fikr for Printing, Publishing and Distribution, Beirut, n.d., vol. 1, p. 315.
3. Al-Tabarani, Abu al-Qasim Sulayman ibn Ahmad (d. 360 AH), Al-Mu'jam al-Awsat, edited by the Research Department of Dar al-Haramayn, Dar al-Haramayn for Printing, Publishing and Distribution, Riyadh, (1415 AH/1995 CE), vol. 7, p. 215.
4. Al-Tirmidhi, Abu Isa Muhammad ibn Isa (d. 279 AH), Sunan al-Tirmidhi al-Jami' al-Sahih, edited and corrected by Abd al-Rahman Muhammad Uthman, 2nd edition, Dar al-Fikr for Printing, Publishing and Distribution, Beirut, (1403 AH/1983 CE), vol. 4, p. 198.
5. Ibn Manzur, Abu al-Fadl Jamal al-Din Muhammad ibn Makram, Lisan al-Arab, bib article, Beirut, 1954-1956, p. Ibn Sayyidah, Abu al-Hasan Ali ibn Ismail al-Andalusi, al-Mukhass, undated, folder 1-5, Beirut; Ahmed, Reda, Dictionary of the Language Text, Beirut, 1958, p. 363.
6. Safar, Fuad, Excavations of the Directorate of Antiquities at Tell Hassuna, Sumer Journal, Vol. 1, No. 1, p. 15.
7. Surah Al-Ma'idah Ayah 6.
8. Surah An-Nisa, Ayah 43
9. Tal Hassuna is located in the Al-Shura district of Nineveh Governorate, (32 km) south of Mosul. It was excavated by the Iraqi Directorate of Antiquities in the years 1943-1944. The Tal is small in area, its area is estimated at (200×150 m), and the highest point is raised above the adjacent plain by approximately (7) meters. For further information, see: Baqir, Taha, Introduction to the History of Ancient Civilizations, "A Concise History of the Civilization of Mesopotamia," Dar al-Shu'un al-Thaqafiya, Ministry of Culture and Information, Baghdad, 2nd ed., 1976, p. 210; Saggs, Harry, The Power of Assyria,
10. translated by Amer Suleiman, Scientific Academy Press, Baghdad, 1999, pp. 28-29.
11. Suleiman, Muwaffaq Jirjis, Architecture of the Ancient Iraqi House in Prehistoric Times, unpublished Master's thesis, University of Baghdad, College of Arts - Department of Archaeology, 1976, pp. 156-157.
12. Elizabeth Stone; Paul Zimanski "Survey and Excavation of the Rocky Tell Settlement near Ur from the First Sea Dynasty (1721-1430 BC)", translated by Dr. Abdul Amir Al-Hamdani, Sumer Magazine, Issue 67, 2021 AD, Iraq - Baghdad, p. 31.
13. It is a raised area of land located south of the Ziggurat of Ashur. Locally, it was called al-Majannah because it was used as a cemetery by the surrounding inhabitants. Al-Majannah, with a fatha on the mim and jim and a shadda on the nun, means cemetery. This term is used locally in western Iraq, the Levant, Yemen, Algeria, and Libya for a cemetery in general, or specifically for children's graves. Egyptians use synonyms for it, such as Jabbanaha, city, and others. (Arabic Language Academy, Al-Mu'jam al-Wasit, Madbouli Library, 4th ed., 2004 CE/1425 AH, p. 49).
14. Al-Douri, Riyad; Rashid, Qais Hussein; Hamza Hussein Ali, "Iraqi Archaeological Excavations in the City of Ashur, 1999-2000," Sumer Journal, Vol. 56, 2011, pp. 111-121

15. The word "maskan" is Akkadian and means dwelling or settlement, and it corresponds to the meaning in Arabic. (Hassan al-Najafi, Dictionary of Terms and Figures in Ancient Iraq, Dar Wasit, n.d., p. 133).
16. Archaeological Sites in Iraq, General Directorate of Antiquities, Baghdad, 1970 AD, p. 75.
17. Ali, Hussein Obeid, Annual Report, First Season of the Excavation Mission at Tell Maskin in 2008, Ministry of State for Tourism and Antiquities, General Authority for Antiquities and Heritage, Department of Investigations and Excavations, 2009, p. 1.
18. Ali, Annual Report P 9-10.
19. Ali, Annual Report, P.10.
20. AL Fityan, Ahmed Malik; Abdullah, Zuhair Rajab, 7 years old in Tal Aswad, Baghdad, 1979, FG.3 pL.54, p217
21. Ali, Hussein Ubaid, First Season of Tal Maskan mission, 2008, p 3.
22. Ali, Hussein Ubaid, First Season of Tal Maskan mission, 2008, p 3.
23. Ali, First Season of Tal Maskan mission, 2008, p 3.
24. Ali al-Bir Jibril, Excavations of Fustat, p. 2; Shafi'i, Farid, Arab Architecture in Egypt, p. 316
25. Archaeological Sites in Iraq, General Directorate of Antiquities, Al-Jumhuriya Press, Baghdad, 1970, p. 76.
26. For more information, see: Al-Tamimi, Najat Ali Mohammad, Residential houses discovered in the city of Harbi in light of modern archaeological excavations 1999-2002 AD, p. 13.
27. Ali, Hussein Obeid, Results of the Excavations of the City of Harbi - Fourth Season 2002 AD Unpublished 9-H/T Scientific Documentation Department at the General Authority for Antiquities and Heritage, Baghdad, 2002 AD, p. 16.
28. Ali, Results of the Excavations of the City of Harbi - Fourth Season 2002 AD Unpublished 9-H/T Scientific Documentation Department at the General Authority for Antiquities and Heritage, Baghdad, 2002 AD, p. 16.
29. Archaeological Sites in Iraq..., p. 181.
30. Elewi, Mustafa Qais, Master's Thesis submitted to the Council of the College of Archaeology – Al-Qadisiyah University, Al-Qadisiyah, 2025, p.
31. General Survey Directorate, CAD STROW Map of the Daylam District, District 18, Azraqiyah, Baghdad, 1945.
32. AL Rawi, Nazir Abdullah Ali, "Investigation and Excavation in the Archaeological Hashimiyah of Anbar for the Four Seasons," Unpublished Report, General Authority for Antiquities and Heritage – Scientific Documentation Department, Baghdad 2002, pp. 11-12.
33. Al-Banna, Ibn al-Rami Abu Abdullah Muhammad Abd al-Rahman ibn Ibrahim al-Lakhmi (d. 735 AH), Al-I'lan bi-Ahkam al-Bunyan, edited by Abd al-Rahman ibn Manih al-Atram, Riyadh, 1995, p. 211; Rashid, Qais Hussein, Al-Hashimiyya, the forgotten capital of the Abbasids, pp. 152-154, Dar al-Jawahir for Publishing and Distribution, Baghdad, 2016, p. 18.
34. Issa, Jabbar Ubaid, Final Report of Excavation Mission 52, East Shuaiba, General Authority for Antiquities and Heritage, Department of Investigations and Excavations, 1444 AH/2023 AD.
35. Rashid, Qais Hussein, Al-Hashimiyah: The Forgotten Abbasid Capital, pp. 152-154, Dar Al-Jawahir for Publishing and Distribution, Baghdad, 2016, p. 18.

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36. The Tal al-Shuaiba, Al-Waqai' al-Iraqiya Gazette, No. 955, dated May 23, 1964. Archaeological Sites in Iraq..., p. 46.

¹ . Surah Al-Ma'idah Ayah 6.

² Surah An-Nisa, Ayah 43.

³ . Al-Tirmidhi, Abu Isa Muhammad ibn Isa (d. 279 AH), Sunan al-Tirmidhi al-Jami' al-Sahih, edited and corrected by Abd al-Rahman Muhammad Uthman, 2nd edition, Dar al-Fikr for Printing, Publishing and Distribution, Beirut, (1403 AH/1983 CE), vol. 4, p. 198.

⁴ . Al-Nawawi, Abu Zakariya Muhyi al-Din ibn Sharaf al-Nawawi (d. 676 AH), Al-Majmu', Dar al-Fikr for Printing, Publishing and Distribution, Beirut, n.d., vol. 1, p. 315.

⁵ . Al-Tabarani, Abu al-Qasim Sulayman ibn Ahmad (d. 360 AH), Al-Mu'jam al-Awsat, edited by the Research Department of Dar al-Haramayn, Dar al-Haramayn for Printing, Publishing and Distribution, Riyadh, (1415 AH/1995 CE), vol. 7, p. 215.

⁶ . Al-Azami Muhammad Taha, Defensive Walls and Fortifications in Ancient Iraqi Architecture, PhD thesis submitted to the Council of the College of Arts - Department of Archeology - University of Baghdad, 1992, p. 157.

⁷ . Ibn Manzur, Abu al-Fadl Jamal al-Din Muhammad ibn Makram, Lisan al-Arab, bib article, Beirut, 1954-1956, p. Ibn Sayyidah, Abu al-Hasan Ali ibn Ismail al-Andalusi, al-Mukhass, undated, folder 1-5, Beirut; Ahmed, Reda, Dictionary of the Language Text, Beirut, 1958, p. 363.

⁸ . Tal Hassuna is located in the Al-Shura district of Nineveh Governorate, (32 km) south of Mosul. It was excavated by the Iraqi Directorate of Antiquities in the years 1943-1944. The Tal is small in area, its area is estimated at (200×150 m), and the highest point is raised above the adjacent plain by approximately (7) meters. For further information, see: Baqir, Taha, Introduction to the History of Ancient Civilizations, "A Concise History of the Civilization of Mesopotamia," Dar al-Shu'un al-Thaqafiya, Ministry of Culture and Information, Baghdad, 2nd ed., 1976, p. 210; Saggs, Harry, The Power of Assyria, translated by Amer Suleiman, Scientific Academy Press, Baghdad, 1999, pp. 28-29.

⁹ . Safar, Fuad, Excavations of the Directorate of Antiquities at Tell Hassuna, Sumer Journal, Vol. 1, No. 1, p. 15.

¹⁰ . Suleiman, Muwaffaq Jirjis, Architecture of the Ancient Iraqi House in Prehistoric Times, unpublished Master's thesis, University of Baghdad, College of Arts - Department of Archaeology, 1976, pp. 156-157.

¹¹ . Elizabeth Stone; Paul Zimanski "Survey and Excavation of the Rocky Tell Settlement near Ur from the First Sea Dynasty (1721-1430 BC)", translated by Dr. Abdul Amir Al-Hamdani, Sumer Magazine, Issue 67, 2021 AD, Iraq - Baghdad, p. 31.

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- ¹³ . Al-Douri, Riyad; Rashid, Qais Hussein; Hamza Hussein Ali, "Iraqi Archaeological Excavations in the City of Ashur, 1999-2000," Sumer Journal, Vol. 56, 2011, pp. 111-121
- ¹⁴ . The word "maskan" is Akkadian and means dwelling or settlement, and it corresponds to the meaning in Arabic. (Hassan al-Najafi, Dictionary of Terms and Figures in Ancient Iraq, Dar Wasit, n.d., p. 133).
- ¹⁵ . Archaeological Sites in Iraq, General Directorate of Antiquities, Baghdad, 1970 AD, p. 75.
- ¹⁶ . Ali, Hussein Obeid, Annual Report, First Season of the Excavation Mission at Tell Maskin in 2008, Ministry of State for Tourism and Antiquities, General Authority for Antiquities and Heritage, Department of Investigations and Excavations, 2009, p. 1.
- ¹⁷ . Ali , Annual Report P 9-10.
- ¹⁸ . Ali, Annual Report , P.10.
- ¹⁹ . AL Fityan, Ahmed Malik; Abdullah, Zuhair Rajab, 7 years old in Tal Aswad, Baghdad, 1979, FG.3 pL.54, p217
- ²⁰ . Ali, Hussein Ubaid, First Season of Tal Maskan mission , 2008 , p 3.
- ²¹ . Ali, Hussein Ubaid, First Season of Tal Maskan mission , 2008 , p 3.
- ²² . Ali, First Season of Tal Maskan mission , 2008 , p 3.
- ²³ . Ali al-Bir Jibril, Excavations of Fustat, p. 2; Shafi'i, Farid, Arab Architecture in Egypt, p. 316
- ²⁴ . Archaeological Sites in Iraq, General Directorate of Antiquities, Al-Jumhuriya Press, Baghdad, 1970, p. 76.
- ²⁵ . For more information, see: Al-Tamimi, Najat Ali Mohammad, Residential houses discovered in the city of Harbi in light of modern archaeological excavations 1999-2002 AD, p. 13.
- ²⁶ . Ali, Hussein Obeid, Results of the Excavations of the City of Harbi - Fourth Season 2002 AD Unpublished 9-H/T Scientific Documentation Department at the General Authority for Antiquities and Heritage, Baghdad, 2002 AD, p. 16.
- ²⁷ . Ali, Results of the Excavations of the City of Harbi - Fourth Season 2002 AD Unpublished 9-H/T Scientific Documentation Department at the General Authority for Antiquities and Heritage, Baghdad, 2002 AD, p. 16.
- ²⁸ . Archaeological Sites in Iraq..., p. 181.
- ²⁹ . Elewi, Mustafa Qais, Master's Thesis submitted to the Council of the College of Archaeology – Al-Qadisiyah University, Al-Qadisiyah, 2025, p.
- ³⁰ . General Survey Directorate, CAD STROW Map of the Daylam District, District 18, Azraqiyah, Baghdad, 1945.
- ³¹ . Rashid, Qais Hussein, Al-Hashimiyah: The Forgotten Abbasid Capital, pp. 152-154, Dar Al-Jawahir for Publishing and Distribution, Baghdad, 2016, p. 18.
- ³² . AL Rawi, Nazir Abdullah Ali, "Investigation and Excavation in the Archaeological Hashimiyah of Anbar for the Four Seasons," Unpublished Report, General Authority for Antiquities and Heritage – Scientific Documentation Department, Baghdad 2002, pp. 11-12.
- ³³ . Al-Banna, Ibn al-Rami Abu Abdullah Muhammad Abd al-Rahman ibn Ibrahim al-Lakhmi (d. 735 AH), Al-I'lan bi-Ahkam al-Bunyan, edited by Abd al-Rahman ibn Manih al-Atram, Riyadh, 1995, p. 211; Rashid, Qais Hussein, Al-Hashimiyah, the forgotten capital of the Abbasids, pp. 152-154, Dar al-Jawahir for Publishing and Distribution, Baghdad, 2016, p. 18.

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³⁴ . The Tal al-Shuaiba, Al-Waqai' al-Iraqiya Gazette, No. 955, dated May 23, 1964. Archaeological Sites in Iraq..., p. 46.

³⁵ . Issa, Jabbar Ubaid, Final Report of Excavation Mission 52, East Shuaiba, General Authority for Antiquities and Heritage, Department of Investigations and Excavations, 1444 AH/2023 AD.

³⁶ . Ibid .

³⁷ . Ibid .

³⁸ . Ibid.