Building Assyrian society: the case of the Tell Sabi Abyad Dunnu
Lanjouw, T.J.R.

Building Assyrian Society:

The Case of the Tell Sabi Abyad *Dunnu*

Tijm Lanjouw

Building Assyrian Society: The Case of the Tell Sabi Abyad Dunnu

Proefschrift

ter verkrijging van

de graad van doctor aan de Universiteit Leiden,

op gezag van rector magnificus prof.dr.ir. H. Bijl,

volgens besluit van het college voor promoties

te verdedigen op dinsdag 9 december 2025

klokke 10 uur

door

Tijmen Jan Robin Lanjouw

geboren te Groningen

in 1982

Supervisor: Prof. dr. Bleda S. Düring
Additional Supervisor Prof. dr. Peter M.M.G. Akkermans

Doctorate Committee: Prof. dr. Jan C.A. Kolen (chair)
Prof. dr. Joanita A.C. Vroom (secretary)
Prof. dr. M. Pascal Butterlin (Université Paris 1 Panthéon-Sorbonne)
Dr. Ing. Moritz Kinzel (German Archaeological Institute Istanbul)
Dr. Jennifer L. Swerida

This PhD research was conducted within the framework of the ERC-funded project 'Consolidating Empire. Reconstructing Hegemonic Practices of the Middle Assyrian Empire at the Late Bronze Age Fortified Estate of Tell Sabi Abyad, Syria, ca. 1230 – 1180 BC', directed by prof. dr. B.S. Düring.

To my father

Acknowledgements

There are several people without whom the realisation of this dissertation would not have been possible. First and foremost, I wish to thank my supervisor, Bleda Düring. Your patience, guidance, and gentle but persistent encouragement, especially in the many years after my PhD position had formally ended, have been invaluable. I am deeply grateful for the time and care you put into commenting on draft after draft, even when I insisted on rewriting chapters from scratch. I will also fondly remember our journey to Erbil in Iraqi Kurdistan in search of a new Middle Assyrian site. Though brief, it was filled with slightly absurd yet fascinating moments, and it allowed us to get to know each other better. Thank you for bringing me along on that adventure.

I would also like to thank the *Dunnu* team, who made my Leiden years such an enjoyable and unforgettable experience. Although we went our separate ways long ago, the memories remain vivid: legendary *Dunnu* dinners, intense and never-ending stratigraphy debates, the Berlin excursion, symposia and conferences, *Dunnu* drinks, and even spontaneous beach trips - where we once reconstructed the entire excavation from sand, entirely from memory. Thank you, Victor, Merel, Hannah, Bleda, and Frans.

A special word is owed to Frans Wiggermann, who sadly passed away in 2024. His work on the texts from Tell Sabi Abyad forms an important foundation for this dissertation, but I remember him above all for his kindness. I will never forget that he offered me a place to stay - the very first time we met, in Belgisch Biercafé Olivier - and that he turned out to be the most liberal landlord and a truly pleasant housemate.

My sincere gratitude goes to Peter Akkermans and to the many people who excavated at Tell Sabi Abyad. Without your labour, perseverance, and resilience under the blazing sun and in biting dust storms, this desk-based research could never have existed. Your hardship has not been forgotten: I have read your notes, deciphered your scribbles on forms, studied your sketches, and relied on your reports. I also want to acknowledge those who remain largely silent in the documentation, the local workers, whose contribution is no less significant.

I am grateful to my friends and colleagues who read parts of this dissertation in preparation for the mock defence: Rogier, Eva, Aris, Victor, Lennart, Marleen, and Jitte. My thanks also go to my paranymphs, Niels and Lennart, for their support in the final months.

Finally, my deepest thanks go to my wife and girlfriend, Laurien, for sharing the burden that this dissertation placed on our life together. And to our children, Lennie and Lau: thank you for your presence and your wonderful, cheerful chaos.

Table of contents

I. Introduction[1]

I.1 The Tell Sabi Abyad *Dunnu*

Although archaeologists came to Tell Sabi Abyad to investigate a late Neolithic settlement in 1986, they were immediately struck by the large walls of a Late Bronze Age structure on the summit of the ancient mound. When excavation progressed, the settlement's distinct fortified character and unusual spatial organization became clear (Akkermans, Limpens and Spoor, 1993) and tablets with cuneiform writing indicated that they were excavating a Middle Assyrian foundation dating to the late 13th and early 12th centuries BCE. During this period, the Assyrian king Tukulti-Ninurta I actively lead an expansionist agenda conquering and attempting to consolidate territory far west from Aššur. The increasing number of tablets unearthed in the subsequent years, especially those found in 1998, helped to identify the settlement as a '*Dunnu*'. According to Frans Wiggermann, this was "a fortified agricultural production centre" (Wiggermann, 2000, p. 172). Although *dunnu's* were known by scholars studying legal contracts and administrative writing, the physical remains of a *dunnu* had never been found. Even though more recently other sites representing *dunnu's* have been found or inferred, the Middle Assyrian fortified settlement of Tell Sabi Abyad remains the primary source of archaeological and textual evidence for Assyrian presence in the Balikh river valley, as well as of the Middle Assyrian *Dunnu* institution in general. No other *Dunnu* has been uncovered by excavation to such an extent, revealing a near complete architectural plan and thousands of left-behind objects. At the same time the amount of textual information about a *dunnu* is also without comparison. Due to this unique circumstance of preservation, the *Dunnu* of Tell Sabi Abyad forms a very interesting case both in archaeological and historical terms. The rarity of finding an actual *Dunnu* from this period, as well as the possibility that this particular usage of a more ancient social institution (see II.4) may well be called an innovation by the Assyrians, justify a closer investigation of its physical character and the information on its functioning on various domains we may be able to glean from that. There are important questions to be answered regarding its functioning on various spatial levels or modalities (local, regional, internal, external), and different domains of human society (economy, military, political, etc). In this research we focus on the architecture and how it reflects choices made on the level of design (top down, predetermined), and on the level of daily use (bottom up, ad hoc) in order to structure relations and activities.

---

[1] The literature review for this dissertation was primarily conducted between 2012 and 2016. While some more recent works have been included, the study largely reflects perspectives and findings published prior to 2016.

Figure 1. The Dunnu being excavated and documented in 1998. North-western corner, looking towards the east (photo by P.M.M.G Akkermans).

I.2 Research aim

The extensive excavation of the *Dunnu* has given us a remarkable dataset of material remains of a relatively short-lived community. In just two generations the physical form had morphed into something new. The nature of these changes, which are the results of intentional human action to modify the structure of the settlement, is not the same everywhere in the *Dunnu,* nor were they all timed synchronously. We are able to identify larger and smaller modifications. Larger building phases affect certain areas, while in others the built environment seems to have grown in a less structured way, which could be taken as the existence of a contrast between planned construction and organic modifications. We may briefly reflect on the normative side of such interpretation, since 'less structured' can simply be replaced by 'a different purpose' as these places could nevertheless be the location of very structured human behaviours, as well as be *the result of* very structured human behaviour. Whatever ones *a priori* views, general observations of the *Dunnu* allows us to state that there is a comparatively large variation in construction types and architectural forms with varying rates of change. So, the question is justified to what degree these reflect social changes, or changes in the overall purpose of certain sectors of the settlement, or the functioning of the settlement as an integrated spatial unit.

Figure 2. Plan of the Dunnu including all excavated architecture, all phases combined. In blue a fosse surrounding the settlement. Grid blocks are 10x10 meters.

The aim of this study is to better understand the interaction between people and the built environment of the *Dunnu*. By analysing the layout, its constructional features, and the timing and nature of the changes, we may learn how this community interacted with the built environment, and what this interaction tells us about the people that lived there. Hence the study aims to reveal how people are actively involved in creating and modifying the built environment of the *Dunnu* in order to attain certain goals, and the effect this had on the functioning of the community. An essential theoretical question here is the matter of the direction of influence in the relationship between people and the built/material environment. This is a complex question that does not seem to have a single answer, as influencing or determining factors are intertwined and depend on context. The perspective taken in this dissertation attempts to cover both the deterministic aspect of the physical environment, as well as the power of human agents to make certain decisions within a bandwidth of freedom of choice.

The overarching research aim is that in understanding how the *Dunnu* worked as a building, we learn in turn to understand the role of the Assyrian empire near the western frontier. And how the Assyrians tried to hold onto an empire in the dangerously instable world of the late Bronze Age. Within the consolidating empire project, this study forms part of, this is the general question that was posed.

I.3 Research questions

From the previous discussion follows the research question of the current study:

> *What does the built environment of the Dunnu, and changes therein, tell us about the relation between people and built environment, and the purpose and functioning of the complex?*

The supporting questions deal with subtopics that need to be dealt with in order to develop a holistic perspective on the interactions between people and the *Dunnu* (read further below in methodological section).

- What was the historical context that lead to the creation of the *Dunnu* and how may it have influenced its architectural layout? (chapter 2)
- How did environmental and material context influence the architecture of the *Dunnu*? (chapters 5 and 6)
- How did technology influence the architecture of the *Dunnu*? (chapter 6)
- How was the *Dunnu* constructed and what are the modifications over time? (chapter 5).
- How did spatial and physical factors constrain and enable human movement, interaction and generally activity? (chapter 9)

Figure 3. The excavated heavy walls of one of the Dunnu's most prominent buildings: "the tower". In the area in front, the remains of a large staircase (photo by P.M.M.G. Akkermans).

I.4 Theoretical frameworks

This study used various frameworks for analysis and interpretation. In the history of theoretical thought on the relationship between people and the (built) environment, anthropological perspectives deriving from functionalism and structuralism have been influential (Lawrence and Low, 1990), but their ultimate impact on archaeology is limited as these anthropological approaches propose theoretical generalisations based on detailed studies of living cultures. Given that this is not achievable in archaeology, archaeological approaches to architecture are for a large part dictated by the available data: essentially incomplete and mute. On one hand there are approaches that focus on technological and construction aspects of architectural remains. On the other hand, there are theories that assume that we can understand the social, cultural or experiential dimensions of architecture by looking at observable, material characteristics.

In this study, various approaches are used with some innovations in order to gain an understanding of how the *Dunnu* was conceived, built and used. Archaeological interpretation is layered and hierarchical in nature, requiring first and foremost a detailed classification and understanding of the archaeological data, to serve as a basis for more hypothetical models of the relationship between people and the built environment. For the classification and interpretation of excavated remains, architectural features and deposits, theories about site formation derived from both ethnoarchaeological (Hall, McBride and Riddell, 1973; Kramer, 1979; Horne, 1982) and archaeological studies (Schiffer, 1983; Miller Rosen, 1986; Stein, 1987) are used. However, since architectural features are the result of specialised building activity, knowledge about ancient architecture is required to limit the degree in which misinterpretation of features shapes our high-level understanding of the site. It builds on studies of ancient Mesopotamian architecture that describe and analyse building techniques allowing for an in depth understanding of how a structure came practically into being (Loud and Altman, 1936; Woolley, 1955). These data driven, location specific approaches are contextualised in a more holistic view on architecture, that approaches the built environment as a result of a complex system (Nijst *et al.*, 1973; Ragette, 2003). This latter approach invites us to think about economic, cultural, political or environmental factors in the formation of a building, including characteristics such as location, shape, material.

The next level of archaeological interpretation attempts to create models for the use of architecture based on primary data, or newly derived data such as graphical analysis of spatial structure. The latter part in this case, refers to access analysis of the architectural plans. Simple access analysis is a commonly used technique in categorisation or social analysis of building plans (e.g. Miglus, 1999). A more complex form of access analysis is derived from space syntax, a theory and set of mathematical techniques based on patterns of movement and visibility used to look at settlement and house plans, revealing their underlying spatial structure (Hillier and Hanson, 1984; Hillier, 2007, 2014). Hillier and Hanson have extensively built on a theoretical framework to support their method, in which they argue that the spatial structure is ultimately the determining factor in how a settlement or building is used. This means that any other properties such as presence of certain activities or specific placement of functions or symbolic communication, is always derived from the spatial structure, and are therefore of secondary importance in the analysis of (architectural/urban/domestic) space. Most archaeologists would not agree with such a view, because they consider it narrowly deterministic, but many have suggested space syntax a useful tool nonetheless (Brown, 1990). Various studies, used in this dissertation as inspiration, have used this tool alongside others, and also integrate other physical properties of architecture that we assume help us to understand its use and function (Sanders, 1990; Fisher, 2009, 2014; Paliou, Wheatley and Earl, 2011; Stöger, 2011, chap. 6). Rather than assuming the spatial network determines everything, they are interested in the relation between material properties (size, colour, material, form) and their placement in the spatial network, also relating it to sight.

A framework in which these properties are used to understand the relationship between people and the built environment has been offered by Amos Rapoport (1980, 2006; 1990), which has been influential in archaeology including the work cited above. The work of Rapoport focusses on how the built environment is used to suggest expected behaviour of its users. It does this amongst others by strategic placement of physical elements, most prominently (semi) fixed features (e.g. decorations, furniture). In addition, this type of communication is always based on a redundancy of signals: a multitude of things and properties of a space that signal expected behaviour. The perspective is useful in archaeology as it suggests that we can reconstruct meaning or use through material and contextual analysis. Though the function might be lost in archaeological contexts, the redundancy is something that might be observable and something we can document. Thus, by simply recording and contrasting the variability in use of colour, materials or dimensions and the effect of light we start learning which parts of the built environment were architecturally distinct, and attempt to explain those distinctions.

I.5 Methodology

Considering the multifactorial model of explanation opted for in this study, a number of aspects are to be taken into consideration in order to understand how the physical *Dunnu* attained its characteristics, and how this impacted human behaviour:

- Cultural models of buildings and construction, e.g. other *dunnu's* or building types that may be part of a *dunnu*.
- The historical context and motives for the construction, hence the Assyrian expansion, and reasons for building a *dunnu*.
- The local conditions, including building materials, topography, climate, hydrology, political, military and social conditions.
- The modifications in the physical layout of the *Dunnu*, and their associated functional changes.

Broadly speaking, these topics are dealt with by dividing the study in three general steps. First the local conditions and historical context are discussed. The second step is the treatment of the archaeological data and all methodological issues that come with its reconstruction. The third is the analysis of the building plan, and reconstructed architecture and changes in the built environment.

The first step involves a literature study, summarising and commenting on the scholarship related to this period and region. It makes us aware of the political, social, economic and environmental conditions and developments. It sets the scene and helps us place into context the decisions that shaped the foundation of the *Dunnu*, and also its ultimate fate.

In the second step the archaeological material will be discussed and interpreted. First, we need to deal with the problematic nature of archaeological data, its possibilities and its limitations. Due to the elementary 'incompleteness' of archaeological data, 'interpretations' or reconstruction of excavation data have much impact on various analyses that use this interpreted information. Hence, it is essential to scrutinize the primary data and their interpretations carefully. This is done following a threefold methodology:

- Analysing the primary archaeological data as found in the excavation documentation: the day reports, summaries and photos and drawing. Dealing with architecture and a complex stratigraphy, the aim is to understand the structural architectural remains and their stratigraphic relations.

- Looking at this material from the perspective of similar architecture. Through reasoning by analogy, the architecture and its possible interpretations are narrowed down.
- Applying constructional analysis on the architectural remains. The question is what the properties of the lower part of the architecture give away about the upper construction. The approach applies constructional logic based on the study of materials and techniques.

In this step advantage is taken from a method developed in the field of computer based three-dimensional reconstruction (Reilly, 1992; Lewin and Gross, 1996; Daniels, 1997; Murgatroyd, 2008; Hermon, 2014). 3D reconstruction from this is an iterative problem-solving technique, an approach to reconstruction not working towards a specific final image but experimentally trying to find a number of possible solutions. Acknowledging that there are multiple interpretations possible, the emphasis lies on exploring various options, revealing where uncertainty is involved and offering alternatives to standing interpretations. The acquired information and insights are used in the assessment of the reliability of the subsequent analysis based on this reconstructed data.

The third step attempts to explain the archaeological observations. Although the constructional reasoning of the previous step will already have untangled architectural reasons for the form of the *Dunnu*, here we go on to add additional models. Various models of how the built environment comes into being as well as how it influences people are used to understand different aspects of its physical form and social meaning. For an understanding of the form of the settlement plan we will first start with a typological and morphological analysis of the *Dunnu*. What are the characteristics of the layout and specific parts of the layout, and what does it tell us about its function? Then the spatial structure or configuration of the *Dunnu* will be analysed in more detail. This reveals how space structured human and animal movement, and highlights how well accessible various parts of the settlement were. Hence, it is a way of reconstructing where the more or lesser socially active areas in a settlement may have been. From the perspective of engineering a *dunnu,* such insights tell something about the purpose of the *Dunnu* and its constitutive parts. Moreover, we may learn how the physical environment structured the day to day live of people living in or visiting the settlement.

I.6 Archaeological data

The possibilities for analysis in this study are for a large part determined by the available types of information resulting from the excavation methods and systems of administration used by the Tell Sabi Abyad excavation project. The data was collected during a series of excavation campaigns between 1988 and 2010. The project applied a box-grid excavation method with a grid consisting of 10x10 m squares projected over the site. The primary unit of excavation and administration are therefore the squares. Each square was excavated individually over the course of one or more excavation season(s). The actual excavated area of each square measured 9x9m, 50 cm out from all sides of the square, to be left standing as section profiles. Although the box-grid method allows for vertical stratigraphic validation while performing horizontal excavation, one of the downsides is that the 1 m wide balks left standing in between the squares obscures stratigraphic relations and connections. This can be a limiting factor in understanding the relation between use or construction phases across different squares.

The administrative classes that are used are feature, locus, and lot. Features and loci are what in general are called ‘contexts’ in archaeology. ‘Loci’ are distinctive layers of ground, recognized during excavation, but sometimes they are arbitrary boundaries created after 20 cm of ground removal. They have been recorded on ‘deposition’ forms, and drawn in on daily square sketches. ‘Features’ are constructed elements such as walls, bins or ovens. For each locus or feature, ‘lots’ were assigned to finds associated with these. Lots are purely an administrative unit and have no archaeological significance. Aside from forms documenting features, loci/deposit and finds, trench supervisors kept a daily notebook which recorded the progress, observations and hypotheses. An updated plan sketch of the square was made every day with all visible features and loci. The results of a season of excavation were often (but not always, presumably due to time pressure) summarised in a report, which also included a preliminary outline of the phasing. The detailed excavation documentation was used in this study to reconstruct cross-sections in buildings, allowing for the comparative analysis of processes of deposition and site formation related to the buildings of the *Dunnu* (chapter IV). In addition, it was used to create a database of features and spaces, storing information on stratigraphic classification, construction materials, methods, dimensions and interpretations. Included were all architectural features, mainly walls, but also for all other fixed features including ovens, cooking places, and bins. Although the forms used in the field to describe features required the administrator to fill in some basic information on construction, such as building material specifications and method of bonding, this was not consistently done. The database is thus far from complete, and this has an effect on the analysis of construction and architecture (chapters V and VI).

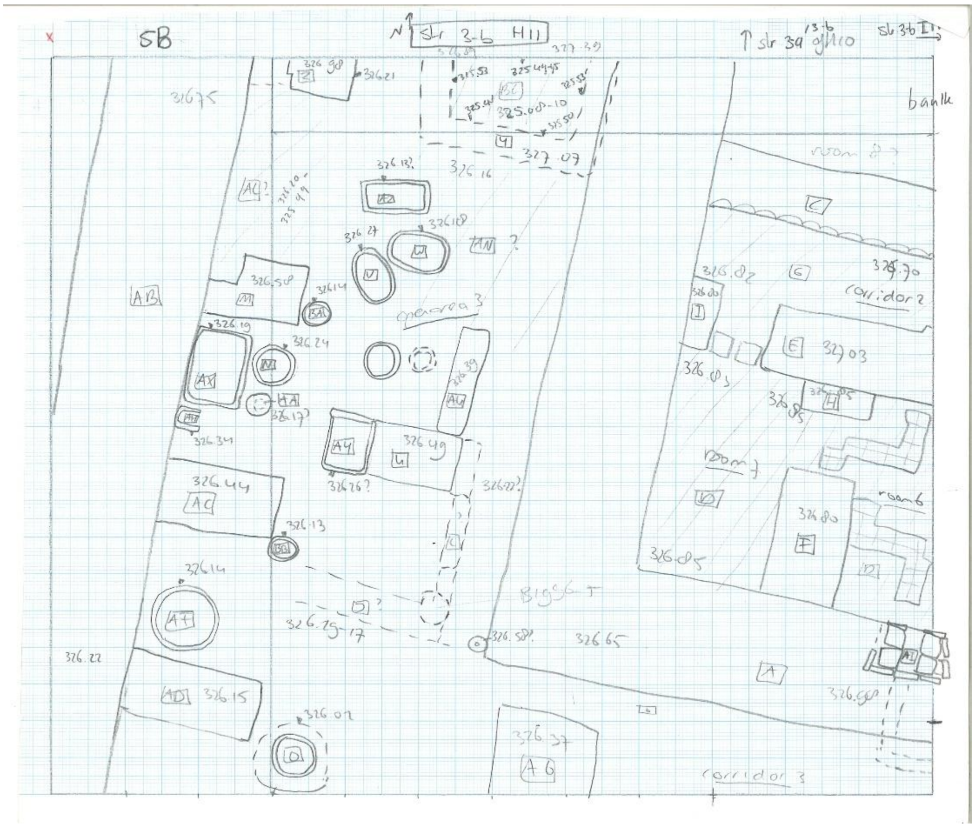


Figure 4. Example of a stratum (reconstructed phase) drawing, square H11.

Figure 5. Example of a final square drawing, square H11.

Plan drawings of the architecture and other features were made on a daily basis in the field by trench supervisors. Final plan drawings, focussing on the architecture were hand drawn by a professional draughtsperson. The field sketches are often less accurate, but more complete. They include many features that did not end up on the final drawings. The final drawings are more accurate, and contain a lot of useful information about the brickwork and condition of the walls. They often include small elevation drawings next to the plans, which elucidate archaeological contexts that were not (accurately) described in the day reports. In addition, in post-excavation work, stratum drawings were made to accompany the stratum reports (discussed below). These are essentially phase plans for each individual square, and include all features found in excavation.

In the years after the excavation, the fieldwork data was further summarised and interpreted in a series of stratigraphy reports by the main project assistant. These were meant to unify the results in an easily readable series of documents and create local chronologies. Here, the concept of a stratum is introduced to group surfaces, walls, and other features in a contemporary use phase. An attempt was also made to link the strata across different squares, to determine contemporaneous archaeological site horizons. For this a so called 'concordance table' was created in an excel file, which associates strata with 'levels' and 'sublevels'. Earlier in the project, a general site phasing had already been established which distinguished a certain number of 'levels'. The levels are applicable across the site. However, since local phasing in the squares often did not display the same number of phases ('strata') as the levels, the concept of sublevels was introduced. The use of this terminology to describe archaeological phases, as well as the manner in which levels were defined is however problematic, and is critically evaluated in this dissertation (see VI.3.1).

For the study performed for this dissertation, both final plan drawings and stratum drawings were scanned and digitized to be used in a GIS (Geographic Information System). This GIS was used as the main hub of information, linking scans, digital plans, and the architecture and features database mentioned above. In addition, level heights data taken during excavation were used to reconstruct a 3D version of the excavation (Figure 6), which allowed 3D visualization of spatial and stratigraphic relationships and formed the basis for experimental reconstructions.

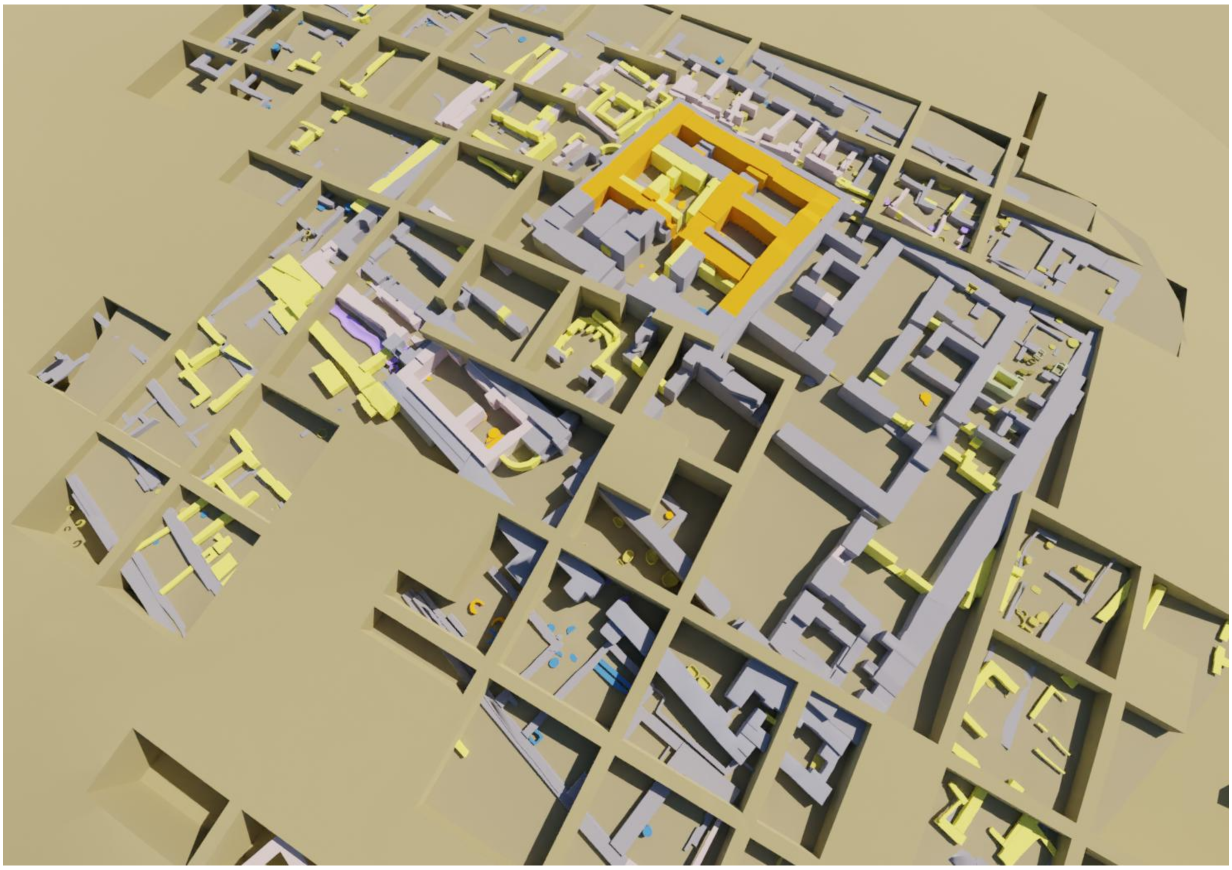


Figure 6. Rendered view of the 3D reconstructed remains of the excavation, combining all phases.

I.7 Consolidating empire

This study is part of the project 'consolidating empire'[2], that was conceived by dr. Bleda Düring in order to analyse and disclose all archaeological and textual data from the *Dunnu* of tell Sabi Abyad. The project aimed to study the origins of imperialism by investigating Middle Assyrian imperial practices from a general point of view, relating archaeological information to the historical discourse, and from a specific point of view at the *Dunnu* of Tell Sabi Abyad. It is meant to give a bottom-up perspective on imperial practices, as seen from the physical evidence of actual Assyrian presence, as opposed to a top-down perspective as is given by the annals of the conquests of kings, which can only give a very general idea of conquest and consolidation. Finally, the divergent perspectives are combined. Within the ambit of consolidating empire, a number of specific studies were made, all focused on the *Dunnu* of Tell Sabi Abyad. The agricultural economy is further investigated by means of archaeobotanical analysis.[3] The spatial distribution of activities has been studied through an analysis of the occurrence of small finds and other features (Klinkenberg, 2016). Detailed descriptions of the architecture and stratigraphy are

---

[2] Full project title: "Consolidating Empire: Reconstructing Hegemonic Practices of the Middle Assyrian Empire at the Late Bronze Age Fortified Estate of Tell Sabi Abyad, Syria, ca. 1230 – 1180 BC".
[3] This subproject was ended prematurely, but some preliminary results can be read in Fantone (2015).

being prepared (Brüning & Plug, in press), as well as the publication of the extensive body of cuneiform tablets (Wiggermann, in press). Moreover, an overarching study of Middle Assyrian imperialism has appeared by the hand of Bleda Düring (2020).

I.8 Contribution to present knowledge

Recuperating the research aims, the study intends to give a detailed insight in the social and behavioural mechanics of a unique Late Bronze Age settlement type, a *dunnu*. It is hoped to be useful in a specifically historical perspective, teaching us more about Middle Assyrian imperial practices and life, and in a comparative context of multi-functional walled settlements throughout history. Moreover, it is hoped that it will give impetus to developing new methods of excavating and recording, and dealing with excavation data. The study has tried to integrate archaeological data analysis, method and theory in an open-minded and open-ended way. The study also aimed on creating an awareness of the influence of the applied methods of excavation and recording on later analysis. Although this influence is generally acknowledged by archaeologists, it has not sufficiently used to re-assess and develop excavation and recording methods. Moreover, the application of other fields of knowledge, although often found in the thinking of archaeologists, could benefit from a better systemisation and documentation of the process increasing scientific transparency. Experimental archaeology, both in the real and virtual world, and ethnoarchaeology, are often found relatively isolated to the rest of the excavation branch of the discipline and should be more integrated so real world knowledge can be better applied on the interpretation of archaeology.

I.9 Reference site plans

Individual spaces (rooms, open areas) were named and numbered in the field, with reference to the square in which they were found. For this study, the spaces of the *Dunnu* have been redefined and named using a different system based on a spatial definition of ‘sector’, ‘building’ and ‘space’[4]. Four sectors have been defined, which are spatially related sections of the *Dunnu:* Northwest (NW), Northeast (NE), Southeast (SE) and Southwest (SW). Spaces have been grouped in structural/spatial units that are defined as ‘buildings’ (see VI.4). These are numbered in sequence for each sector (e.g. NW-4, SE-3). Finally, individual spaces within these units are given a letter (e.g. SW-8b, NE-5d). The two large central buildings diverge from this system, as they did not receive a sector assignation but are referred to with their building name (i.e. tower and residence).

[4] Plans with these space names are included as appendices.

II. Historical and Geographic Contexts

II.1 Introduction

This chapter is an introduction to the historic and cultural backgrounds, the geographic context and the archaeology of the *Dunnu* of Tell Sabi Abyad. In the first place it should help the reader to understand the time-period and region of the world. Secondly, the information is relevant for this study in particular as a context for the interaction between people and built environment. As has been emphasized in the introduction, the *Dunnu* was conceived in a specific historical and cultural context and natural environment, which all contributed to its design and physical character and played a role in how it functioned as spatial, social and cultural system.

II.2 What is a *Dunnu*?

As may be read in the introduction, a definition of a *Dunnu* is "a fortified agricultural production centre" (Wiggermann, 2000, p. 172). Although this definition is correct in a general sense, it conceals the complexity of the subject. Textual evidence suggests that not every *Dunnu* was the same, and physical archaeological evidence is extremely limited. Besides, we need to deal with the complicated relation with another concept known from Bronze Age sources, the *Dimtu*, which seems to be earlier in origin but largely overlaps in meaning. A brief excursion into the cultural historical background of the phenomenon should therefore be made first.

II.3 Historic background of the *Dunnu* concept

The earliest textual references to *Dimtu* appear in the records of the Ur III state (2112-2004 BCE). After this, both *Dimtu* and *Dunnu* are found during the earlier half of the second millennium BC (Koliński, 2001, p. 36). They are not attested in the north, despite numerous preserved sources, until we arrive in the 16th century, suggesting that the concept was a southern Mesopotamian invention. In the territory of the kingdom of Arraphe, which also included the city of Nuzi from which many of the texts originate, we have the names of 216 *Dimtu* dating to the 16th and 15th centuries BC (Koliński, 2001, appendix A). Interestingly, while the *Dimtu/Dunnu* gain prominence in the north, they dwindle in the south. The Mitanni kingdom and the Middle Assyrian Empire included respectively *Dimtu* or *Dunnu* in their systems of administration and political and military control. Later, the *Dunnu* hardly occurs in the first millennium apart in some toponyms that may very likely go back to the second millennium. It therefore seems that with the decline of the Bronze Age societies, and the advent of new ones in the Iron Age, the conditions changed and the economic, political, and military need for the *Dunnu/Dimtu* seems to have vanished. No Neo-Assyrian *dunnu's* are known to have existed, which is likely to be related to new forms of socio-political organization. Moreover, even though *dunnu's* and *dimtu's* of various periods and places share many characteristics (discussed below), its precise functioning in the framework of society or the state may vary depending on place and time.

II.4 The use of *dunnu's* by the Middle Assyrian state

To understand the functioning of the *Dunnu* in the Middle Assyrian state, we have only very little material available (Koliński, 2001; Düring, 2015). Only 29 *Dunnu,* unevenly distributed over the Middle Assyrian territory are known from the textual sources, another six have been proposed based on archaeological evidence alone (Düring, 2015, p. 53; Puljiz and Qasim, 2020). Of most of the recorded instances, we know little more than their names. Almost half of all attested Middle Assyrian *dunnu's* are found in the administration of the town of Sibaniba (Tell Billa), located in the eastern part of the Empire well over a 100 km north of Aššur (Kolinski, 2014a, p. 22). Dating to the 13th century before the reign of Tukulti Ninurta I, they may have been established during the phase of eastern expansion of the Assyrian state prior to the western expansion which resulted in the foundation of the *Dunnu* at Tell Sabi Abyad. However, their exact origins and the context of their foundation remain unclear and they may thus also have been 'indigenous' socio-economic institutions. Other *dunnu's* are found sparsely distributed over the Middle Assyrian Empire. However, there is more abundant evidence for their presence in the Northern Balikh valley, all known from Tell Sabi Abyad's administration. The observed irregular geographic distribution of the *Dunnu's* may simply reflect the scarcity and patchy nature of the textual evidence. On the other hand, we have many texts from the Khabur valley, but *dunnu's* do not feature regularly in them. The impression therefore rises that *dunnu's* may have been founded under specific circumstances, part of the imperial strategic toolset used by the Middle Assyrian empire (Düring, 2015; B. Düring, 2020). Thus, the working hypothesis that is favoured currently is that they functioned as a kind of colonial settlement where previous settlement patterns were an insufficient basis for the organization of an agricultural economy (Radner, 2004; Kolinski, 2014a). At least, in respect to the settlement decline in the Balikh valley (see below) and possibly efforts of repopulation by the Assyrians, it seems to have functioned in such a context. The defensive aspects of such settlements moreover hint at a situation that requires extra security. Border lands or conquered territory with rebellious populations would seem to be likely contexts of use. Moreover, in rural regions the *Dunnu* seems a viable territorial and economic strategy.

Koliński (2014a, p. 24) argued that the fact that instances of named *dunnu's* make up only 5% of the total corpus of known toponyms, implies that *dunnu's* may not have played an important role as has been thought previously. Indeed, the total number of known *Dunnu* from the Middle Assyrian texts (29) contrasts starkly with the total number of *Dimtu* from the much smaller kingdoms of Arraphe (216) or Ugarit (81). Aside from the probability that Arrapheans and Ugariteans had a different concept of what constitutes a *Dimtu* or *Dunnu*, the discrepancy seems to suggest that in these kingdoms, the *Dimtu* fulfilled a dominant role in the organization of the entire territory and were integral part of the settlement pattern. Apparently, the *Dunnu* did not play the same role in the Middle Assyrian territorial organization. However, its relative numerical insignificance may not necessarily mean that individual *dunnu's* were not of paramount importance to the success of the Middle Assyrian state. All the evidence we have from the *Dunnu* of Tell Sabi Abyad suggests it was an important stronghold, trade hub and power base for one of the most important figures of the time. It does therefore seem that they may be important for our understanding of the functioning of the Middle Assyrian state and its early hegemony. Moreover, the *Dunnu* may even be considered as one of the defining characteristics of the Middle Assyrian empire, as the *Dunnu* lost all relevance in the Neo-Assyrian empire thereafter.

In view of the present state of knowledge, the conclusion must be that the Assyrians made use of *dunnu's* as a way of organizing and securing territory only sparingly, and only there where the local military, demographic or political situation demanded it. It was a strategic tool, used were necessary. However, considering the relative dearth of information, such a view may easily be challenged or modified by future findings.

II.5 *Dunnu*'s & dimtu's in comparative perspectve

Kolinski (2001, pp. 126–127) already noted the similarities of the *dimtu/dunnu* with constructions found in neighbouring cultures, such as Egypt, the levant or Elam. Zoomed out far enough we may see the general principle of an estate or agricultural territory, centred by a fortified settlement or farmhouse make an appearance in many later periods and other regions as well. There are clear superficial similarities with the 'fortified farmhouse' (often: 'Qala'), a frequently recurring phenomenon of the rural Middle East and Mediterranean that has quickly fallen out of use during the modernizing 20th century but for a few pockets where older social structures survive. Examples run from Afghanistan to Morocco (see also Table 7).[5] These rural fortresses, as they are sometimes called, are heavily walled constructions with multiple interior structures serving various social and economic functions. They are often run by the head of a certain influential family, in a social organization which included subordinate families residing in the same fortified settlement. Similarly, the owner might be living on site or be an absentee landlord living in town. They universally serve important economic functions as centres of agricultural production and safeguarding harvests. The difference with the Middle Assyrian *Dunnu* regards their institutional status within a state organization, and the effect this may have on possible additional functions - administrative, military strategic, non-agricultural productive, trade - they hence receive. As

[5] This type of rapidly disappearing settlement has attracted surprisingly little academic interest. In general, no more than cursory reference is made to them. Only of the Qala in Afghanistan and the Kasba and Tighremt in Morocco (which are an independent development), detailed descriptions of these structures and their socio-economic and cultural contexts exist. Afganistan: Hallet & Samizay (1980), in Iran: Horne (1993, pp. 50–51), in Iraq: Aurenche (1977, p. 115), in Morocco: Nijst *et al.* (1973, pp. 186–209).

discussed above, in the Bronze Age they formed instruments of the state used for territorial control in a socio-political system which was based on grants to elite members of society.

Considering the frequent recurrence of fortified estates cross-culturally, and the fact that in certain city states or kingdoms *dunnu's/dimtus* were part of the socio-economical organization of these states, the hypothesis may be offered that during the Bronze Age already present social institutions were incorporated in the state and transformed into tools of control (Düring, 2015). However, with attempts of later Assyrian imperial polities to limit the power of families in order to centralise power and increase its operational efficiency, such social institutions became to be regarded inefficient and as liabilities for the survival of the state (Brown, 2013). This in turn may explain their disappearance from the later sources. It may have been that the fortified farm continued to exist as a low-key socio-economic structure. At the same time however, its widespread geographic and temporal occurrence suggests that it is a phenomenon may be easily reinvented after a temporary disappearance. Both aspects may explain the omnipresence of the phenomenon throughout history.

II.6 Geographical setting

In the following section the geographical settings of the *Dunnu* of Tell Sabi Abyad will be discussed, focussing on finding an explanation for its geographic location, and the natural affordances of the landscape. Apart from giving a general idea of the environment that people had to deal with, these are topics that are also relevant for the discussion of construction materials and methods, and the problem of water supply.

II.6.1 Physical geography and natural resources

The *Dunnu* is found in the Balikh river basin, a 100 kilometre long north-south running valley in the gently undulating to flat Syrian steppe. In the north, the basin is bordered by the foothills of the Anatolian heights, in the south by the Euphrates. It covers an area nowadays dissected by the modern border between Turkey and Syria, but in ancient times formed more or less a geographic unit. The Balikh river is a relatively narrow perennial stream fed by the 'Ain al 'Arus spring, near Tell Abyad just south of the Syrian-Turkish border. The valley continues up further north across the border. A natural boundary with gently sloping land separates the Balikh valley with the Harran plain in the north. Here, running across this higher land the Jullab river is found, a tributary of the Balikh. In the middle of the 20th century it did often not reach its confluence with the Balikh due to tapping of its waters for irrigation (Lloyd and Brice, 1951).

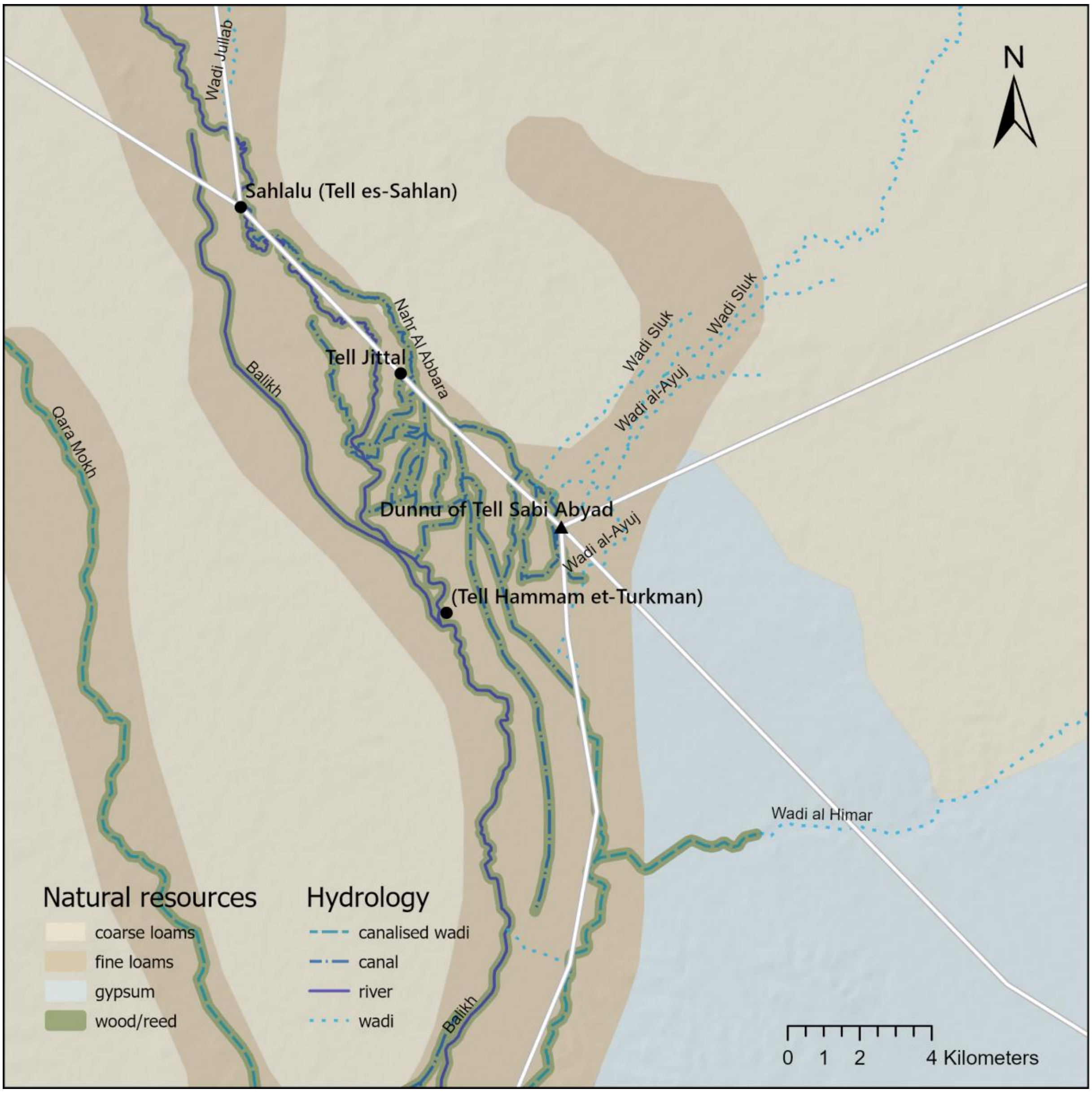


Figure 7. Physical geography and natural resources of the upper Balikh around Tell Sabi Abyad. Derived from the landuse/soil map dataset (Mathys, 2017)*. Note that wood/reed is inferred from the presence of semi-permanent bodies of water. Most likely this distribution was also determined by the presence of marshy conditions, which occurred during large parts of antiquity in the area west of Tell Sabi Abyad.*

The Balikh valley cuts into depositionary rock formed in a lagoonal environment during the Miocene, 23 to 5 million years ago. It is characterised by an interbedded sequence of marls, gypsum, clays, silty sandstones and limestones (Mulders, 1969, p. 36). Especially limestone and gypsum rock are found near the surface over large areas of the desert and steppe landscape bordering the Balikh river. The lower river valley is a flat area constituting the Pleistocene and earlier Holocene flood plains of the Balikh. These are alluvial deposits containing pebbles, sands, sandy loams, and loams. In these older deposits, the current Balikh has cut its course through towards the Euphrates in the south.

The area of the ancient river terraces formed by the Balikh and its tributaries is a strip of land just one to five kilometres in width. This area roughly constitutes the limits of arable land. Beyond this area, soils in sufficient thickness for agriculture are often not present. When they are, in wadis for example, lack of water forms a challenge. Significantly, the *Dunnu* is located in one of the wider parts of the valley, near the confluence of various wadis, where more arable soils are available.

The current Balikh meanders in a flood plain of about 150 wide, 4 to 5 meters below the most recent terrace (Mulders, 1969, p. 49). The valley is not drained by just a single stream, the Nahr Balikh. Over a large part of its length, the Wadi al-Keder is found running parallel to the Balikh. A number of other wadis feed into one of these streams. The Qara Mokh drains a large part of the western valley, while the Wadi Sluk and Wadi Al Ayuj drain a part of the upper eastern valley. The Qara Mokh is almost devoid of ancient sites, while the area of the wadis Sluk and Al Ayui still have attracted settlement in the past. Possibly this is related to a better water supply due to the presence of a small spring fed stream running parallel to the wadi Sluk (Rayne, 2015, p. 431). Although this stream is never given much heed in other studies about Balikh valley, it must have had an important auxiliary function in the water supply of the area. Irrigation and drainage activities by people have altered the hydrology of the area (Wilkinson, 1998; Rayne, 2015). Examples are the Sahlan-Hammam canal, and the Nahr al-Abbara, both branching from the Balikh near Tell es-Sahlan. The visible remains of these, and other canal systems mostly date to the Hellenistic and Islamic periods. However, since earlier sites line up with the Nahr al-Abbara, it is possible that it may have had a Bronze Age forerunner (Rayne, 2015, p. 423).

At present, the Balikh valley is nearly completely deforested and entirely exploited agriculturally. In the past, landscape and vegetation had a different character. The difference is mainly the result of human activities, since the climate has not changed significantly. The area between Tell Sabi Abyad and the Balikh is a badly drained shallow basin, which is conducive to the development of marshes. Less than a century ago, marshland was common in the upper Balikh valley, noted amongst other by archaeologist Max Mallowan (Mallowan, 1946) who described the difficulties to cross the landscape in the 1930s due to marshland and flooding near Tell es-Sahlan. Still today the remains of former water collection areas are visible from the sky as geomorphological scars in the landscape (Hritz, 2013; Rayne, 2015). One of the main challenges of this area has therefore always been drainage, which explains the multitude channels crisscrossing the basin. This extensive drainage system is as far as we know mediaeval in date (Rayne, 2015), which may indicate that during most of antiquity, a considerable area remained marshland. Based on the presence of a few sites lining the edges of these former marshlands Hritz (2013, p. 154) argues that during the Bronze Age, some populations targeted the exploitation of these marshes specifically. Marshes could have sustained quite some useful resources close to Tell Sabi Abyad, such as wood and reeds for construction, and fish, fowl and other wild animals for food. The analysis of carbonised wood samples from Neolithic (Akkermans, 1993, p. 213) as well as Late Bronze Age (Fantone, pers. comm. 2014) contexts shows that Poplar, Ash and Willow were used in both periods. Although river transport of timber from upstream forest resources is not out of the question, it is quite likely that these trees had a local origin.

Above and beyond the river terraces and the lower wadi valleys, the steppe stretches. This is arid land with only spread-out bushy vegetation able to root deep to access water. Grasses and flowers may grow during spring, but most wither during the soaring heat of the summer. This ecological niche is extensively used for grazing and in the past for hunting, and is home to pastoralists with herds, and nomads. The importance of these people and this ecological niche is considerable for the agriculturalists living in the Balikh valley, judging from the numerous bones of herded animals found in excavations of settlements. Hunting on species like Gazelle has also been attested for both the Neolithic as the Bronze Age (Cavallo, 2002; Russell and Buitenhuis, 2008). Together with local marshland exploitation and agriculture steppe exploitation, the hunt may be considered one of the three pillars of subsistence of the Balikh society (Hritz, 2013).

II.6.2 Climate

The climate in the Balikh valley is characterised by dry hot summers, and relatively cold winters with rainfall. Data from Raqqa give an indication of the range of temperatures (Mulders, 1969, table 3). On average temperatures ranges from 6 degrees Celsius in January to 30 degrees in July. It may freeze up to minus 8 degrees in winter, while the maximum daily temperature in summer may rise to 46 degrees. Differences between night and day temperatures are significant, especially during summer when the air humidity is low and heat radiation easily escapes. This also means that temperature differences between sun and shade, outside and inside are considerable and offer some human comfort in the generally harsh climate.

Rain occurs from October to May, with January being the wettest month. The months June to September are practically dry. Most rainfall occurs in very short periods, falling from the clouds in bursts. From north to south precipitation in the valley decreases significantly (Mulders, 1969, table 1; Hole and Zaitchik, 2007, fig. 2). Tell Abyad on the Syrian-Turkish border, receives on average 250 to 300 mm yearly while at Raqqa this is 150 to 200 mm. Fluctuations of yearly rainfall are significant, with exceptionally dry and wet years during which rainfall will surpass the average ranges. Although it is possible to perform rainfed agriculture between 200 and 250 mm, this zone yields a high risk of crop failure. A minimum of 250 mm rainfall is required if rainfed agriculture is to be performed with an acceptable reliability and predictability (Hole and Zaitchik, 2007, p. 140). Barley and some legumes are best grown in these ranges, and where precipitation fluctuates less between the years, also wheat. But wheat is best grown when rainfall is over 300 mm on average. Of course, the reliability and predictability of harvests is greatly improved with irrigation. Considering the great yearly fluctuations in rainfall and regular draughts, it comes as no surprise that irrigation has been employed during long periods of human history (Rayne, 2015).

An important aspect of the climate are the sand-dust storms, which hinder any human activity outside. They occur most frequently from March to July, when wind velocity is highest (Mulders, 1969, p. 24).

During these months, 2 to 3 days on average are hit by such storms. They may last from anything between a few hours and 2 days. Visibility during these storms is about 1000 meter, but in especially dense dust clouds it may happen that a person sees no further than 25 meter (Mulders, 1969, p. 24).

II.7 Settlement pattern and population trend during the Late Bronze Age

The north-southerly orientation of the valley has dictated the general shape of the settlement pattern in all periods of human (pre)history. The largest settlements are found in the northern part of the Balikh valley, while the size of settlements and population density clearly decreases towards the south (Lyon, 2000; Kolinski, 2014b). This pattern may largely be attributed to the climate, increasingly arid, and the physical geography, an increasingly narrow valley. It has been argued that a fully-fledged urban landscape, like that in the valleys of the Euphrates and Habur, never developed in the Balikh (Hritz, 2013), but settlements such as Sahlalu and Hammam et Turkman are nonetheless substantial towns. Although the general geographic pattern of settlement distribution is largely stable, significant demographic fluctuations occurred impacting the settlement density. Archaeological surveys have shown that during the Middle Bronze Age, the river basin was relatively densely populated (Curvers, 1991; Lyon, 2000). A settlement system was present with evenly distributed larger sites that may be regarded as local centres that divided the territory of the valley in various units with corresponding secondary and tertiary settlements. Population levels went down in Mitanni times and seems to decline further during Assyrian rule while at the same time a few new settlements appear.[6] The significant decline in settlement numbers from the Mittani to the Middle Assyrian period has been connected to historically attested Assyrian raids of the area during its initial conquest (Lyon 2000; Düring, 2021, p. 88). Evidence for episodes of conflagration or abandonment on a number of sites and textual descriptions that suggest the area was dominated by pastoral groups such as the Suteans support Düring's hypothesis.[7]

[6] The surveys of Curvers and Lyon seem to disagree about the magnitude of this decline, which has been attributed to Curvers's inability to recognize a certain sub-period (Kolinski, 2014b).

[7] It is possible however that the picture of demographic decline has been exaggerated by a binary distinction between pottery styles used as chronological diagnostics. According to Duistermaat (2014, p. 133) Mitanni and Middle Assyrian pottery traditions in the Balikh are show much continuation, and have considerable overlap both stylistically and chronologically. If correct, this would blur the Mitanni to Middle Assyrian transition and make a demographic collapse less pronounced.

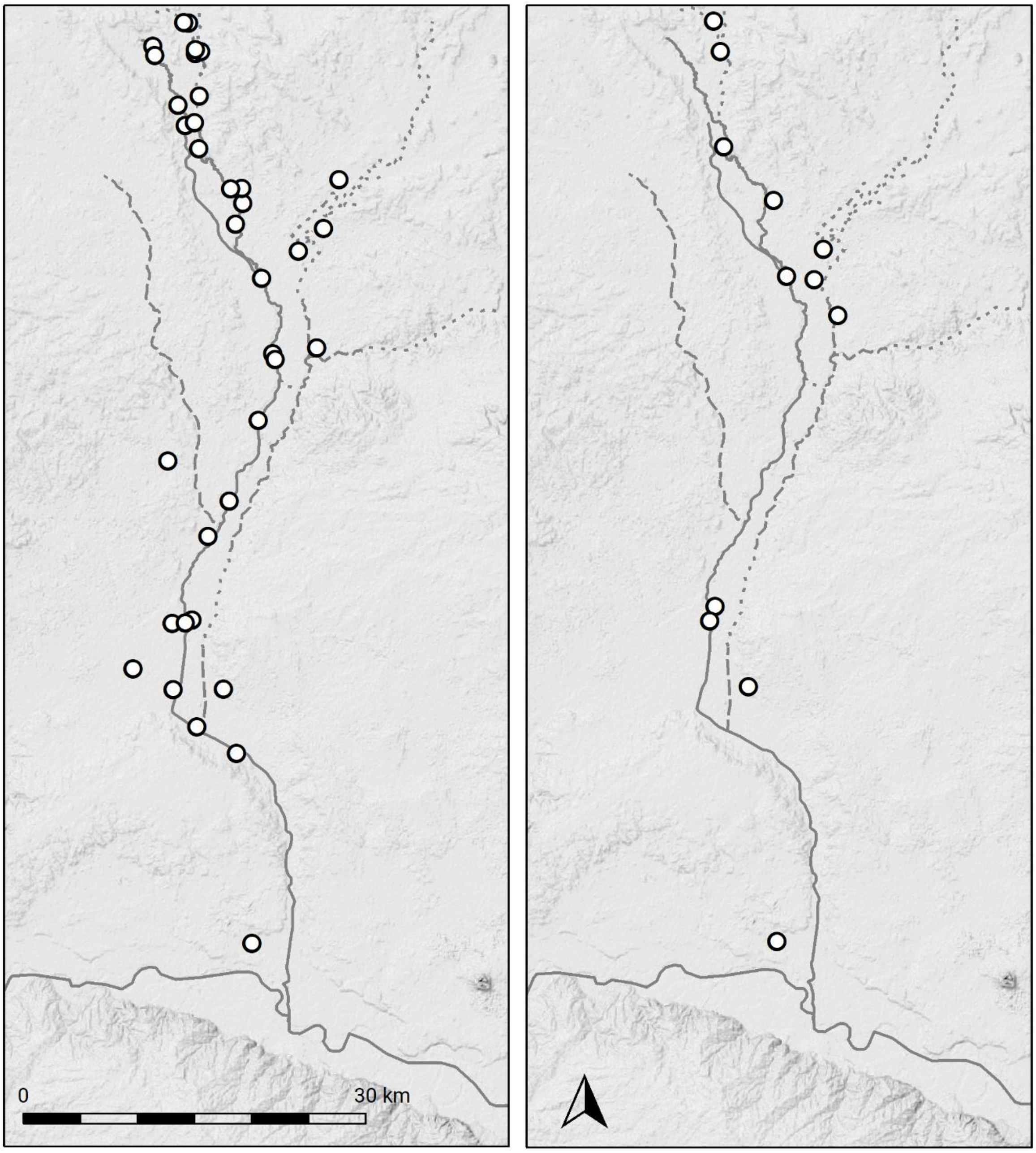


Figure 8. Mittani and Middle Assyrian period settlements in the Balikh valle. Redrawn by author after Lyon 2000, figures 4 and 7.

II.8 Historical setting

The *Dunnu* of Tell Sabi Abyad was built in tumultuous times. A time during which the political and military balances in Northern Mesopotamia had come to shift (Postgate, 1992, p. 247). The Assyrian state had just started to assert its position as a regional power, and played an important role in the destruction of the kingdom of Mitanni, which was called Hanigalbat by the Assyrians. For about a century (approximately 1440 to 1340) Aššur was a vassal state of Mitanni (Kolinski, 2014a, p. 9). During the reign of Assyrian king Aššur-uballiṭ I this changed, although his activities were initially directed at conquering Babylon and Mitanni territory in the east. Under Adad-nīrari I (1295-1264 BC) it is clear that the roles were reversed: Mitanni/Hanigalbat was now itself a vassal state of Assyria. During the reign of this king and that of his son Salmanessar I (1263-34 BC) Hanigalbat rebelled a number of times, each time met with forceful response by Assyria. Both kings lead campaigns far westward from Aššur, and reached the banks of the Euphrates nearly 500 km away from the city. It was Salmanessar I who put a definite end to the semi-independent status of Hanigalbat, and started to incorporate it into the Assyrian state, a process that was completed during the long reign of his successor Tukulti-Ninurta I (1233-1197 BC) (Kolinski, 2014a, p. 10). Tukulti-Ninurta I is widely considered to be one of the most successful kings of the Middle Assyrian phase, during which an Assyrian empire took shape.

It is therefore no coincidence that the earliest texts found at Tell Sabi Abyad date to the first decade of Tukulti-Ninurta's reign, the 1230s BC. It places the foundation of the *Dunnu* just after a phase of military conquest, in an effort to control an area and make it profitable for the Assyrian state. Although the Assyrians settled on more locations in the Balikh basin, and definitely built more than one fortified settlement, the *Dunnu* of Tell Sabi Abyad stands out because its owner was nobody less than a person who bore the title 'King of Hanigalbat'. In other contexts, this person is referred to as grand vizier, or governor of the western province. But it is significant that the title king was maintained. Although Hanigalbat/Mitanni had ceased to exist as an independent state, the title of king associated with this territory, had not. The fate of the *Dunnu* must therefore be seen in the light of the political and military successes and failures of this powerful individual. This is in fact one of the distinctive characteristics of the Middle Assyrian empire, its reliance on high ranking individuals or families to which power and control were outsourced (Brown, 2013, pp. 106–112). Since there was no centralised state apparatus in place, this was initially the most practical and fastest way to organise territorial control for the king at Aššur. However, it also created a weakness, that would play out soon.

There were three kings of Hanigalbat, owners of the *Dunnu,* that lived and died during the period that the *Dunnu* was in use. The first is Aššur-Idin, followed by Shulmanu-Musabsi, and then Ilī-Padâ. As an effect of the considerable amount of power instilled in this individual, the house of Ilī-Padâ became a threat to the throne. Although we are not in the possession of explicit evidence, it is quite likely that Ilī-Padâ was one of the 'magnates' who conspired with Aššur-nadin-apli to assassinate his father, the old king Tukulti-Ninurta I (Wiggermann, 2006, p. 95). That Ilī-Padâ was involved seems to be implied by the fact that a few years later, the king of Babylonia addressed Ilī-Padâ and Aššur-nirari III, as 'the two kings of Assyria', suggesting that Ilī-Padâ had profited from the change of power (Wiggermann, 2006, p. 95). It was eventually a son of Ilī-Padâ, Ninurta-apil-Ekur, who usurped the Assyrian crown after a return from Babylon, where he had spent a brief period in exile. We may imagine that henceforth, cynically understanding the risk, no-one else was to be given the opportunities that finally put the kin of Ilī-Padâ in supreme power. This may have been an important motivation for Ninurta-apil-Ekur to put an end to the kingship of Hanigalbat. This spectacle of political intrigue will have had direct repercussions on the status of the *Dunnu*, and its importance as part the power base of its owner (Düring, 2015, p. 62).

After Ilī-Padâ's death and his son's ascension to the throne, evidence for administration drops sharply on Tell Sabi Abyad.

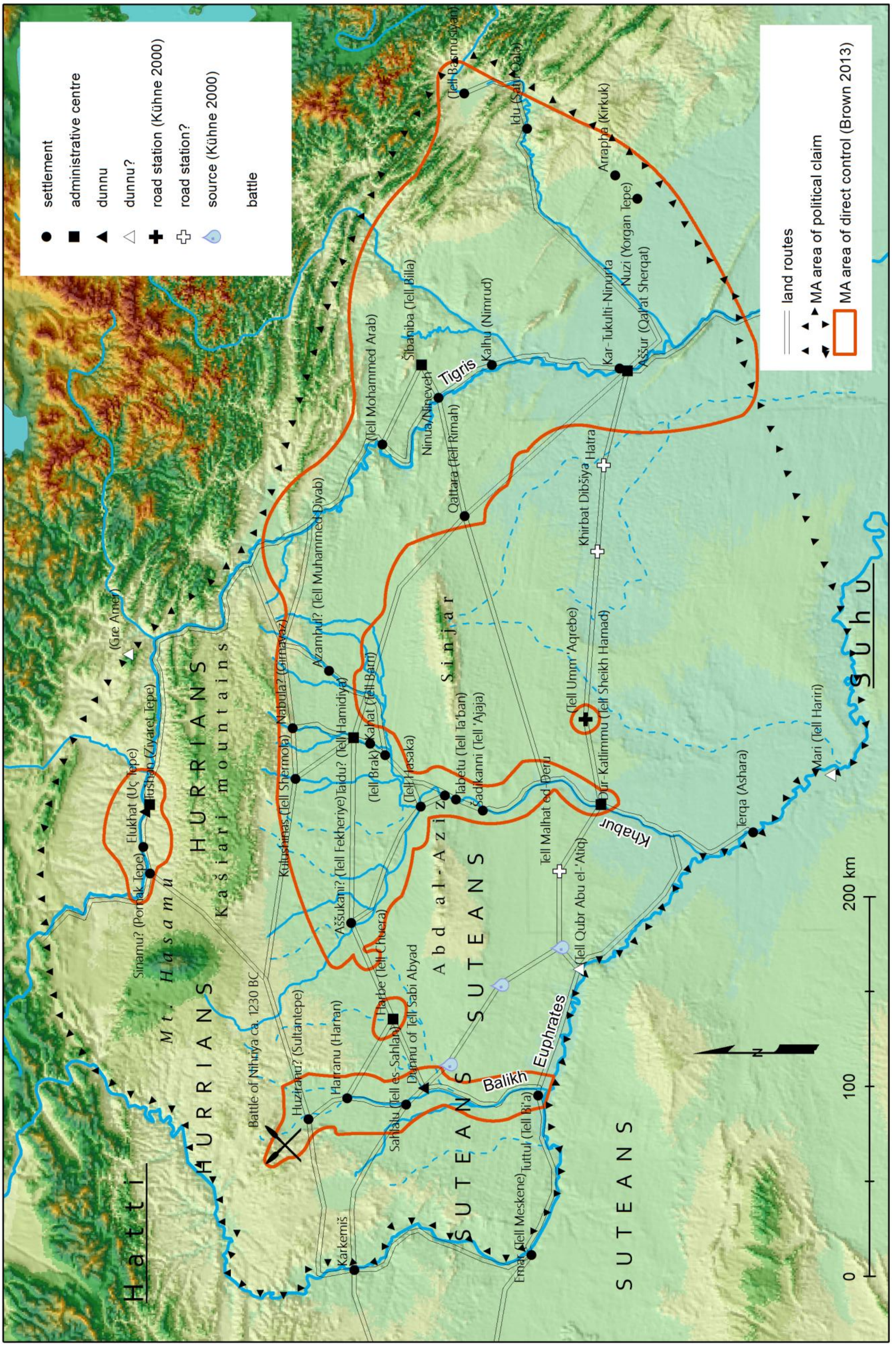

settlement
administrative centre
dunnu
dunnu?
road station (Kühne 2000)
road station?
source (Kühne 2000)
battle
land routes
MA area of political claim
MA area of direct control (Brown 2013)
Hatti
HURRIANS
Mt. Hasamu
Kašiari mountains
SUTEANS
Abd al-Aziz
Sinjar
Suhu
Tigris
Euphrates
Balikh
Khabur
Battle of Nihriya ca. 1230 BC
Karkemiš
Emar (Tell Meskene)
Tuttul (Tell Bi'a)
Huzirānu? (Sultantepe)
Harranu (Harran)
Sahlalu (Tell es-Sahlan)
Dunnu of Tell Sabi Abyad
Harbe (Tell Chuera)
Aššukani? (Tell Fekheriye)
Kulišhinaš (Tell Shermola)
Taidu? (Tell Hamidiya)
Nabula? (Girnavaz)
Azambul? (Tell Muhammed Diyab)
Kahat (Tell Barri)
(Tell Brak)
(Tell Hasaka)
Tabetu (Tell Ta'ban)
Šadikanni (Tell 'Ajaja)
Dur-Katlimmu (Tell Sheikh Hamad)
(Tell Umm 'Aqrebe)
Tell Malhat ed-Deru
(Tell Qubr Abu el-'Atiq)
Terqa (Ashara)
Mari (Tell Hariri)
Sinamu? (Pornak Tepe)
Flukhat (Uç Tepe)
Tušhan (Ziyaret Tepe)
(Gre Amer)
(Tell Mohammed Arab)
Šibaniba (Tell Billa)
Ninua/Nineveh
Kalhu (Nimrud)
Qattara (Tell Rimah)
Khirbat Dibšiya
Hatra
Kar-Tukulti-Ninurta
Aššur (Qal'at Sherqat)
Nuzi (Yorgan Tepe)
Arrapha (Kirkuk)
Idu (Satu Qala)
(Tell Basmusiyan)
0
100
200 km
N

Figure 9 (previous page). Late Bronze Age Northern Mesopotamia and the Middle Assyrian state. Sources used: Cancik-Kirschbaum (Cancik-Kirschbaum, 1996)*, Brown* (Brown, 2014)*, with adaptations, Cancik-Kirschbaum (toponyms 2012), Kühne* (Kühne, 2000)*, Radner* (Radner, 2004). *Otto 2014*

However, we must consider also larger regional and supra-regional developments that may have caused Assyria to pull back from its western territories. The end of the *Dunnu* coincides with the crisis years of the 'Late Bronze Age collapse' of various complex societies in the Western Asia (Van de Mieroop, 2007; Cline, 2014). By the time of the Late Bronze Age Western Asia and the Eastern Mediterranean were part of a tightly connected and globalized world. Due to a complex of – heatedly debated – causes, the system was brought to a grinding halt, and the movement of people, war and destruction of cities that is seen in this era must be viewed as symptoms of this collapse (Cline, 2014). It also affected northern Syria and southern Turkey, the world with which the *Dunnu* of Tell Sabi Abyad was in close contact. In the period around 1190-1170 BC various large and important cities were destroyed, including Ugarit on the coast and Emar on the Euphrates. Both these cities were important polities as well as trade centres through which goods were funnelled towards the Assyrian empire. In the same period one of the most powerful states of the Bronze Age, the Hittite empire, ceased to exist as well. Karkamiš, a city of which we know that the *Dunnu* received some trade from, was controlled by the Hittites. It continued to exist independently, and its king declared himself the heir of the Hittite kingship, but it must have suffered severely from the collapsing polities around it. Inside Assyrian territory, the case of nearby Tell Chuera, ancient Ḫarbe, about 50 km east from the *Dunnu* seems illustrative of the fate of this region. Ḫarbe suffered problems with attacks as well (Cancik-Kirschbaum, 1996), and although it may not have been destroyed by it, it was in the end simply abandoned during the 12th century. More similar cases can be pointed out (Brown, 2014). Although this seems to suggest an Assyrian abandonment of these territories, there was not yet a definitive retreat. Historical sources indicate that after the dead of Tukulti-Ninurta I, there was a period of turmoil, corresponding also to the abandonment of aforementioned sites. However, during the reigns of Tiglath-pileser I (1114–1076 BCE) Assyria seems to have regained some of its control of the western territories (Postgate, 1992, p. 249). This is corroborated by the archaeological evidence. New discoveries gradually start to reveal to us a fortified border along the upper and middle Euphrates (Tenu, 2023). These fortifications with Assyrian material culture and administration indicates a defensive stance and an attempt to regain and preserve territorial control in the 12th and 11th centuries. However sites like the *Dunnu* of Tell Sabi Abyad, that were abandoned in the period of Assyrian political crisis and wider regional turmoil, did not recover their former status. Although Assyrian presence is continued on a lower level, it generally seems that the Balikh was abandoned by the high-ranking political elite responsible for developing the area (Brown, 2013).

II.9 The situation in Western Assyria

Even before the Assyrian abandonment of the Balikh, the impression given by various sources, from Tell Sheikh Hamad to Tell Sabi Abyad, is that the western part of the empire was never entirely stable. Texts from Tell Sheikh Hamad refer to problems with *nakru*, or 'enemies', probably Hurrians, remainders of Mitanni supporters (Cancik-Kirschbaum, 1996). They occupy the area of the Kasiari mountains in the north, and attack convoys and cities, like Tell Chuera, 50 km east of Tell Sabi Abyad (Jakob, 2014). Moreover, these sources frequently allude to the danger of the looming presence of the Hittites. Large military operations by Sîn-Mudammeq (a general serving under Ilī-Padâ) extending over the entire Balikh and further west to round up prisoners (of war?) trying to flee back to Karkamiš is illustrative of the tense situation. On other times however, Ilī-Padâ comes in support of Karkamiš with an army to Emar to help suppress a rebellion there. Emar was under the control of the king of Karkamiš. Even though at times enemies, there is probably a shared interest by the Assyrian and Hittite state to collaborate on this level. Cities such as Emar were important trade hubs, connecting both states. More generally one can suppose this was a shared enemy that was more effectively combatted together.

Another group that offered some challenges to the Assyrian state were Suteans, a nomadic people that inhabited the steppe in between Balikh and Habur, and south of the Euphrates. They were not unfavourable towards the Assyrians, as Assyrian state officials relied on their knowledge of steppe and desert routes (Wiggermann, 2010, p. 37), used them for intelligence about enemy movements (T93-2, T04-13), and even invited them to official dinners (T93-3). However, a treaty with the Suteans found at Tell Sabi Abyad (T04-37) lists them as enemies but for one group or tribe, so-called Nihsānu Suteans (Wiggermann, 2010, pp. 55–56). The agreement stipulates that the Nihsānu Suteans are not allowed to shelter enemies of the state, e.g. Kassites, Suheans, Subareans, Hittites, and other Suteans. Another article provided for the reimbursement of possessions taken by Assyrians from Suteans and taken by Suteans from Assyrians. This alludes to previous injustices enacted by both sides against the other, and the treaty was probably a way to resolve such tensions. Apparently, the Assyrians saw the friendship of these Suteans as beneficial. Or at the least acted out of pragmatic motives in absence of military capacity to expel or supress them. Quite interestingly, the last two articles – out of six – are arrangements regarding beer consumption. The treaty states that beer bought by Suteans from the *Dunnu* is only allowed to be consumed in their own camp. Moreover, it requires that Suteans should leave a deposit when beer could not be paid for directly, and ensured fair treatment of Suteans by Assyrians collecting open beer bills. The last were apparently picking random Suteans for the settlement of debts made by others. In conclusion, the treaty gives us valuable insight in the conditions of the western Empire, as it reflects a situation where the Assyrian state is looking for allies in a potentially hostile environment.

II.10 The role of the *Dunnu* in networks of trade, supply and communication

In the previous it was shown that the *Dunnu* of Tell Sabi Abyad was located near the western frontier of the Middle Assyrian state. This is a fact that cannot be emphasized enough, as it explains a lot about the role and fate of the *Dunnu.* Here, the Assyrian state was bordered by Hittite vassal states and prosperous cities Karkamiš and Emar, trade hubs receiving goods from Canaan, Turkey and Egypt

(Faist, 2006). Trade from the west must have accessed the Assyrian empire on at least three points. A northern route ran from Karkamiš to Huziranu and is attested for instance in a letter from Dur-Katlimmu listing the stops of a caravan that was attacked after the town of Ḫarbe (Cancik-Kirschbaum, 1996). A southern route ran from Emar to Tuttul. For this route, there is little direct evidence, but it is implied by geographic logic and the fact that both places were important centres during the Late Bronze Age. However, the evidence seems to suggest that during Middle Assyrian times at least, the trade balance tilted towards the northern routes. A central route must have led from Karkamiš towards the *Dunnu* of Tell Sabi Abyad. As identified by Kühne (Kühne, 2000), from the *Dunnu* eastwards the route continued through the steppe following springs and probably had road stations at regular distances, passing Dur-Katlimmu and finally reaching Aššur. The importance of keeping this route open for travel and trade is implied by the attestation of policing activities, which is how Wiggermann (2010, p. 39) interprets the supplying of passing groups of chariot teams at the *Dunnu*.[8] As far as we can tell, the international trade goods administrated in the *Dunnu* came from Karkamiš. At the *Dunnu* such trade had to be cleared before travelling on to Aššur, and it has thus been characterised as a custom post (Akkermans, 2006, p. 201; Akkermans and Wiggermann, 2015, p. 109). It must be emphasised however, that the evidence for these statements is just a single letter (T 93-20)[9], in which a trades representative of the house of Ilī-Padâ demands all trade from Karkamiš to be checked and sealed before transported further east.

It is interesting to linger briefly on the question of why the *Dunnu* was chosen as place for a custom post, and what this essentially meant. From the perspective of lines of communication, the *Dunnu* of Tell Sabi Abyad is located on a strategic point. It is on a nearly straight line between Karkamiš, Dur-Katlimmu, the capital of the western half of the Middle Assyrian Empire, and finally Aššur. Any trade or message with a direct destination to either Dur-Katlimmu or Aššur without delay, would thus take this route. However, trade caravans generally trade along a series of towns, not necessarily taking the most direct route from one point to another: they went were the commerce was at.[10] Perhaps excluded to this mercantile logic are the trade interests of the palaces and the kings, who controlled a large part of the trade and the merchants. From the point of view of the central authority in Aššur a fast and direct line with the west would be preferred, both from the perspective of internal communications, as well as fast supply route for goods. It is possible to see the location of the *Dunnu* in this light, since through Ilī-Padâ, it was connected to the trade interests of the central authorities. Another observation supporting the idea of a specific and special role of the *Dunnu* in the trade of the Middle Assyrian empire, is its relative position on the Assyrian frontier. Although the *Dunnu* has been characterised as a frontier

[8] As found in T 93-4 and T 98-12.
[9] Part of the content is published in Wiggermann & Akkermans (2015).
[10] See Faist (2006, p. 157) for the suggestion that the Middle Assyrian state gave much room to independent entrepreneurialism, as opposed to the palace economies of Ugarit and Nuzi.

settlement (Akkermans, Limpens and Spoor, 1993) and a place where goods were cleared, it was not necessarily always the first Assyrian locality on the way from Karkamiš to the Middle Assyrian empire. Depending on which route one took, this was in many cases the much larger town of Saẖlalu, modern tell Sahlan, just a short day walk from the *Dunnu,* and possibly other places under Assyrian control further west. These settlements will have attracted caravans. It is therefore possible that the *Dunnu* was just one of the various locations where goods were cleared, and probably not all goods coming from the west and heading for Aššur went past the *Dunnu.* Trading caravans often took detours, following the chain of settlements. The *Dunnu* however is located on the crossing of a steppe route that went to the Habur and Aššur in a straight line. Hence, for a specific category of goods, the *Dunnu* may have been used as a station and a reliable line of communication in general with the capital.

A north-south route following the Balikh river valley also passed the *Dunnu*. This route was the main line of communication between the settlements of the Balikh valley, and was more of intraregional importance than the east-west route, which, as discussed, functioned as an artery for international trade and communication between the different regions of the empire. But also on the north-south route, the *Dunnu* seems to be located on a strategic position: about half-way the Balikh valley basin. This position would make it a practical central place or a base of operation in the valley. Also, it made the *Dunnu* easily reachable for people needing business with Ilī-Padâ or his representatives. That communication along this line was important is abundantly reflected by the texts of *Dunnu*. Towns such as Ḫuzirānu and Ḫarrān in the northern half of the valley, as well as Tuttul at the southern end, are mentioned relatively frequently in the texts. How easily communications and flow of goods went along this line is reflected for instance by tablet 98-77. The text records a debt of 6 doves, 4 turtle doves and one *mesukku*-bird of the governor of Ḫuziranu to Buria, the chief steward of the *Dunnu* before Tammitte (Wiggermann, 2010, p. 38). The north-south route will also have connected the various *dunnu's* that are attested in the texts of Tell Sabi Abyad. A total of six other *dunnu's* are known from the texts of Tell Sabi Abyad[11], some of which also occur in texts from Dur-Katlimmu. Although of none of them we know the precise spot, they were certainly located in the ambit of the Balikh valley.

Other connections that appear important based on the relative times that they are mentioned in the texts are Aššukani and Šuadikanni (both three times). Aššukani is often identified with Tell Fekheriye on the upper Khabur. Its reference in the texts of the *Dunnu* makes sense, as it is the closest connection to the Khabur river valley and most certainly the route of caravans not heading for Aššur right away. Surprising absentees from the *Dunnu's* texts are Ḫarbe (modern Tell Chuera), not far from the *Dunnu* on route to Aššukani, and Dur-Katlimmu, supposedly the western capital and the important intermediary stop

---

[11] Dunni-Aššur (possession of Sin-Mudammeq, the second most important in command), Dunni-Dagal, *Dunnu*-ša-Buria, *Dunnu*-ša-Kidin-ilāni, Dunni-ša-Šubrê, *Dunnu*-ša-Urdi.

between Aššur and the *Dunnu*. We can only explain their absence as a result of the rather small sample the texts represent. Texts from Ḫarbe (Jakob, 2009) do also not explicitly mention the *Dunnu*, but they do regularly refer to messengers being send to and from aforementioned Saḫlalu/Tell Sahlan, the largest Middle Assyrian site in the middle Balikh.[12] With 10 references, Saḫlalu is also the most frequently mentioned toponym in the *Dunnu* texts, which may be attributed to its vicinity to the town. In the context of messages from Saḫlalu to Ḫarbe, a certain Mannukîja is mentioned, who is supposed to supply horses and chariots to the elite soldiers of general Sîn-Mudammeq (Jakob, 2009, letter 11). It is quite likely that in fact Mannu-kî-Adad is meant, the earlier steward of the *Dunnu*, in this instance referred to with his common nickname (Jakob, 2009, p. 51). It fits in well with the picture we get from a few of the texts of the *Dunnu*, which indicate that the *Dunnu* supplied Assyrian soldiers with food, horses and chariots (Wiggermann, 2010, p. 39).[13,14]

II.11 *Dunnu*'s in the Balikh valley

The Assyrians established various *dunnu's* in Balikh valley and brought in people deported from elsewhere. This could be taken to imply a deliberate strategy of control and even 'colonization', unheard of in preceding periods of history and unique to Middle Assyrian territory (Düring, 2015). We know the names of six other *dunnu's* in the Balikh valley: Dunni-Aššur, Dunni-Dagal, *Dunnu*-ša-Buria, *Dunnu*-ša-Kidin-ilāni, Dunni-ša-Šubrê and *Dunnu*-ša-Urdi. Where exactly they were located, we do not know, although some approximations are possible. As may be expected, their distribution would have followed the general orientation of the river.

Unfortunately, we know very little about how they related to the already present settlement pattern: did they take over administrative and economical functions from existing sites and centres? Already noted above was their exceptional number in respect of the total number of *dunnu's* known from Middle Assyrian sources, which points at the unique conditions in the Balikh. As discussed, in the absence of a well-organized and centralized 'urban' landscape characterised by towns and hinterlands, a *dunnu* system may have been an appropriate approach. The largest part of the resettled rural population will not have lived in these *dunnu's*. This is at least the impression we get, on the basis of population estimates of the dependents of Tell Sabi Abyad's *Dunnu*, who can never have all lived at the *Dunnu* (Wiggermann, 2000). But the number of known sites within the catchment of the *Dunnu* is too small to accommodate all these people. Some kind of dispersed settlement pattern with small isolated farmsteads

---

[12] 12 times the town of Saḫlalu is mentioned in the texts from Ḫarbe, which makes it the second most frequently mentioned toponym after Ḫarbe itself (Jakob, 2009, p. 163).

[13] Evidence for chariot production and provisioning chariot teams is found in tablets T98-7, T98-12, T98-41 and T98-56.

[14] Mannukîja is mentioned one other time in Ḫarbe when he stops by for provisions, interestingly accompanying Hittite envoys to the town of Aššukanni (Jakob, 2009, letter 54).

outside the major tells may explain this absence. These are harder to pick up using the extensive survey methods focussed on tells employed by the surveyors. However, small villages are explicitly mentioned in T 96-36:

> "Give out the seed corn of the chief farmers of the villages which they did not yet receive, and give out seed corn to Kurbānu, so that he can cultivate the field (in the district) of Sahlalu, which Sin-mudammeq himself showed him."

These villages do not necessarily have to be searched for in the direct vicinity of the *Dunnu* as one of the receivers of seed corn is located in the district of Sahlalu, which is 12 kilometres away. The seed corn that is talked about may not even have been stored at the *Dunnu.* It simply confirms the administrative influence of the *Dunnu,* which seems to have reached beyond its local catchment, set as a circle with a radius of 5 km. The *dunnu's* will thus definitely have influenced the pattern of settlement in the valley, but the manner in which remains unclear until other *dunnu's* and associated settlements are found.

As proper *dunnu's,* they will mostly have focussed on the agricultural exploitation of the river valley and on managing the pastoral economy. This is at least the focus that is revealed by the texts found at Tell Sabi Abyad. It is not clear how similar or different the various *dunnu's* in the Balikh valley were from each other. But it is unlikely that they were all exactly the same. For instance, not all *dunnu's* would have acted the same as the *Dunnu* of Tell Sabi Abyad in being a border post through which goods heading to Aššur were cleared. Nor might all of them have produced chariots. Perhaps they all specialised in a certain manufacturing industry, or perhaps others functioned purely as large state-run farms and had no other functions added, although the last seems unlikely. At least for two of them, Dunni-Aššur and Dunni-Dagal, there are clear indications that they were more than large, defended farms with some administrative functions. Both can be considered proper fortresses with a military function since, according to letter 2 from Dur-Katlimmu, they housed contingents of soldiers (Cancik-Kirschbaum, 1996). In this letter, Dunni-Aššur is referred to as the stronghold of Sîn-mudammeq, a general serving under the grand-vizier Aššur-iddin. Important to our understanding of the role of *dunnu's* in the Balikh valley is that both Dunni-Aššur and Dunni-Dagal are places from which Sîn-mudammeq can draw soldiers for a large-scale military action in the Balikh chasing run-aways. Although the *Dunnu* of Tell Sabi Abyad on occasion supplied a passing army with food (T 98-119) there is no evidence that it housed soldiers permanently. Several buildings in the northern part of the settlement have been tentatively suggested by the excavators to be barracks. We will return to this issue in the synthesis (VII.6.7).

II.12 Conclusion

In this chapter the physical and historical conditions of the foundation and functioning of the *Dunnu* have been discussed. These conditions would have had repercussions on the architectural forms, spatial organisation and building activities at the *Dunnu*. Hence, we may interpret the form of the architecture in the light of the insecure political and military situation, but at the same time as a result of a longer tradition in '*dunnu* construction'. However, as we have few incomplete examples of *dunnu's* and potential *dunnu's*, we cannot identify how much was borrowed from this tradition, or to what degree it was innovated in order to suit the local conditions with all encountered problems. Settlement foundation is often a combination of ideal form and pragmatic decisions adjusting to local circumstances. The Assyrians are likely to have worked with some basic understanding or even a theory – be it implicit or explicit - about what constitutes a good *dunnu.* Surveyors and engineers involved with its construction must have had some frame of reference. Considering the diversity of the functions *dunnu's* would have combined, it is likely that they used a modular concept. Functional modules could be added or removed at wish. This is not different from other examples of multi-functional settlements in history, which probably were all a combination of planned action and ad-hoc adaptation.

Considering the historical and geographic context discussed in this chapter, the most important functions that the architecture should fulfil in the case of the *Dunnu* are to produce and secure grain harvests, offer a central place for administration and jurisdiction on occasion, and manage trade. It had also an important function in managing and controlling people. Goods had to come in, go out, be stored, given out as rations, etc. Above all, in some way it needed to convince people that their live was managed, and that the ones in power did that for you. In order to do this, a *dunnu* needs to be looking outwards, as well as looking inwards. That means that the interior needs to be secure enough that people do not easily enter, steal or take possession of the *Dunnu*, while at the same time allow people to come inside to do their daily business: stowing away harvests, producing bread, pottery etc. In the final chapter (VII), we will return to this topic and discuss how these deductions tie in with the archaeological evidence and analysis of the reconstructed built environment.

However, first we need to concern ourselves with the nature of the archaeological evidence. The current chapter formed the deductive framework: we tried to hypothesise what *dunnu's* generally are and what they were in this particular historical and geographic context. In the next chapters we shall focus on the archaeological data.

III. The Archaeology of the *Dunnu* of Tell Sabi Abyad

Excavations on Tell Sabi Abyad started in 1986. The initial primary focus of investigation was the Neolithic settlement, but soon the remains of a Late Bronze Age fortified settlement, a *Dunnu*, surfaced as well, which has been under investigation since the late 1980s (Akkermans and Rossmeisl, 1990; Akkermans, Limpens and Spoor, 1993; Akkermans, 2006; Akkermans and Wiggermann, 2015). It was excavated by teams of primarily students and staff from Leiden University and locally hired workers lead by professor Peter Akkermans until 2011, after which work came to a forced halt as result of the war in Syria. The excavations have largely unearthed the Late Bronze Age settlement, although minor parts remain unexcavated. Of the core settlement within the exterior fortification wall, the excavated area is about 90%. Most of the remaining 10% consists of square balks that were left standing. Since these are comparatively minor features, and form no large contiguous blocks, we can relatively confidently reconstruct many missing parts. However, not in all squares the earliest Late Bronze Age levels have been uncovered, which contributes to a mildly biased picture in favour of the higher levels which were uncovered more completely. If we take the whole settlement, including all areas on both sides of the moat, only an estimated 55% has been excavated. However, this number depends on the estimate of the original extent of the settlement, which is hard to assess since it is clear that the edges have largely been eroded away. Nevertheless, the ratio of excavated total area to the complete original settlement area is large compared to other excavated sites. The conclusion is thus that we have a comparatively complete picture of the settlement, which increases the analytical potential.

III.1 Stratigraphy and chronology

The settlement was founded on a Neolithic habitation mound dating to the Late Neolithic. In many cases, Neolithic cultural material including sherds, installations, and buildings, are found directly below Late Bronze Age walls and floors. The stratigraphic make-up of the Late Bronze Age settlement reveals various periods of use, natural decay, and instances of demolition and construction. Each of these left characteristic traces in the stratigraphic record. In most cases, not much material is deposited on the initial floors, indicating active usage and cleaning. On various places, this is interrupted by layers of variable thickness (20-110 cm) containing primarily construction rubble. This is generally followed by a new floor and a new use-phase. Therefore, such stratigraphic sequences most likely indicate demolition and construction. The number of such consequent rebuilding cycles varies between groups of buildings, which makes it hard to understand the chronological relations between these events. In certain other areas during the primary use phase of the *Dunnu*, and especially in the 'after-life' of the *Dunnu*, we find stratigraphic units consisting of layered or laminated sediments. These reflect periods of natural decay, although they are often mixed-in with cultural material, suggesting that during such phases use would have continued. The thickness of the single distinguishable layers of sediment in a larger deposit of layered sediments varies significantly. This is indicative of a variable rate of decay, and infill through eolic sedimentation and erosion of the architecture. Such rates may be depending on the architectural context, importance and use of a certain area. See chapter 3 for further discussion of these issues.

Main phase	Level	Character
?	7	Pre-Assyrian/Mitanni. Precise extents unclear. Focussed on single central building but possibly with certain use area around.
1230 BCE *Dunnu* phase 1184 BCE	6	Beginning of Assyrian *Dunnu*, construction, active usage, occasional rebuilding. Administration.
	5	End of Assyrian *Dunnu*, internal function shifts to pottery manufacture. Administration.
HEAVILY BURNT MATERIAL – PRIMARY TABLET CONTEXTS		
ABANDONMENT	ABANDONMENT	ABANDONMENT
Farmstead phase	4	Re-use of *Dunnu*, domestic. Some manufacture. Some renovation & some new light architecture.
	3	Similar to level 4, but locally already built over primary phase settlement walls.
ABANDONMENT	ABANDONMENT	ABANDONMENT
Late phase	2	Completely new buildings running over older architecture. Heavy architecture.

Table 1. General archaeological chronology of the Dunnu.

Very generally, we may divide the stratigraphy in a primary use-phase, characterised by relatively little deposition, a secondary use phase characterised by much deposition of material, and a tertiary use-phase during which the original settlement was completely buried and oveuilt. The primary use phase is in some places ended by a large fire, which left a distinct stratigraphic mark in large areas of the settlement. Floors and walls are burnt red, orange and green, while burnt mud brick rubble, construction wood, blackened barley and chaff is found on top of floors and within room fills. Sedimentation and additional rubble layers generally follows the burnt layer, and over time new architecture is added, or older buildings are re-used. Buildings may be partly renovated, but in other cases new use-surfaces occur on top of rubble layers within buildings that do not in all cases seem to have been roofed anew. It is clear that habitation occurs in between ruins, which by chance also justifies the designation 'secondary use-phase' qualitatively. At some point, walls are built over the remains of the walls of the first settlement, indicating that the ruins were now almost completely eroded and covered up.

Figure 10. Plans made for levels 6, 5 and 4, colours indicating important zones of modification from level 6 to 5. Colours by author (after Akkermans and Wiggermann, 2015).

Akkermans' interpretation of the stratigraphy distinguishes 7 levels (Akkermans and Wiggermann, 2015). The boundaries of these are however often hard to draw due to phases of continuous use and architectural renewal, which will be discussed in detail in chapter IV and V. Complete and synchronised settlement plans are therefore difficult to produce, and may give a somewhat misleading picture of certain fixed architectural phases. This is problematic for levels 7 through 5, between which no site-wide stratigraphic boundaries exist. It is clear however that by the end of level 5, most areas have risen in elevation due to decay, sedimentation and architectural renewal. On the other hand, some areas have not risen at all, or not at the same rate as others, producing variations in accumulated levels. The fire at the end of level 5, and the messy state of the subsequent layer due to abandonment, scavenging and collapse, did most likely occur in a relatively narrow time-frame. It forms a distinct stratigraphic end-point for level 5 and the primary use-phase, interrupting the continuous use-cycle. Levels 4 and 3 are part of the secondary use-phase and show stratigraphic continuity in a phase during which the buildings of the primary use-phase are still present, but in an increasingly ruined state. Level 2 is formed by the establishment of a heavy walled building on top of the ancients remains of the *Dunnu*, clearly disregarding the older architecture, and indicating that we are dealing with a new settlement altogether. Level 1 is not relevant here, but it is used to indicate the mediaeval Islamic burial ground on top of the Late Bronze Age remains.

III.2 Dating

Accurate dating is possible both through dates mentioned on the cuneiform tablets, and C14 dating. A few tablets contain Assyrian *limus*, or year-names (Figure 11), which allows us to date administrative activity on the *Dunnu* from 1229 to 1184[15] [16]. However, by far the largest number of dated tablets are found in the range of the years 1197 to 1184, peaking in 1188-1187 (Figure 12). Moreover, only 3 of the 12 datable tablet collections contain tablets that belong to the period before 1197 (Figure 13). It is important to emphasize that this uneven temporal distribution of dates is not reflective of the intensity of administrative activity in certain periods, but a result of the habit of recycling clay tablets after their use has expired. Only some tablets are preserved, for instance if they contain information that must be preserved or more accidentally as part of random discards that were not recycled (Klinkenberg and Düring, 2023). As regards to the latest dated sources, a few tablets referring to a certain ‘lord’ Kidin-Sîn seem to post-date the primary use-phase. Nonetheless, the main administration of the Assyrian *dunnu* stopped in or just after 1184.

C14 dating has been performed on eight samples taken from early stratigraphic contexts, representing the potential inception of the *Dunnu* and late ones representing its end[17]. These suggest a starting point at 1297

[15] Dates used in this study follow the Middle Chronology.
[16] The *limus* have been identified and listed by Frans Wiggermann and shared in internal documents with the research group. Publication of this entire corpus is forthcoming.
[17] Executed by the Centre of Isotope Research, University of Groningen.

+/- 64 BCE, and a final date of 1121 +/- 66 BCE. This covers and extends the period of use as indicated by the tablets, which is expected considering the small subsample of tablets with surviving *limu* dates. The C14 dates are thus a more realistic reflection of period of habitation, albeit with a for this context relatively large margin of error.

Figure 11. Location of tablets with limu *dates* (after Klinkenberg, 2016, fig. 4.31).

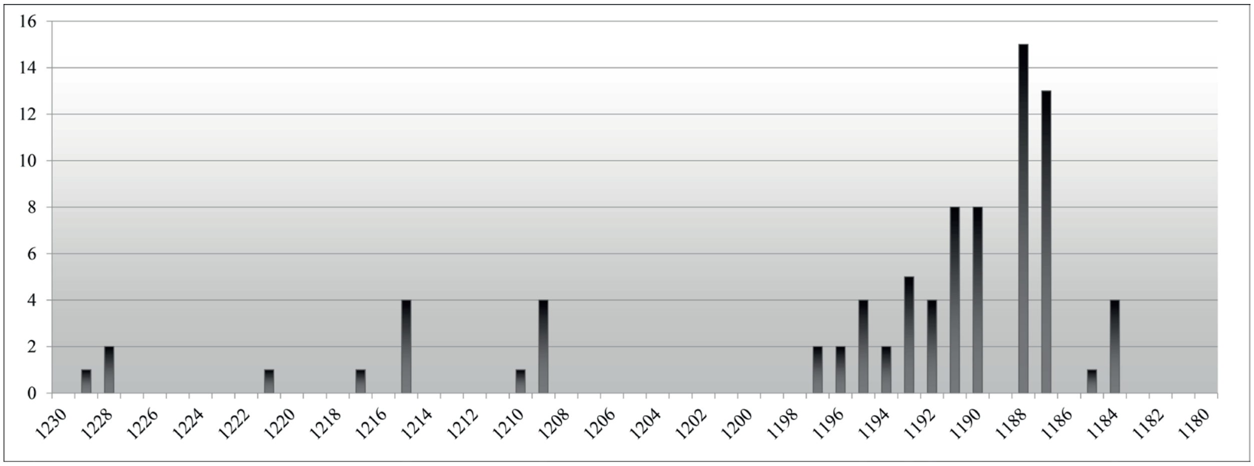


Figure 12. Number of dated writing tablets for each year, showing a peak in the final years (after Klinkenberg, 2016, fig. 4.30).

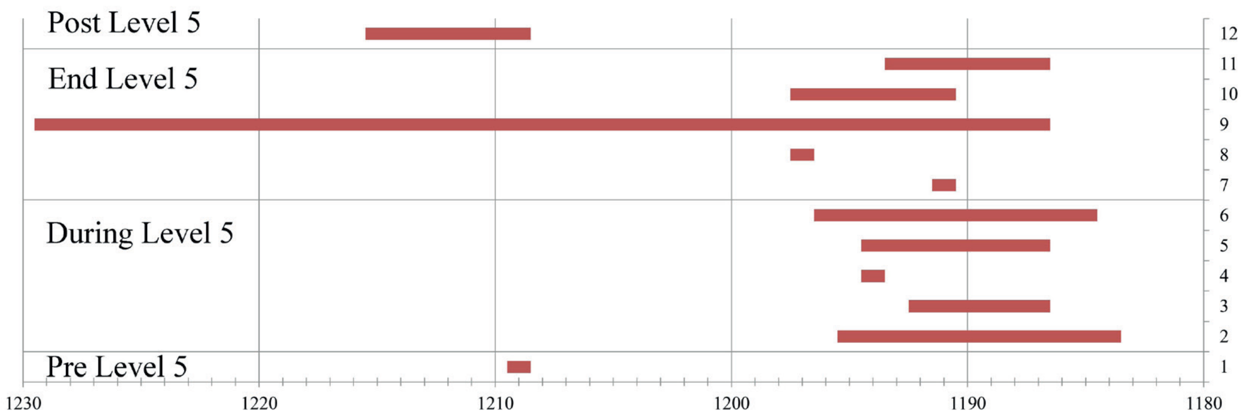


Figure 13. Dating ranges of the various limu *dated tablet groups* (after Klinkenberg, 2016, fig. 4.32).

III.3 Cuneiform tablets

About 400 clay tablets containing written evidence of administration and correspondence were excavated. Most tablets occur in larger concentrations. Since such groups often also show much coherence regarding the involved individuals and administrated activities, we may speak of private 'archives'. On the other hand, much is missing, and they represent only a very small subset of the total of writing once present on the site. Moreover, many strays and refitted tablets indicate that the archives were much meddled with during or after discard.

Six larger concentrations of tablets were excavated, and many smaller ones, or single, isolated ones. Klinkenberg's analysis of the contexts of deposition showed that most of the tablet assemblages were discarded as secondary refuse (Klinkenberg, 2016). In one case, the archive belonging to the last steward, Tammitte, found in the north-western corner, the tablets are multi-directionally distributed in a 30 cm thick earth layer, clearly indicating they were deposited as part of that layer. Others were found in large scatters on top of floors, indicating that they had been moved from their original location. In a few instances only, collapse had saved tablets from being re-located from their original place of discard or storage.

The tablets show us a world otherwise unknown to us, but at the same time also a world that is confirmed by the archaeology. They confirm the picture of a settlement that is primarily involved with food production and storage of crops, mainly barley, and played a central role in the pastoral economy (Wiggermann, 2000). On the other hand, the tablets give a rich view on the internal logistics and organization of production and storage, international trade, judicial matters, and the background and identities of the people that lived here (Wiggermann, 2000, 2006, 2007, 2010).

III.4 Architecture

The architecture of the *Dunnu* will be subject of two detailed chapters in this dissertation. This paragraph aims to give an introductory overview. The architectural remains of the *Dunnu* consist of mud brick walls which have been preserved relatively well. However, the level of preservation varies considerably: the best-preserved parts were still standing three meters high, while at the worst preserved parts no architecture at all is found due to heavy erosion around the edges of the settlement. At the boundary of the preserved area, of many walls just a few centimetres remain standing. This state of affairs clearly impacts our ability to reconstruct the original architecture and understand the function of the buildings, or more general the spatial functioning of the *Dunnu* as a single larger unit.

Walls are universally built of large square mud bricks, measuring 36 cm to 42 cm in width and 9 to 12 cm in thickness. Such bricks weigh on average 20 to 25 kg each, which is just about the weight that can be handled with some ease using two hands. Wall width varies significantly, from 1 to 7 bricks, which is indicative of differences in structural function, discussed in chapter 7. Wall construction is simple and straightforward, using running bonds and is, certain exceptions aside, characterised by an absence of foundation trenches. Vaulting is applied over narrow passages, such as doorways and corridors, and for stairway construction. For the existence of larger vaults there is no evidence, although its absence cannot be does not mean absence of presence, since Bronze Age architecture from other sites in the Western Asia supplies us with ample parallel evidence for the use of larger above-ground vaults of up to 3 meter (Besenval, 1984; Oates, 1990). Roofs were however most likely primarily of the flat mud terrace type, constructed of beams crossed by purlins covered by reeds and 30 to 40 cm of loam. Some remains of burnt construction wood have been found and occasionally imprints of the reed coverage that formed a membrane to keep the loam roof deck in place. However, only very few pieces of construction wood have been found of a sufficient circumference to cover the larger spaces of up to 5 meters. This is surprising, considering the large-scale fire that ended the primary phase and thus the potential incidence of timber preservation. This may indicate that significant scavenging and re-cycling of construction materials did take place afterwards.

One well-preserved stairway has been found in the centrally located ‘tower’ building. The spaciously dimensioned and heavy, vaulted construction of this stairway suggests that it did not just run up to a roof, but had at least one and perhaps a number of additional floors. Two more stairways were identified along the fortification wall, which thus gave access to the wall-way and the appending buildings. Although no steps were preserved, perhaps indicating a lighter construction method using more easily decayable materials, the long and narrow rooms can hardly have been constructed for any other purpose than to hold the steps of stairs.

The general architectural layout of the *Dunnu* is formed by a core consisting of two large near square buildings in the middle, their architectural character differing strongly. One being extremely heavy, with 9 small rooms arranged in a tree like configuration, the other showing a distinct plan with a large central space winged by two ‘apartments’ fitted with bitumen-sealed baked tile pavement bathrooms. Clearly, the first building is rather utilitarian in nature, and has been named ‘the tower’ and ‘the fortress’ in the excavation documentation for reason of its thick walls, the other was residential in nature, and has been characterised as a ‘palace’, in earlier publications. Whether the remains justify the term ‘palace’ is questionable, but it was most definitely the residential area of important individuals. These two large buildings are surrounded by a continuous ring of open space of varying width, on the other side of which we find more buildings perched against a large encircling fortification wall. The variety in form and size of these buildings probably also indicates a variety in functionality. Two gates, an old, and a new one, are found in the northern façade of the fortification. The old one is integrated in the architecture and loses its function after the construction of the new gate, which is, curiously, slightly less heavy. A small postern gate, or back door, is found in the south-eastern corner. Outside the fortification wall a 6 to 16-meter-wide space boasts what seems a relatively dense concentration of architectural structures. The entire complex discussed so far is encircled by a three-meter-deep dry moat that can as far as we know could be crossed on just one place in a certain period. This passage shifted during the use of the *Dunnu* from the northern part of the western side to the western part of the northern side of the *Dunnu*. Other crossings are not known, but large parts of the moat remain to be investigated. The moat seems to have served as a measure of defence only temporarily, since it filled up during the use of the *Dunnu* and is even overbuilt at some point. This must have occurred late in the primary use-phase. Outside the moat, yet more buildings are found, which show less variation in wall construction width and room size than the core. These have occasionally been characterised as barracks or stables by the excavators, however in absence of good evidence for their usage.

The precise extent of this outer shell of architecture is unclear due to partial excavation and poor preservation.

The architectural characteristics seem to justify the classification as a fortified settlement that housed a number of people and functions, which is in general what a *dunnu* is expected to be.

III.5 Moveable objects

The registered object assemblage of the *Dunnu* of Tell Sabi Abyad counts nearly 10.000 objects, which cover all late Bronze Age settlement phases hence also the post-Assyrian phases (Klinkenberg, 2016). By far most objects are stone implements or ceramic vessels, which are indeed the material categories that preserve best. Including the clay cuneiform tablets, stone and clay objects constitute over 95% of the total number of finds. Bronze objects include 11 arrow heads, two daggers, two axes, a hoe, a sickle, four spear heads, one bowl, a razor, jewellery, a few (cloth) pins and small tools. Bronze objects are thus relatively rare, which is to be attributed to the value of the material which make them susceptible to re-use or recycling. Some of the larger objects, such as undamaged spear heads, the bronze bowl, and axes were clearly lost in catastrophic collapse related to the fire at the end of the first use-phase (Klinkenberg, 2016, p. 160). Other objects include relatively small numbers of glass (beads) and bone (combs, needles) items. Although many smaller and larger objects such as a wide range of tools and weapons would have been made partly or completely of perishable materials such as wood and reed, none of this has survived. Especially reed would originally have been used in plenty for furniture, mats, constructional elements and especially baskets of variable size and function. In the excavations of Neolithic Tell Sabi Abyad evidence for wickerwork was more regularly found, mainly preserved as impressions in bitumen (Berghuijs, 2013). Its relative absence in Late Bronze Age contexts may mean that in the Late Bronze Age wickerwork was not as commonly waterproofed with bitumen, or that pottery was more universally used as a container. Other plant-fibre materials such as cloth and rope did also not survive apart for its occasional impression in pottery.

III.6 Fixed features

Fixed features, also known as installations in archaeological practice, include primarily (bread) ovens, cooking places, hearths, bins and kilns.[18] Approximately 220 bread ovens belonging to the primary phase (levels 7>5) were found. Such ovens are generally circular and range in size from 35 to 100 cm, and are

[18] Inventories and reports on the fire features (ovens, kilns, hearths and cooking places) and bins were written by student interns Donna de Groene (de Groene, 2015) and Dimitri Jachvliani (2015).

most commonly 50 to 70 cm in diameter. They resemble ovens used in traditional settings today known as *tannur,* which etymologic origin can be found in the Akkadian word for oven (and kiln), *tinûru* (Tkáčová, 2013). About 25 hearths, which may have been used for cooking as well, and five built-in cooking places were excavated. The cooking places take the form of low U-shaped niches which were used to contain the fuel for a fire, while their low walls supported a cooking pot. All are located along the walls of the same room, which is thus identified as a 'kitchen'. A total of eight up draught pottery kilns were excavated: four outside the walled part of the settlement, and four within the walls.[19] The exterior kilns are early in date, and are taken no longer in use during the primary phase, while the interior kilns are late additions and seem to indicate a functional shift in the fortified core of the *Dunnu*. About 80 bins have been identified, which come in a variety of shapes, sizes and construction materials. Bins are generally rectangular constructions with walls shaped out of clay or constructed of mud bricks. A few larger bins have been described as 'silo's' in the excavation notes, but there is no indication these were indeed used for grain storage. The precise use of bins is not clear, but many of them are relatively small and are likely to have fulfilled the function of short-time storage for goods or foodstuffs. Also, a number of installations that relate to the water/waste management of the settlement such as toilets, cess pits, gutters, irregular drainage channels, and small basins have been identified. No wells were located on site, nor any large basins, which implies that water had to be carried to the summit of the tell from the nearest irrigation channel and stored in vessels.

III.7 Functions and activities

The objects and the texts found in the excavations give insight in the range of human activities, and the general functions – economic, military, social and political – of the settlement. The treatment below is much indebted to the thesis of Victor Klinkenberg (2016), and published and unpublished material of Frans Wiggermann about the cuneiform tablets. These provide us with the basic hypotheses regarding the functions and activities that the physical settlement structure had to accommodate.

III.7.1 Crop production & storage

Agriculture is clearly one of the main functions of the *Dunnu* of Tell Saby Abyad, as much of the evidence points at managing the agricultural economy of the territory and the bulk storage of crops. The texts about the agricultural economy have been exhaustively dealt with by Frans Wiggermann (2000). Some document the distribution of rations to *Dunnu* workers, or of seed corn, and one especially important one records a procedure that was called the 'dissolution of the grain heap' or *pišerti karūʾe* (T98-115). During the dissolution the labour costs and seed corn where subtracted from the fresh harvest, and the left over was

[19] The kilns and the *dunnu's* pottery production have been studied by Kim Duistermaat (2007).

added to the storage (Wiggermann, 2000, p. 179). From it we know that at some point a total amount of 10.759 *homer* or 667 metric tonnes of barley was stored in the *Dunnu*. The total harvest that year was 4873 *homer* or 302 metric tonnes, from which rations and seed corn was subtracted before the remainder was moved to storage.

The archaeological evidence helps us to identify the species of grain, but it largely confirms the focus on barley cultivation. The lion share of the grain is made up by hulled 2-row barley (*Hordeum vulgare* ssp. *distichon*), found at a proportion of 80%-90% of the sample aggregate (Fantone, 2015, p. 219). To a lesser degree 6-row barley (*Hordeum vulgare* ssp. *vulgare*), naked wheat (*Triticum durum/aestivum*) and emmer wheat (*Triticum turgidum* ssp. *dicoccon*) are identified. The wheat is not found in the texts, which may be a coincidence, or it may mean that it was not produced under the auspices of the *Dunnu*, but by the free farmers and sold or traded privately.

The harvest of 302 tonnes of barley mentioned above is used by Wiggermann (2000, p. 183) to approximate the required acreage under cultivation. To it must be added land that is not cultivated by the *Dunnu* directly but by farmers for their own use which can be approximated using parallel evidence, fallow land, and an estimation of pasture, woods and wasteland. The total of territory needed for all this fits into a circle of a 3.5 km radius. This seems like a realistic figure and proves that the *Dunnu* was the centre of a agricultural estate comparable to the size of an average pre-modern European village and territory (Roberts, 1996). Although modest in scope to modern standards, this was probably a significant enterprise in the Late Bronze Age.

The tonnages of barley administrated implies the presence of a granary structure that was used, and perhaps built, specifically for this purpose. Although the excavation has revealed a few hundred 'bins' or small fixed storage containers, these were most likely used for short-term storage within specific production or logistical chains, and not only for barley. On the other hand, the large heap of burnt barley found in the courtyard of the residence does suggest bulk storage. However, as this is found in a final phase of the *Dunnu* when it is destroyed by a fire, it seems unlikely this is a typical storage representative for the earlier phases. As will be argued in this dissertation, the most likely candidate for a granary is the large central building, a thick-walled building containing rooms with narrow access ways, and probably more rooms on a second floor which all may have been used for storage.

Besides barley and wheat, other products must have been produced in the territory of the *Dunnu*. In one personnel list, 2 gardeners appear on the payroll of the *Dunnu* and in another 3 (T98-45, T99-5+). Compared to the hundreds of people involved in the barley production, this is very little. Archaeologically this is reflected by much less evidence for other botanical products, which includes garlic, lentils and a few herbs.

The texts frequently refer to cress as an important part of the meal (T93-6, T96-11, T98-117, T98-127), and on occasion we find references to terebinth nuts, onions, chick-peas, coriander, cumin, and sesame (T98-117, T98-73). Some of these must have been produced in gardens near to the *Dunnu*. The spices, however, were evidently traded as they occur as payment in texts dealing with the administration of trade.

III.7.2 Animal husbandry & housing

Both the texts and the archaeological finds suggest that the pastoral economy was important for the *Dunnu*. Animal bone was found in large quantities. A sample (n = 1217) of the faunal remains has been analysed, showing that goat/sheep were most common (47%), followed by equids (horse/donkey/mule) (25%), pig (13%), gazelle (8%), and cow (7%) (Cavallo, 2002). This is similar to other sites of this period, and has a large overlap with the species that are found in the texts, apart from Gazelle, a hunted species and apparently not part of the official administration. Also pig is only indirectly mentioned as food, but not the activity of rearing them (Wiggermann, 2000, p. 199). The absence of pig in the administrative sources of ancient Western Asia is a common feature of the region, and has been associated with the small scale nature of pig rearing (Zeder, 1998). The text-based numerical analysis, which may be more reliable since individual animals are counted rather than totals of bones, suggest an even larger discrepancy between ovids and other animals than the archaeological evidence. Ovids may thus make up to 90% of the animal stock (Wiggermann, 2000, p. 198).[20] The tablets refer frequently to herding, the consumption of sheep and goat, the use of their skin and hair, and the trading of these animals (T93-3, T97-18, T98-34, T98-43, T98-82, T98-91).

As for the other animals, bovids (castrated bulls and cows) are a relatively small group. Oxen are assumed to have been used primarily to pull ploughs, although this use has not been recorded. In the records, they were used for threshing grain (T97-17), pull wagons (T96-9) and for their skin (T98-14). Wiggermann (2000, p. 198) estimates a population of 250 to 500 bovids being trained or used for agricultural tasks in the territory of the *Dunnu*. Donkeys are supposed to be the standard draught animal, for local transportation and in long distance caravans, but they are only mentioned once on record as cart pullers. The animals were used in T98-119 to provision the soldiers of Ilī-Padâ. A rough estimate is that between 100 and 200 donkeys were employed by the *Dunnu* (Wiggermann, 2000, p. 192).[21] Pigs were probably mainly kept for consumption. Apart for the mention of pork in a food inventory (T98-31), there is little evidence for their use recorded in the texts. Wiggermann (2000, p. 192) estimates a total of 100 pigs, based on comparative

---

[20] Gazelle, included in the percentages of animal bone found in excavation, is not included in the text-based counts.
[21] Wiggermann bases his estimates on a text from Kar-Tukulti-Ninurta which lists the possessions of average families.

evidence. Judging from their numerical presence in the faunal material, their contribution to the diet must have been reasonably large. Horses had an important military function and a clear status animal. There are multiple references to the horses of Ilī-Padâ, and of charioteers. The texts add ostriches to the list of species that are being kept at the *Dunnu* (T97-33). Ostrich eggshell also occasionally turned up in excavation, but no bones have been found indicating they were not frequently consumed. Gazelle is found amongst the faunal remains in the excavation, but not mentioned at all in the administration. This implies that hunted species are not traded or used otherwise economically and are thus consumed directly on site. Both hunted and herded species confirm that the steppe was an important resource and base of subsistence. The fact that at some point a group of merchants receives 36 donkeys and 64 sheep (T97-18) moreover suggests a for-profit motive of rearing animals.

A question regards the location where these animals were kept or housed. The texts clearly indicate that many of the goats, sheep, donkeys, mules, cows, bulls and oxen were herded when they were not needed for work. Their location would have been the steppe or the marshy areas near the river. Some of the animals must however have been kept near or in the *Dunnu*, which has certain implications for the use of space. Pigs, ostriches and the 'sheep of the stable' (T98-43), suggest that animals were fattened by grain rather than herded and housed in pens or stables in and around the *Dunnu* (Wiggermann, 2000, p. 200). Some donkeys will also have had a place. On some occasions, large flocks or herds must have been present nearby, or an increased number of donkeys and horses of the merchants and charioteers. The larger groups of animals were naturally housed outside the main structures, probably with the herdsmen camping near them. As for the horses, the most valuable of animals, we may expect these to be stabled in a secure area, possibly even in the intramural area of the *Dunnu*. The area directly east of the residence appears to be the best candidate for the stables (see VI.9.2).

III.7.3 Food preparation

The harvested crops were used for consumption, either directly or after treatment to produce other types of food or products used in cooking. In fact, Klinkenberg's (2016) spatial and functional analysis shows that by far the largest number of objects relates in some way to food production or consumption. Stone objects such as grinding slabs, grinders, pestles and mortars point at grinding and crushing. Many grinding slabs were undoubtedly used to produce flour from barley. Flour does not occur commonly in the texts, which is understandable since it would have been made only when it was needed. Other food processing activities that are documented in the texts are for instance the oil-pressers 'dehulling sesame' (T93-7), for which a type of pestle and mortar would probably have been used.

Barley was thus the main staple food. It was used as animal fodder, to brew beer and bake bread. The 220 ovens mentioned that have been excavated (not all in use simultaneously), were for a large part used for bread baking. The importance of bread baking is supported by the texts belonging to the administration of baker Paja, found in the south-eastern and south-western corners of the *Dunnu*. Ethnoarchaeological examples suggest that barley might have been used to bake a tough, dry barley bread (Fantone, 2015, p. 223). This has historically been a very popular bread as it could be stored for months. Storage of such bread was however not recorded in the texts. The bread ovens nevertheless point at large scale bread production, mainly in the southern part of the *Dunnu*. Significantly, this is within the area of the main fortification walls near to where baker's Paja's administration was unearthed. Considerable numbers of similar ovens have however also been found in the settlement beyond these walls. This may reflect a separation between the official and administrated *Dunnu* bakery inside the walls, and ovens used for bread baking for private consumption.

A significant volume of pottery must be associated with beer production (Klinkenberg, 2016). Beer was next to bread the most important staple food, so this comes as no surprise. Klinkenberg (2016, p. 192) identifies a building in the centre north (building NE-2) as a brewery, although there are two additional potential beer brewing locations based on the presence of strainers and large vessels with a base hole. Beer is also amply attested in the texts. Deliveries of beer for a meal of Ilī-Padâ (T97-23 and T97-24) are recorded, and the presence of a brewer on site is proven by a letter of Sîn-Mudammeq in which he complains about an ignored order to ask the brewer of the *Dunnu* to send a potter to him in Dunni-aššur (T93-3). The brewer apparently controlled the potters, which suggests a relative high social standing of the brewer, and underlines the importance of beer throughout all levels of society. Also, no evidence for beer brewing outside the fortification walls is found, showing how much the central authority was concerned with controlling its production and, consumption. This puts into perspective the treaty with the Suteans discussed previously (T04-37), who were not allowed to drink beer bought from the brewer at the brewery of the *Dunnu* but should take it to their own '*Dunnu*'. It is very interesting to note that, in view of the previous, this seems to indicate a spot within the walled area.

The use of barley as animal fodder is a somewhat neglected topic in archaeology. But it was most certainly of high importance. Barley was used as fodder for the horses of Ilī-Padâ (T98-33). But more significant amounts of fodder needed to go to the cattle and donkeys. Barley straw, possibly chaff of barley, was used to feed these. Storage of barley straw is recorded in other texts, but not in those of the *Dunnu*. However, large quantities of burned plant fibre, possibly chaff or straw, were found in an area in the *Dunnu* directly west of the residence (see VI.9.2). Like the burnt barley grain found inside the residence, this may be related to stored harvest.

The inhabitants of the *Dunnu* cooked their food inside the *Dunnu.* We assume that many of the fireplaces that were excavated were used for cooking. There is one location where large-scale cooking did take place for certain, which is in an area in front of the central building. Here in a room a series of inbuild stoves are found, thus establishing a space that we might call a kitchen. These relatively large stoves could be fitted with cooking pots with contents of about 40 litres, also excavated in the same area, proving that significant amounts of food could be cooked here (Klinkenberg, 2016). What this centralisation of cooking indicates precisely is unclear. Was this a daily occurrence or only for special occasions such as the dinners that Ilī-Padâ held, as recorded in the texts (Wiggermann, 2010, p. 21)? In the first case, this would mean a meal was cooked for the entire *Dunnu* staff of an estimated 60 individuals (Wiggermann, 2000, p. 184) every day. If so, this would have increased the efficiency of the operation allowing people more time on their tasks. On the other hand, the many other distributed fireplaces could also be taken as evidence for widespread private cooking activity.

Meat production or cooking is not mentioned in the texts, but animals were naturally consumed which is shown by the faunal material found in excavation. Unfortunately, no spatial analysis of the faunal remains has been performed, which could have identified slaughter areas or locations for disposal of bones of consumed meat. A butcher is not mentioned in the texts, but there should be a location or more locations in or around the *Dunnu* where these animals were temporarily kept, and slaughtered.

It is likely that food preparation activity mostly served the group of dependents living on the site, but the texts also reveal the possibility of externals coming to the *Dunnu* to buy drinks and possibly food. Hence, food and primarily beer production also were traded some cases. On the other hand, externals such as the army and merchants also received barley and animals from the *Dunnu*, but were probably expected to prepare their food and eat elsewhere.

III.7.4 Housing

Wiggermann (2000, p. 191) estimates that roughly 60 people could be housed in the walled precinct of the *Dunnu*. This number is based on a rough surface estimate, which excludes the areas probably needed for representation, administration and storage: e.g. most of the western half, plus the large central building. Several excavated structures are likely interpreted as houses or apartments with private bathrooms. It seems likely that these were inhabited by the inhabitants of the *Dunnu* with higher status. The small somewhat irregular structures in the south and southeast of the *Dunnu* can be tentatively interpreted as small domestic units (Klinkenberg, 2016). As Klinkenberg also includes roof and second floor areas, his calculations of potential floor surface used for living suggests more people could have lived within the walled area. A more precise allocation of space for domestic purposes is attempted in the last chapter (VII.5.3). But multi-functionality is likely to be the norm, with few areas purely used for private living/sleeping.

III.7.5 Administration

The presence of many cuneiform tablets implies a very active and meticulous administration. Probably the largest part of the administration was dedicated to agricultural production. This included recording the amount of harvest that was stored, the giving out of seed corn, and the rations for the personnel. This fell under the responsibility of the steward of the *Dunnu,* the highest official on site. Administration related to food production, mainly bread and beer, was not the responsibility of the steward, but was the concern of the baker and brewer. In contrast to barley, records of stocks of beer and bread were apparently not kept. It is only mentioned when it is send out, or when supplies are needed. The second important aspect of the administration was the clearance of trade goods coming from the west that are shipped to Aššur.

The concentrations of tablets indicate the presence of various separated archives, kept by various individuals on site: the baker, the brewer, the steward and a scribe (see VII.5.2). These probably kept their administrations near their private quarters, and near the loci of their main economic activity.[22] In the case of the stewards, who were responsible for the main administration of incoming and outgoing staples and goods, the activity of administration probably involved interaction with many others. Therefore, to prevent undesired movement of these visiting people, a fixed location or 'office' near the entrance is practical and logical. The archaeological evidence does indeed imply the main official courtyard as the location of this activity.

III.7.6 Judicial

It is possible that the *Dunnu* acted as a court of justice on occasion. Verdicts were spoken by the same figures who ruled: the king and its high-ranking representatives or relatives. We have relatively little evidence for such occasions happening in the *Dunnu*, but there are some indications. One tablet (T97-5) records the transaction of a donkey of princess Epirat-aššur, possibly the grand-vizier's wife, judges favourably in an issue a man from Suadikanni is involved in. It is interesting that a woman is allocated such responsibilities, although not unheard of even in patriarchal societies such as the Assyrian. Moreover, Suadikanni is 150 km eastward from the *Dunnu*, on the Khabur river, which reveals an incredible range of action. This however, is not unexpected if we indeed deal with the wife of the king of the entire land of Hanigalbat. It makes clear how mobile these individuals were, and that the court of justice is wherever such an individual is, which is not on a fixed location. The *Dunnu* will thus have acted as a court of justice only on occasion. Another reference to this function is made in the treaty with the Suteans (T04-37). Article 4

---

[22] Nevertheless, the archaeological context of their deposition implies some movement of these archives before being discarded (Klinkenberg, 2016).

stipulates that whenever a problem rises with the returning of unlawfully confiscated possessions to Suteans, sheiks of two specific subgroups of the Suteans will act as witnesses in court. The fact that (a copy of) the treaty is found at the *Dunnu*, suggests that this court could have been in the *Dunnu*.

III.7.7 Production and manufacture

There is evidence for production of pottery, bronze, beads, leather or leather products, and chariots.

The eight excavated kilns, sometimes with associated workshop areas, suggest that pottery was produced intermittently on-site by mobile potters. However, as will be argued later (VI.8.3) at least 4 of these kilns are stratigraphically dated to a phase that the *Dunnu* had shrunk to its inner core and some of its original architectural functions and spatial organization had been modified or abandoned. The question of temporal representativity of the sample is therefore an important one, that has so far not been tackled. The local pottery production has been studied comprehensively by Kim Duistermaat (2007).

Bronze tool manufacture must have taken place, since some slags and moulds were found, but no workshop was identified. Also, for bead manufacture evidence has been found in the form of small stocks of half-products and bead working tools. Two letters by Ilī-Padâ to the steward of the *Dunnu* (T 96-1, T 97-34) mention perfume makers, but they seem to be located elsewhere as they need to be supplied with oils and spice plants from the *Dunnu* (Wiggermann, 2000, p. 173).

The most interesting aspect of the manufacture economy of the *Dunnu* is most definitely the production of chariots. For this, supplies of bronze, wood, leather and rope would be necessary. Animal resources used in chariot production that did not preserve physically are known to us through the texts, such as the use of fat and skin of wild boar (T93-10, T98-7, T98-56). The fat may have been used to lubricate the hubs and bearings of the wheels, while the skin would have made a strong and light-weight front cover for the wooden frame of the upper part that housed the soldiers. Hides of goats and oxen are also mentioned in a few instances.

Leather production is implied in the texts, but there is no direct evidence (Wiggermann, 2000, p. 198). Various administrative texts refer to the delivery of donkey, sheep and cow hides to the *Dunnu* (T 98-14, T 98-124), while another mentions the delivery of leather to a leather worker involved with chariot manufacture (T 98-56). Hence, it seems likely that the hides are procured in or around the *Dunnu* as well.

A surprising absentee is a cloth producing industry of which wool and linen yarn and cloth would be the main products. Hardly any loom weights have been found, nor many spindle whorls (Klinkenberg, 2016). In one text (T 97-34) Ilī-Padâ requests his steward to send him 'good linen' for his residence, but there is no indication that this is a *dunnu* product, neither is it clear where this residence is located if not in the

Dunnu. The mobility of both the steward and the grand-vizier may mean that this shipment could be send from and to almost anywhere, while the function of the *Dunnu* as trade-hub may also easily explain the presence of linen fabric there. Linen was certainly used to make clothing, as dress makers are attested (Wiggermann, 2000, p. 190). Bronze and bone needles are also found commonly in the *Dunnu* (Klinkenberg, 2016). The evidence therefore suggests that linen or wool fabrics were not produced at the *Dunnu*, but blankets and clothing were.

III.7.8 Trade & customs post

The role of the *Dunnu* in trade networks has been discussed before (see II.10). One of the supposed special roles of the *Dunnu* is to act as a custom post in which trade goods coming from Western Syria and the Levant are cleared before further travel towards the Habur and Assur (Akkermans and Wiggermann, 2015, pp. 109–110). Evidence is found in tablet 93-20:

"Speak to Tammitte, thus says Nāsir-Nabû: (react) as soon as you have read my tablet. Earlier I gave you the following instruction: 'caravans which come to me from Karkamiš may not pass without your consent and (I added) seal all wares.' Now I have heard that caravans have (in fact) set out towards me (and I repeat) 'whichever caravans come to me, be they of Ilī-padâ, of the princess, or of the nobles, seal everything.' I have also heard that they are carrying balsam; (if) any balsam is missing, you […] to be executed." (Akkermans and Wiggermann, 2015, p. 110).

It must be said that this is the only text specifically referring to caravan clearance. To what extent this was a commonly performed procedure at the *Dunnu*, or whether all caravans coming from the west had to pass the *Dunnu*, or could also be cleared elsewhere is therefore not certain. The fact that it required a letter to emphasize that this task of high importance should be carried out, may also suggest that it was not part of daily business. On the other hand, given the fact that the *Dunnu* was controlled by the highest ranking representative of the king, the *Dunnu* would be a logical location for such activity.

Aside from administrating long distance trade, merchants that bring or take goods from the *Dunnu* to be delivered elsewhere, appear frequently in other administrative texts (Wiggermann, 2000, 2010). Examples are merchants to have received 36 donkey and 64 sheep (T 97-18), coriander, cumin and rams (T 98-73), 405 kg of bark of *kiškanû* tree to exchange for an equal amount of tin (T 98-80), to deliver 0.25 homer (25 litre) of honey (T 98-92), or arrived with spice plants from Sidon (T 98-63).

III.7.9 Military & control

As has already been pointed out earlier, the degree to which *dunnu's* in general had an important military function may have varied. With regards to the *Dunnu* of Tell Sabi Abyad, the evidence is unclear. It does not seem that a large group of soldiers was permanently based here, but one text refers to cavalry men in service of the *Dunnu* (T 97-6). Other texts document the provisioning of passing groups of soldiers (T 97-10) and chariot teams (T 98-12, T 98-41).[23] The *Dunnu* may have had a more general military function in the sense that it was strategically placed to secure and control an area and vital routes.

Although near the edge of the empire, the *Dunnu* is not a boundary fortress. The location of the actual boundary, whether it was strictly linear in nature or more a transitional zone, is unclear. There certainly is an attempted claim of the Assyrian rulers to extend the territory up to upper Euphrates. Kings Adad Nirari I and Salmanessar I campaigned here in the mid-13th century (Kertai, 2009, pp. 28–33), but it is unlikely they gained full control, as they came into conflict with the Hittites. After the collapse of the Hittite empire, the Assyrians appear to have taken their chances and made another more successful attempt to control the area until the upper Euphrates. Archaeological evidence shows a string of fortified sites indicating militarised border defence (Tenu, 2023). But at this time (12th and 11th centuries), the *Dunnu* had already ceased to exist. During the period of the *Dunnu* the transition to foreign territory was probably located in the sparsely populated steppe zone between the Balikh and the Euphrates. It is likely that Assyrian territory included the entire Balikh valley, i.e. both banks of the river. The *Dunnu* was located on the eastern edge of the Balikh valley, and thus a short distance behind the actual frontier. It was not the first settlement a traveller or enemy army coming from the north or west would find. But danger did not come only from the north or west where the Hittites resided, but also from within Assyrian territory. As has been discussed above, the situation was such that bands of 'enemy's' were attacking Assyrian controlled settlements, and especially caravans. Hence, there would be a need for internal defence, which could explain the perimeter wall and moat of the *Dunnu*, giving the *Dunnu* the properties of a fortification.

The location, near the eastern edge of the Balikh valley could point at two other things: it was to safeguard this rich agricultural production area, and to protect and control the routes going further east. Above, two routes were reconstructed from the *Dunnu* in eastern direction: one going north-east towards Ḫarbe (Tell Chuera) and one running across the desert in the direction of Dur-Katlimmu and Aššur. For the latter route, the *Dunnu* was the last settlement of some stature before one launched into a dangerous trip through barren lands. The *Dunnu* was vice versa the first stop for someone coming from the east to the Balikh valley.

III.8 Conclusion

The archaeology of the *Dunnu* of Tell Sabi Abyad reveals a picture of a large complex with many structures varying in dimensions and form. This complexity most probably reflects the multifunctional nature of the

---

[23] See Wiggermann (2000, p. 196) for the references. The full content of the texts remain unfortunately unpublished.

settlement, for which much evidence is found in the excavated artefactual and textual evidence. Time adds another layer of complexity, as the stratigraphic ordering of structures reflects building activity in a settlement that morphed over time. This may also reflect an evolution of functions and modification of spatial organisation of people and activities.

The texts and artefacts are supplementary but highlight different aspects of the local society and economy. In the textual evidence, the agricultural/pastoral economy features most prominently, while the artefactual evidence is for a large part related to food production. The ample archaeological evidence gives insight in the day-to-day activities, which involves grinding, bread making, slaughtering, cooking, beer production, and small-scale storage. The prime focus of the texts is on the administration of the agricultural and pastoral economy. According to the hypothesis of Wiggermann (2000, p. 196), the agricultural surplus was used to sustain the administrative and domestic staff of the *Dunnu* (estimated at 60 people), supply the residence of Ilī-Padâ, provision elements to the army (foot soldiers, cavalry and chariot teams) and send some to the temple in Aššur as part of a tax. It additionally functioned as centre for manufacture of various goods, including chariots, and a customs and trade hub.

Dated evidence (*limmus* on cuneiform tablets) shows that the *Dunnu* was a relatively short-lived settlement, with its primary use phase lasting just about 50 years. Stratigraphically, this phase covers archaeological levels 6 and 5. These levels should not be conceptualised as separate use phases with hard boundaries between them, as will be argued extensively in the next chapter. The complex that is called the *Dunnu* therefore morphed over time into a new complex structure, most likely reflecting change in social en economic use. This chronological and temporal complexity seen in the stratigraphic record also demands us to ask to which degree the textual and artefactual evidence is representative for the entire period. It most certainly is not, as the majority of all archaeological evidence reflects the later phase, towards the end. The moment of abandonment and partial destruction ensured that much of the later evidence was left more or less in situ, although much has probably been meddled with it afterwards. The result is that the archives end at a common date around 1180 BC, and by nature of the way such administrative archives are formed by adding new documents and discarding the old, the body of texts gravitate towards the final phase. This mostly covers the period that Tammitte was steward, and Ilī-Padâ was King of Hanigalbat. That there was an even longer phase before that, is just about discernible. Due to luck, we possess some of the texts associated with the period of Mannu-kî-Adad stewardship under Aššur-Idin, but the total amount of information that can be derived from it is very limited. The artefactual evidence is possibly even more biased towards the end phase, as it mainly reflects what was left at the point of abandonment. Moreover, a messy abandonment phase is associated with re-use, scavenging and relocation of artefacts and building materials. Such processes of artefactual discard as primary, secondary and tertiary deposits, have been studied in detail by Klinkenberg (Klinkenberg, 2016). The biased nature of artefactual evidence towards the later phases is clear when one looks at contexts where multiple floors have been excavated. As a rule, the earlier phase floors and deposits on top of them are relatively devoid of artefacts, if one compares them to the massive amounts found in the abandonment contexts.

In the next chapter, the temporal dimension is further investigated by looking at the formation of architectural deposits from the initial foundation to abandonment and collapse. As the original architecture is preserved relatively well in certain areas, it allows for a better reconstruction of functional settlement change than the other classes of evidence. By tracking how buildings were built, modified and demolished, more can be said about the changing interactions between people and the built environment, and how this bears on shifting patterns in daily life, activities and settlement functions.

IV. Archaeological deposits in the *Dunnu*

This chapter deals with the processes of physical transformation that lead to the *Dunnu's* excavated condition. The main aim is to understand better the relation between archaeological architecture and so called 'infill', e.g. the surrounding soil matrix. Architecture and infill are closely intertwined, as the mass and form of buildings influence patterns of deposition. It is assumed that these patterns can be used to better understand the physical properties of architecture itself such as building height and presence of roofs. In addition, much of these patterns of deposition are created by weathering processes as well as human activity such as construction, demolition and modification. As such, they can be used to understand better the processes of transformation the settlement underwent, and ultimately reveal something about the relation between people and the built environment.

IV.1 The formation of mud brick sites

IV.1.1 Material and deposition

Mud brick structures have their own characteristic formation processes that turn them into buried archaeological sites. These features derive from the main building material: mud brick, or more generally: loam. Its wide range of application, universal availability, fast degradation has resulted in the typical archaeological landscape of the Western Asia. It is one scattered with mounds of ruined architecture, the tells: villages and towns build and rebuild sometimes for periods over millennia. As such, these tells have been studied for understanding their formation processes. This information can in turn be applied to other sites with similar properties, such as the *Dunnu* of Tell Sabi Abyad. Tell formation deposits can be classified as follows (Miller Rosen, 1986, p. 9):

- A primary matrix consisting of decayed mud brick
- A secondary matrix consisting of:
  - Organo-cultural refuse: fine grained sediment with ash. Food remains and dung. In pits and midden areas.
  - Collapsed rubble: heterogeneous sediments derived from reworked brick, stone, fibres and sherds. This is the most prevalent secondary matrix.
  - Water laid deposit: laminated deposits with strong sorting of grain sizes

- Biogenic and geochemically altered sediments. In arid environments, carbonates develop at the surface, causing some cementation. Characteristic for post-abandonment phase.
- Eolian sediments, e.g. wind blow soil particles.
- Alluvial deposition. Relatively rare, considering the morphology and height of most sites.

A large part of our understanding of these archaeological sites comes from documenting and analysing the sequence and relative amounts in which these elements occur in the stratigraphy of a site, building or enclosed space. For instance, layers of eolian sediments interspersed with mud brick erosion deposits reveal a building that is open, and gradually decaying for an extended period of time.[24] Large amounts of unstratified mud brick rubble indicates sudden and fast collapse, while multiple distinguishable layers of mud brick rubble indicate multiple collapse events. Besides these obvious signs of decay following abandonment, a mud brick settlement is continuously in a state of decay. The rain, sun, and wind cause erosion and chemical weathering, resulting in a continuous formation process characterised by addition and removal of sediment (Torraca, Chiari and Gullini, 1972; McIntosh, 1974; Friesem, Karkanas, *et al.*, 2014). To this are added the cultural factors resulting from human activities of construction, levelling, digging, backfilling and demolition, and all economic and domestic activities that cause and move waste (Schiffer, 1983; Stein, 1987; Schiffer, 1996). Together, these result in the complex archaeological phenomenon that we call a 'tell' or settlement mound (Figure 14, Figure 15).

[24] A good case study of this type of formation is discussed in Friesem *et al* (2011).

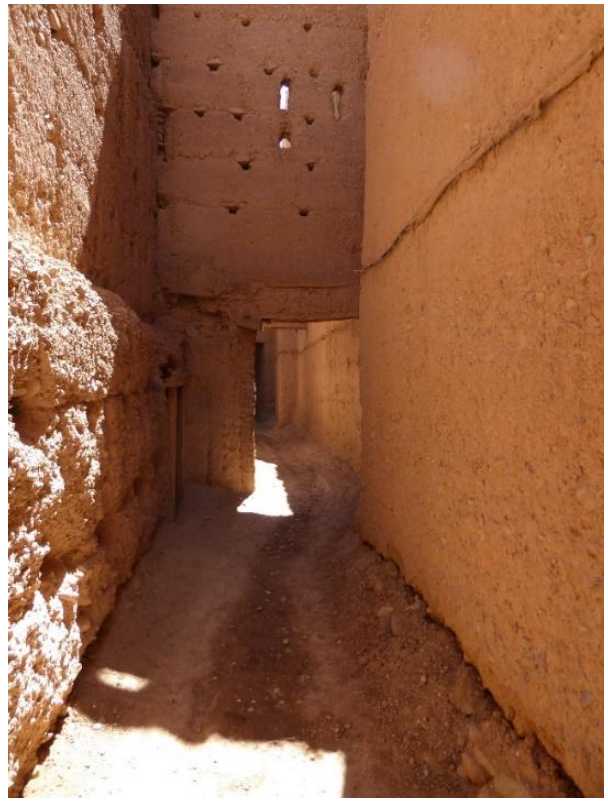


Figure 14 (previous page). Different types of mud brick site formation processes.

Left: Collapse, fortified town near Agdz, SE Morocco. Note that nearly all debris falls inside the building in this case, causing a stark difference in stratigraphy outside and inside.

Right: Water- and gravity-based erosion and sedimentation, same place as previous. Photo by author.

Below: Gradual decay and eolic infill, Gvulot, Israel. Eolic sediments form half of the contents of this experimentally excavated abandoned mud brick house (after Friesem et al. 2011).

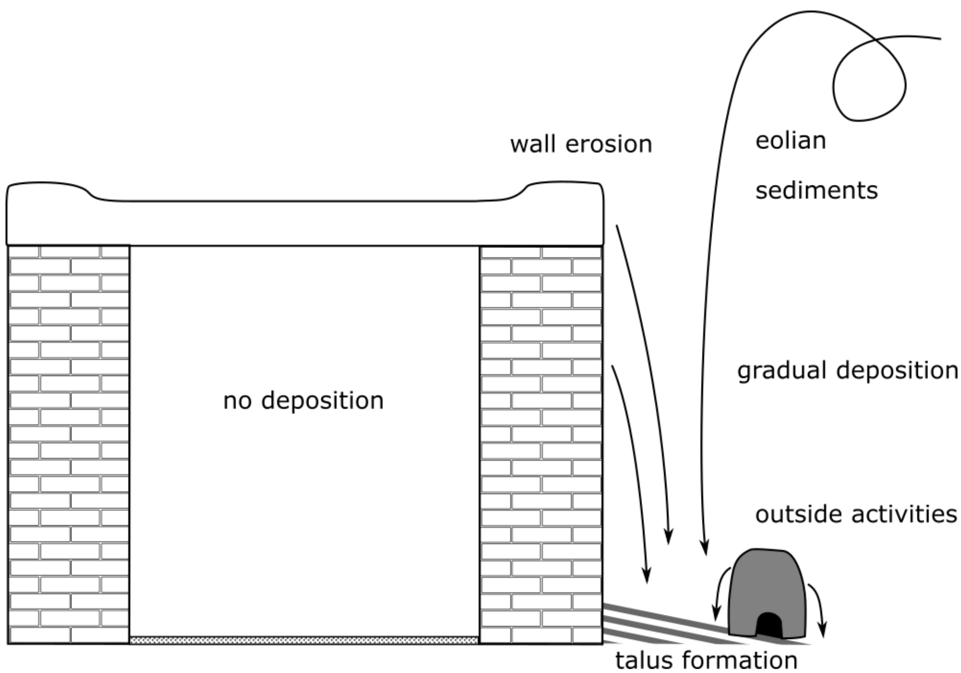


Figure 15. Common natural and cultural sediment deposition processes in loam-based settlements in arid environments.

Even if both addition and removal take place, the net result is generally positive. This fact is put to good use by archaeologists, as it enables them to peel an ancient settlement off from top to bottom, tracing its history back in time. This generally results in a simplified model of stratigraphy with different layers of levels stacked on top of each other, each representing a new phase in history. Although disastrous events such as war and earthquakes may flatten an entire settlement, followed by site wide rebuilding activity may create such blanket phases, for a large part this is not the case (Düring, 2012). For most of the existence of a settlement, it is a much more dynamic and asynchronous occasion.[25] Settlements respond to the natural

[25] The tendency to create blanket phases is critiqued by Düring (2012). And see Carver (2015) for a general critique of the flawed use of the concept of stratigraphy by archaeologists. Warburton (2003) for the view that in the archaeology of the Western Asia, stratigraphy is often not considered further than as a useful device to sequence occupation phases.

as well as to the cultural environment, and dynamically expand, contract and shift. More localised, individual buildings or houses reflect changing human demands, growth or decline of the family, or fluctuating economic welfare. In a very concrete way that means that one building may be in active use, while the one next to it is being demolished and rebuild (Figure 16). This is accompanied by the creation of rubble and levelling deposits and causes the house to 'go up a level', stratigraphically. To develop an understanding of these complex dynamics, which informs our reconstruction of settlement history, we first need to fully understand the depositional history of a site, in other words its formation processes.

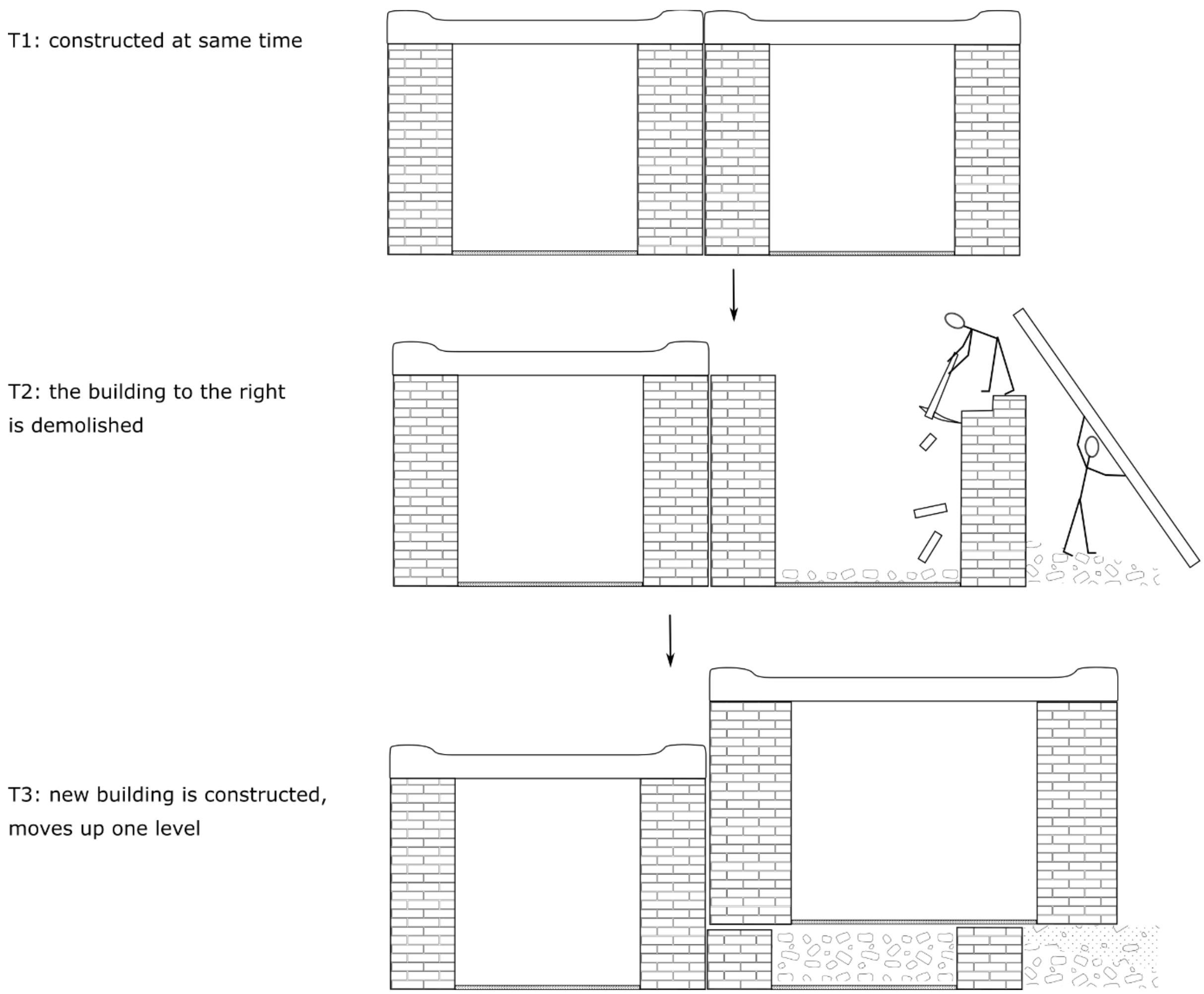


Figure 16. Model of how unparallel life cycles may result in different floor levels inhabited at the same time. If the left building is finally also demolished, a single archaeological 'level' is created, and a false impression of contemporaneity is given.

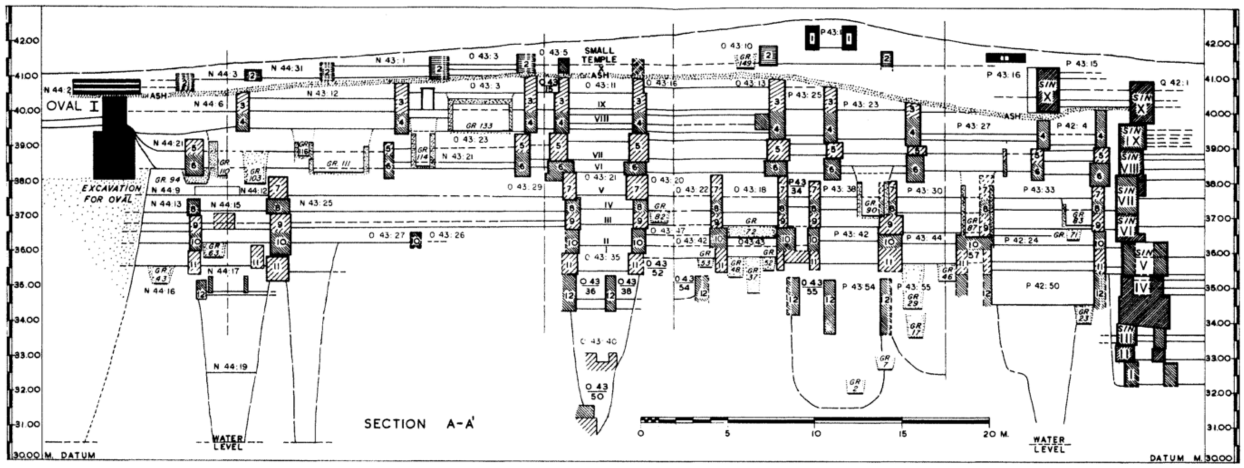


Figure 17. Construction and reconstruction cycle of mud brick houses in a section through the housing area in Khafajah, first half of 3rd millennium BC (after Delougaz, 1940, plate XII).

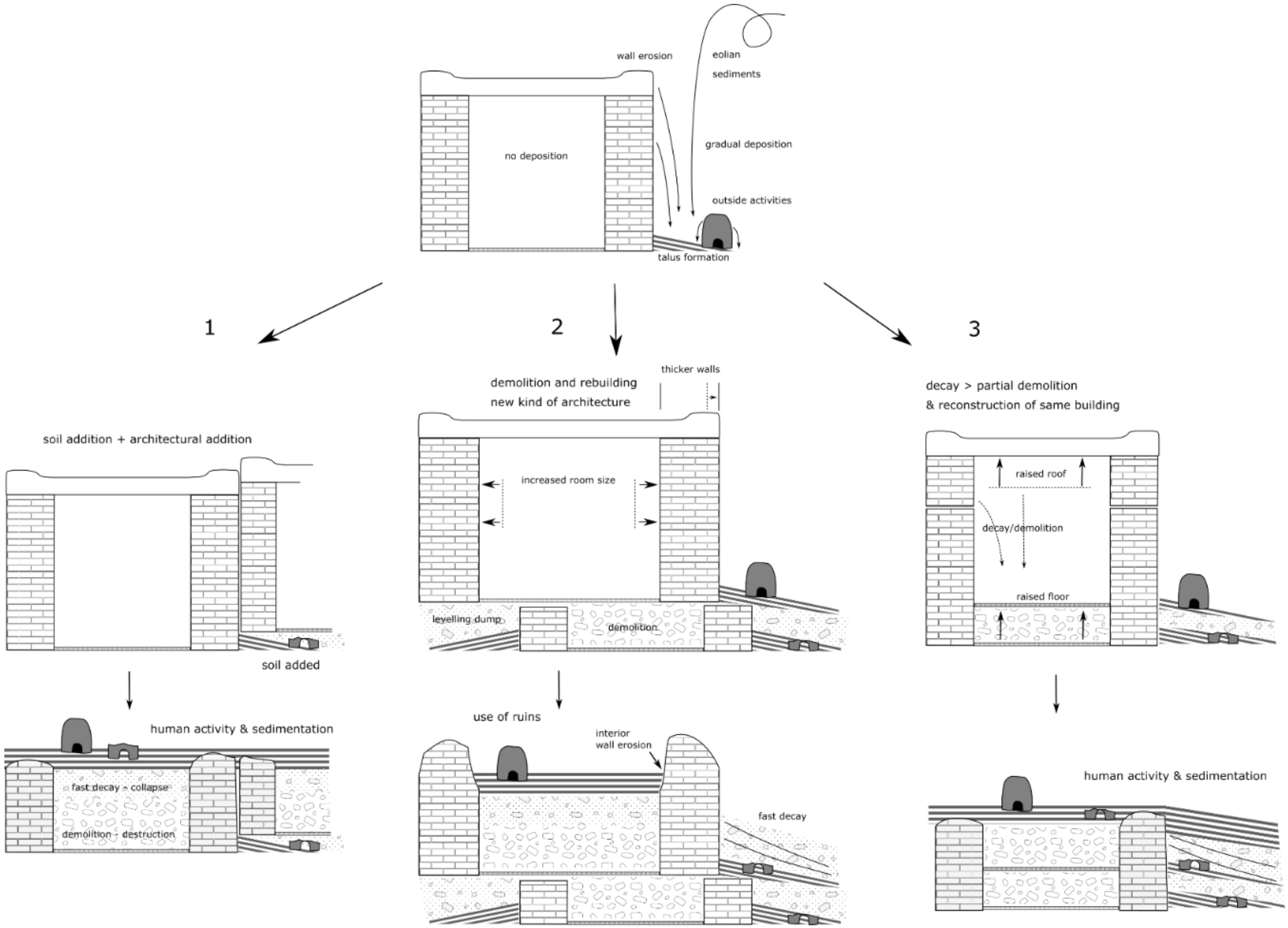


Figure 18. Site formation model developed in this chapter. It includes natural processes of erosion and sedimentation, and cultural factors including different types of architectural modification.

IV.1.2 Global settlement dynamics

The formation of stratigraphy is closely linked to cycles of construction, use and decay. On a higher level, this ties in with settlement dynamics related to social, economic and political processes. A number of ethnoarchaeological studies of village decline and growth link phases of decay to economic or demographic causes. Hall's study of the village of Asvan, in the upper Euphrates region, showed it had at least six distinct faces, and phases, over a period of less than a century (Hall, McBride and Riddell, 1973). Each time house construction or decay could be connected to the migration to and from the village, sometimes related to governmentally organised repopulation and building programs. In fact, it was noted that these phases were so entwined, that it would be hard, better said impossible, to reconstruct from archaeological remains alone. In the case of Horne's study of the Iranian plateau, phases of construction and decay responded to economic and demographic trends, which were in turn closely tied up with the financial means of land owners and the arid climate which did not easily sustain long term permanent settlement (Horne, 1993). These are just two examples of studies in the general region of this study, but such trends have been studied in many cultural and historical contexts, each with a particular mechanic or interplay of factors that may include political, economic, social/demographic, or ecological elements. These affect all settlements, and form the greater context of settlement change, and periods of construction, use and decay.

IV.1.3 The life cycle of a mud brick building

"*The lifetime of some of these buildings was unexpectedly long. Mud brick, so long as it is protected from above, is a durable material, and it has the advantage that it allows of easy repair - it is far simpler to patch a mud-brick wall than one of burnt brick or stone, and it is far simpler to make a new door in, or otherwise modify, a mud-brick than a burnt-brick or stone wall.*" (Woolley, Mallowan and Mitchell, 1976, p. 14). Mud brick sometimes suffers from the prejudice of being a weak building material, that cannot be used to construct lasting architecture. This is not true, but mud brick does require a certain expenditure of effort to sustain on the long term, which is an important part of its life cycle. On the other side, the malleability of the building material is often used to its full potential, making mud brick buildings and settlements a very dynamic phenomenon.

The life cycle of any building includes at least three phases: construction, use, and decay. During use we can identify two important 'sub phases': maintenance and modification. There are choices to be made in each of these steps, such as the quality of the loam and mud brick, the dimensions of the walls and building, the type of timber and roof construction. All such choices will affect in some way its capacity to sustain decay, demolition and destruction. Moreover, during its lifetime differences in maintenance regimes will for a large part be responsible for the length of life of a building. There are no general rules for lifespan, but in many societies a regular mud brick house survives one generation (Table 2).[26] This may be viewed as a cultural choice or a reflection of social structures, rather than the limits of the construction material. Descriptions of house construction in village contexts suggests that houses are simply left to decline when the inhabitants had died, and their off-spring had built their own house elsewhere (Friedl and Loeffler, 1994). In other cases social structures and economic cycles give the impetus for construction, decay and reinvestment (Horne, 1993). In contrast, in an ancient urban context, Woolley and Mallowan find that most houses they excavated in Old Babylonian Ur span the entire period from 2025 to 1763 BCE. This is not to say there was no thorough renovation at times, as thresholds of doors are observably replaced and elevated 2 or 3 times during these 260 years, but the layout and foundations of these buildings is essentially the same. A more recent example is Shibam, the mud brick "skyscraper" city in Yemen[27], whose oldest houses go back 200-300 years, but the city is older and many houses did undergo demolition and complete rebuilding at times (Damluji, 2007). So, a mud brick building can go through a multitude of cycles which constitute construction, use, modification, abandonment, and decay. In theory, the different ways in which these material and cultural aspects play out, will also cause differences in site-formation, and therefore in the final resulting stratigraphy (Figure 18). On many former excavations of West Asian sites, archaeological methodology and technique were generally not developed to a sufficient level to reliably distinguish all such processes, although at some sites like Çatalhöyük these are better attuned to recognizing and interpreting them (Matthews and Farid, 1996).[28]

---

[26] As Kubba (1998, p. 45) remarks, there is no general consensus on this issue. All data is based on incidental reporting during archaeological and ethnographical studies, and never really subject to critical investigation.

[27] These houses are 25-30 meters high.

[28] There are however the occasional experimental studies of recently abandoned mud brick sites, such as those of Friesem *et al.* (Friesem *et al.*, 2011; Friesem, Karkanas, *et al.*, 2014; Friesem, Tsartsidou, *et al.*, 2014) or an example from Botswana (Baloi, 1995) and Ghana (McIntosh, 1974, 1977). But these are too isolated and limited in scope to change archaeological practice.

Lifespan of loam buildings

Source	Place	Building technique	Reported lifespan
Oates (1977)		Mud brick	Well maintained: 40 years
Braidwood and Howe (1960, p. 40)	Iraqi Kurdistan	Puddled mud	"a casually built house": 15 years
Watson (1979)	Western Iran	Puddled mud on limestone rubble foundations	50 years
McIntosh (1974)	Ghana, West Africa	Puddled mud 28 cm thick	Local enquiries: Covered wall, until repair: 6 to 7 years Exposed wall: 2 to 3 years House, before major repairs: 20 years House, well maintained: 70 years
Baloi (1995)	Botswana, southern Africa	Wattle-and-daub, puddled mud, and mud brick	Scholarly estimate: 20 years on average, 50 years maximum Oldest observed house: 46 years Local enquiries: 70 years
Aurenche *et al.* (1997)	Southern Turkey	Loam roof	Roof deck replaced (referring to the loam, unclear whether beams also need replacement): 10 years

Table 2. Reported lifespans of loam houses.

IV.1.4 Other cultural practices causing deposits

Besides construction, decay, maintenance and demolition, there are other aspects of material-cultural life that result in the formation of particular deposits, which can be informative about the microdynamics of life in a mud brick settlement. These are general activities related to economic, industrial or domestic life, waste production and discard and cleaning regime. These are not necessarily unique to mud brick settlements, but loam is involved in many of them. Like buildings, many other elements of use are also constructed of loam: benches, work surfaces, platforms, storage bins, ovens, kilns, troughs, silos, pens, etc. These all have limited – and varying – lifespans, and the intensity or frequency of use will contribute to their decay. Parts of them frequently survive, but mostly they have short use times and are replaced a number of times within the lifespan of a building, or a settlement. Their relationship with the formation of a stratigraphy is cyclical: construction material is taken from the tell and returns to the tell. If we are lucky, we find them in excavation nearly intact, but this then only represents the last generation of a series. The stacking of demolished bread ovens (*tannurs*, or any other ovens) below a single well-preserved one are a typical example of this.

Trash disposal is another contributor to archaeological deposits in general (Schiffer, 1996, pp. 58–72). Activities, such as cooking, tool making, bread baking etc. produce refuse. Settlements often have informally defined areas for trash dumping, or middens. Refuse disposal is often a staged process, in which the stages have been defined as primary and secondary. Thrash is often initially gathered near the place of the activity that it produced, and commonly moved out of the way at some later point (Schiffer, 1996, p. 59). All settlements produce a certain waste pattern in this way, and its direction and movement has been described as the "waste stream" of a settlement.

Related to trash disposal is cleaning. This is quite an ephemeral variable because it is hard to assess that which was removed, but it is nevertheless an important negative contributor the formation of deposits. In fact, as Schiffer (1996, p. 59) states, most societies are involved in periodical cleaning of certain areas of the settlement. The particular cleaning regime is determined by "rates of refuse generation, frequency of activity area use, and variety of activities performed" (Schiffer, 1996, p. 65). We may add that the perceived necessity to keep an area clean may also depend on the social status or function of spaces. Moreover, the cleaning regime may change over time, and rubbish and deposits left in the final stages of use may not be representative for the main phase of use.

IV.2 Building activities causing deposits

The initial construction of any kind of structure may be considered a type of deposit causing activity. A wall or a roof is therefore a deposit, just as natural sediments and refuse deposits are. Primary building activity and its effects in the form of various types of architectural structures are discussed separately (see section V.5). In this section any archaeologically detectable infill deposits are meant in the more traditional sense, caused by 'secondary' building activities such as maintenance and repair, demolition, and modifications.

IV.2.1 Maintenance and repair

Under maintenance and repair we can list activities such as resurfacing, reinforcing, and replacing. This is a understudied topic in archaeology and few good, detailed information is available about practices that goes beyond the anecdotal level. Maintenance and repair in mud brick architecture involves for a large part plastering or rendering walls, ideally every 1 to 3 years. Horne (1994, p. 194) reports that in Tauran, Iran, the exterior is resurfaced every three years. The interior is done once a year unless an expensive plaster is used, in which case plastering also takes place every three years. In Dia, Mali, rendering is a biennial activity (van der Linde, 2002, p. 55). In Aşvan, Turkey, interior floors, walls and ceilings are done on average once a month, while exterior walls are rendered yearly (Hall, McBride and Riddell, 1973, p. 259). Archaeological examples exist of cases of layers up to 10-15 cm in thickness, reflecting many such resurfacing phases

(Woolley, Mallowan and Mitchell, 1976; Miglus *et al.*, 2013). Renders may also have been completely or partly scraped off before applying a new layer. The loam of the roof deck possibly has a 10 year life-expectancy, but this is just reported by one study by Aurenche *et al.* (1997). Depending on how the old roof is removed, it is possible that parts of it end up on the floor and are levelled to form a new floor. The rendering and plastering, as well as renovating the roofs mean that new material is brought in, that will start to erode and contribute to the formation of new deposits.

Elements like door frames, doors, window frames and shutters will need occasional replacement, but this activity leaves few traces in the archaeological record. An interesting maintenance task related to doors is recorded in the Garšana building texts. 'The pulling of doors' (Heimpel, 2009, p. 175) is mentioned quite a few times, and at one time a scribe also lists the expenditure of ½ liter of tallow for lubricating 'door bottoms'. We may therefore associate this task to the dislodging of doors, and cleaning out and lubricating the pivot holes or stones. Although pivot stones and lined pivot holes are often found, rarely they show phases and it will leave an insignificant and unobservable trace on the archaeological record. Theoretically phosphate analysis should be able to pick up the regular use of tallow.

Repair may also involve partial demolition. If a roof is in bad condition, the upper part of a building may be demolished, and built up again. If the new wall part is distinct due to change in material or structural characteristics, it is observable in the archaeological record. However, walls are generally not preserved to this height. If larger structural problems exist, more of the building may be demolished and rebuild on top of existing walls. Note that in wall construction, especially in larger projects, bricks made from different loam sources may be employed causing a similar observable effect. This could create a false impression of a renovation phase.

Instable walls can be reinforced by buttresses or abutments.[29] Most examples of such interventions found in the literature study come however from restoration projects, which are focussed on preserving something that has value as heritage object. Perhaps ancient practice often favoured demolition and rebuilding over stabilizing. Buttresses or abutments found in ancient construction are often part of the original design or employed when a building requires structural reinforcement in case of functional change. In which case it must be classified as a modification rather than a maintenance or repair activity.

[29] Buttress - an architectural structure built against or projecting from a wall which serves to support or reinforce the wall. It is often used in ancient structures as a means of providing support to act against the lateral forces arising out of the roof structures that lack adequate bracing. Abutment – here used in the meaning of a continuous buttress. Its function is to transfer loads from a superstructure to a foundation, or to transfer self-weight or lateral forces.

IV.2.2 Demolition

Unfortunately, demolition is rarely a topic discussed in detail in ethno-archaeological and architecture studies. Most information regarding demolition is from descriptions of archaeological contexts. Although archaeological deposits are often the effect of demolition or collapse events, they do not give information about behavioural and technical aspects involved in the formation of such deposits. A case that is well-described and analysed in detail in view of the sequence of deposits and the events they represent are the houses in Çatalhöyük (Matthews and Farid, 1996). It shows that intentional demolition and rebuilding was very common practice here, and followed a certain procedure. Similar practices will have existed elsewhere. Although the sociocultural context is not always the same, the basic material conditions are similar and the need for demolition and rebuilding is generally present.

Buildings or parts of buildings may be demolished and replaced completely. A bad state of maintenance, a desire to raise the ground level, or to replace a building with a new building of different type or dimensions, may all be motivations for demolition. As has been mentioned already, a house can keep the same dimensions and layout for centuries, but still not be exactly the same physical house. This cycle of construction, demolition and rebuilding is one of the most characteristic aspects of mud brick settlements (figure 16). Regardless historical period or cultural setting, the height of the walls of the previous generation that is left standing seems to be relatively constant at about 50 cm. It is possible that this reflects the acceptable amount of rise in ground level, while keeping the amount of effort to remove the rubble to a minimum. In terms of method, it is probable that walls are broken down from the top, but they may also have been pushed. Generally, the debris is deposited on the interior of the building. Some natural collapse may of course already have occurred if the building was in a bad state and abandoned for a while. But in the case of continuation of the same building plan, it seems likely that the same family that inhabited the house, who decided to renovate and thus demolish the upper part of the house. Some of the collapsed rubble may be removed, but with single floor buildings, it is likely that the volume of the walls is preserved largely inside the collapse. The case of Çatalhöyük shows a more elaborate sequence of fills, perhaps reflecting different practices (Matthews and Farid, 1996). Then the surface is levelled, and a new building is constructed on top using the old walls as outline and foundation if the building was demolished in the context of renovation. But if the reason for demolition was modification, the new building is not likely to have followed the older one's walls.

One ancient Assyrian source (SAA 15 113) explicitly mentions the demolition and rebuilding of a fortification wall of a fort probably similar in size to the *Dunnu* (the full text is given under VI.11.1). It specially targeted the 'southern and eastern directions' (i.e. southern and eastern fortification walls). The reason for demolishing these is not disclosed, nor does it tell how far the demolition went, but such an intervention has archaeological implications. If the wall was really demolished to the last brick, the traces of the renovation would not be observable anymore and an archaeologist would not know that this fortification had two construction phases. But if demolition was not complete, a few brick courses were left standing, on top of which the new wall is built. This might be recognizable as phase in the wall's construction. The completeness of demolition is an issue that is hard to assess, since we lack the empirical data about real practices. Although the archaeological record shows that it was extremely common to leave part of structures standing before a new one is constructed on top, this record is biased towards phenomena that survive.

IV.2.3 Modifications[30]

Loam is a flexible building material, and a building made may be modified or repaired more easily than a building made of baked brick or stone. A German researcher who studied traditional mud brick architecture in Turkey characterised it as 'd*as vegetatives Bauen*', or organic building (Peters, 1982, p. 226). And it has been observed a multiplicity of times in different cultural contexts. Hence, we can expect to see a lot of modifications during the lifetime of a building. We can classify the most common types of modification that may have archaeological consequences:

- Expanding vertically, e.g. adding a floor
- Expanding horizontally, e.g. adding a room or building to the exterior
- Partitioning/merging, e.g. breaking up a space in smaller units, or enlarging it by removing a wall
- Connecting/blocking, e.g. closing or opening a doorway or gate
- Demolition and replacing

Each of these building activities reflect particular choices related to the use and functioning of a building.

Expanding vertically means adding a floor, or multiple floors on top of an existing building, or on top of part of a building. Although the activity is not studied in detail in the ethnoarchaeological studies, it is clear that this may involve reinforcements on ground level in the form of abutments along existing walls. A good example is shown on Figure 19. In such a case, the construction phase would be visible archaeologically. However, the practice to construct the walls of a new house extra wide, with an eye on possible future vertical expansion is also recorded.

[30] This is a general introduction of modification types and practices. Under section V.6, the evidence for modification and repair in the *Dunnu* is discussed.

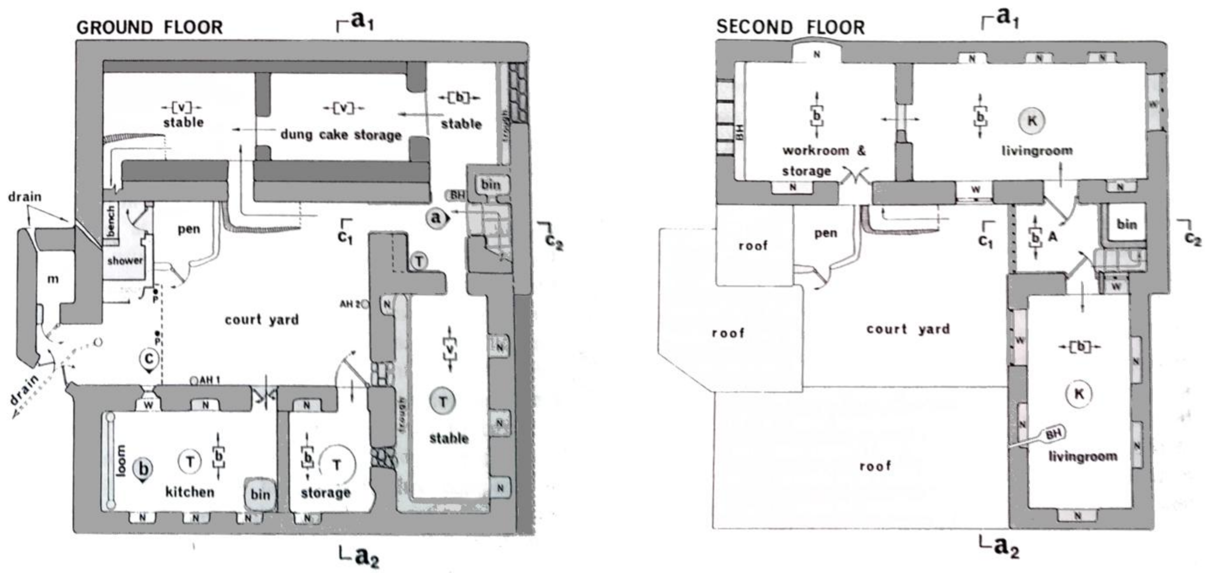


Figure 19. House in Shahabad, Iran. Modifications were made to this house to support a second floor, which it did not originally have. In light grey the original walls, and in dark grey the reinforcements (after Kramer, 1979, p. 148).

Horizontal expansion occurs when new rooms or additional buildings are constructed as an expansion to an existing building. It may be distinguishable from the original construction by various architectural characteristics such as brick colour, wall width, or bonding type. If two walls are abutted rather than bonded, we generally assume one is later than the other. It is however possible that part of the old wall may be demolished and bricked up again and bonded with the new expansion. It is not known how widespread this practice is in ancient mud brick construction. But in such cases differences in brick or mortar colour can be indicative, but these are not always present. The best indicator, in the absence of others, is stratigraphic position. Due to climatic conditions, and the physical nature of mud brick settlements, sediments will always collect in outside areas. These include all types of sedimentation discussed in the beginning of this chapter, and the cultural processes discussed later. Walls or buildings constructed on top of these can be quite safely dated to a later phase of the architecture under study. However, there may be circumstances in which the outside area next to a building does not show this accumulation. In the case of streets or sloped area, it may erode as fast as sediments accumulate. Areas might also be kept very clean. Or an area might be levelled before construction, to ensure the ground surface of the new building is on a level with the ground surface of the old building. But this last practice might not be that widespread, considering the general tendency to simply construct on top of the available surface, and the natural rise observed in most ancient mud brick settlements.

Partitioning and merging are two sides of the same coin, involving either the construction or removal of interior walls to change the size or configuration of spaces. These are often of lighter construction than the load bearing exterior walls, and can be made of mud brick but also using cobbing[31] or a type of wattle-and-daub over a reed or palm leave frame. This naturally influences wall preservation, and they are only rarely recovered.[32] In terms of ordering the events, these can be among the hardest to put in a sequence, as a stratigraphic difference between the original construction and partition wall is not always apparent. There is no sedimentation or gradual layer development taking place on the interior. Only if a partition wall is part of a larger renovation project after a collapse or partial demolition phase resulting in a mud brick rubble deposit on the floor, there is a good indication for temporal difference. Discontinuous plaster or render layers can be another indication for order of construction, and should ideally be studied very closely in order to determine order of construction. Merging spaces is an activity that has less chance of survival because it involves the removal of walls. Only with heavier constructions and large-scale renovations that cause rubble deposits, the bottom part of older partition walls may survive. In all other cases, it will be very hard to recognize a removed wall.

Creating or blocking doorways, gates or windows is a relatively minor event in terms of effort and cost, but can have big consequences on how a building or settlement functions spatially. Blocking generally involves constructing a mud brick wall inside the gap. It is usually recognizable as such, but not always apparent what its temporal relation with the main structure is. Some blockings are completely concealed from view by covering it with the same render as on the adjoining walls, while others have more the character of a quick and rough intervention. This could relate to the visibility of the blocking or status of the space the wall belongs to. Cutting a gap through a wall to create a doorway is not always that easy to recognize, since in archaeological context, bricks are usually very eroded at the jambs and corners of walls. It may be recognizable if the level on which the hole is made, is above the ground level of the wall. However, sometimes an integrated brick threshold of one or two course is part of the original construction. Otherwise, the same 'rules' as with other modifications apply related to our ability to recognize temporal differentiation.

The last type of modification is demolition and replacement. Demolition has been discussed already above. Replacement may involve either rebuilding the same structures on top of the walls of the previous structures. This is generally the case when a building is in a bad condition and requires renovation, while its main type and function probably remains the same. Alternatively, demolition may be followed by a

[31] A common earth construction technique involving balls of loam stacked on top of each other and beaten together.
[32] A rare example has been documented in Nuzi (Starr, 1939, Plate 24B).

completely different type of structure. Such cases would indicate that the motivation for demolition is a functional change, or an up- or downscaling of already present functions of a building.

IV.2.4 Roof beam recycling

Important for the archaeological understanding of mud brick buildings, is that due to the scarcity of this commodity, poles and beams were often reused. Numerous ethnographic observations testify to the salvaging of timber from abandoned houses (Hall, McBride and Riddell, 1973; Kramer, 1979; Friedl and Loeffler, 1994). Coincidentally illustrative is one of Tell Sabi Abyad's cuneiform tablets in which special mention is made of the beams when a farmer has to move places. In tablet 97-17 permission is requested for cattle farmer Sarniqu to take with him his belongings including the beams of his house (Wiggermann, 2000). Taking out beams causes some immediate collapse, and the rapid onset of accelerated decay (Figure 20). There is a large chance that some of this remains visible in the archaeological record. Even if the building is re-used, not all debris is necessarily cleaned up.

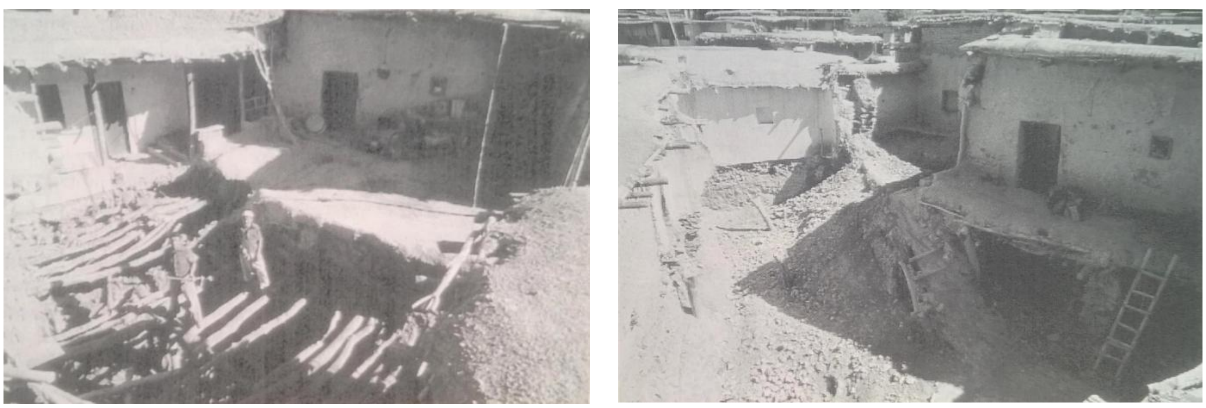


Figure 20. Demolition of a village house in the early 1980s, west Iran. Left: salvaging of roof beams. Right: the same house three years later. Much rubble is lying on the ground, but its distribution is very uneven. The house on the right is still inhabited (After Friedl & Loeffler 1994, figs.6 & 8).

IV.3 Deposit formation and architecture of the *Dunnu*

Now we will direct our attention to the analysis of the archaeological data from the *Dunnu* of Tell Sabi Abyad. As discussed in the introduction, the chronology of the *Dunnu* has been described in terms of a sequence of stratigraphic levels: level 7 to level 1. In this scheme, level 7 represents the oldest pre-Assyrian phase, level 6 and 5 the main Assyrian *Dunnu* phases, level 4 and 3 the contracted *Dunnu* phase and levels 2 and 1 are very shallow and unclear, but may be respectively Hellenistic and Byzantine. These levels are in principle an aggregation of architecture and strata in a single chrono-stratigraphic phase. Besides the implications of using the term 'level', there are also practical issues in the assignation of architecture and strata to certain levels (see VI.3.1). Moreover, from the following discussion it will become clear that neatly separable levels are not only a theoretical but also an actual impossibility in the *Dunnu.* It is however possible to discern four archaeological levels on a lower resolution by drawing boundaries between larger scale changes in mechanism of deposition (see column 'main phase' in Table 1). In this way, the levels are combined as larger stratigraphic units that can be better empirically validated.

IV.3.1 Deposit mapping and classification

Based on the excavation data – e.g. section drawings, field notes and deposit descriptions – the deposits found in the *Dunnu* have been classified according to the various mechanisms as discussed previously in this chapter. In summary, eolian, hydraulic and gravity-based sedimentation are among the natural processes, while human activity such as construction, backfilling, refuse disposal are the cultural contributors to layer deposition. The definition of deposit used here is the common one found in geoarchaeological work, and is derived from geology, where it is called a 'bed', or a "single sedimentation unit formed under essentially constant physical conditions with constant delivery of the same material during deposition" (Stein, 1987, p. 339). Also deposits caused by human activity, such as the construction of a wall or floor, can be considered a single deposit under this definition.

In order to assess the nature of the mechanisms of deposition, attention was paid to layer morphology (irregular or regular surface), layer thickness, layer distribution (even or uneven distribution throughout space), layer consistency (hard, medium hard, soft), layer texture (fine or course), layer colour. Prime indicators for deposition mechanisms are the thickness and content of the layer. The listed properties were chosen as these were normally recorded by the archaeologists either as textual description in notes, or on section drawings. This assessment is summarised in generalised diagrams called deposit sequence graphs such as Figure 21, which are designed to make it easier to visually compare the relative thickness, character and the order in which different deposits occur throughout the spaces of the *Dunnu*.

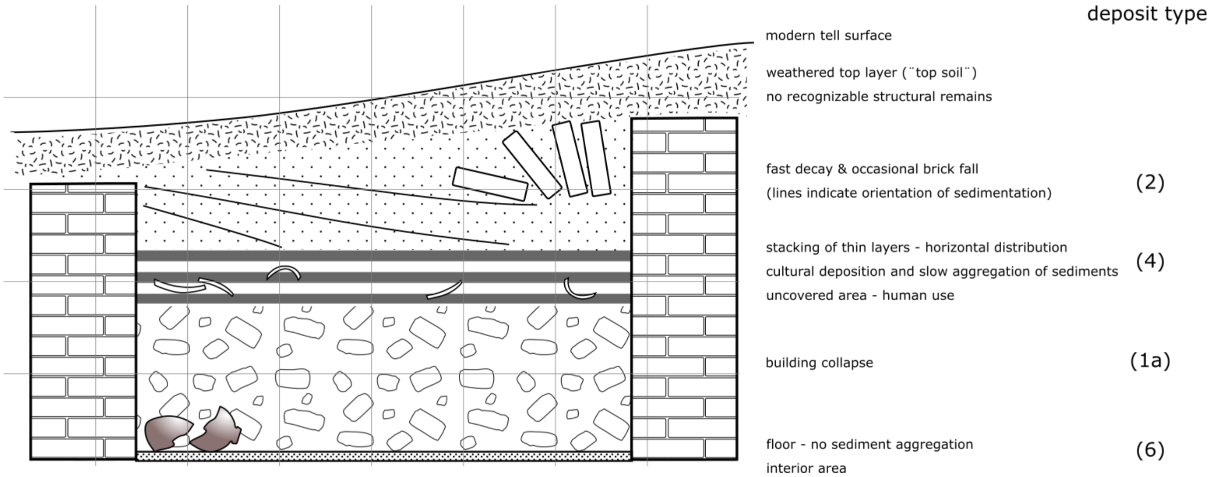
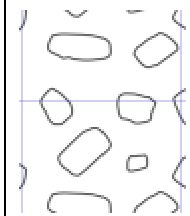
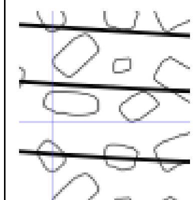
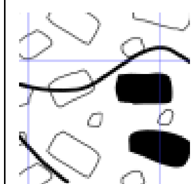
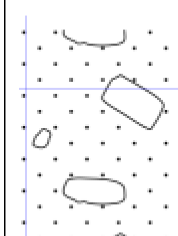
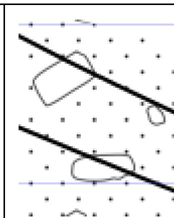
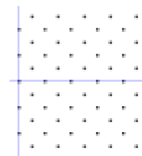
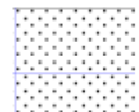
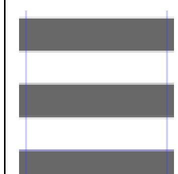
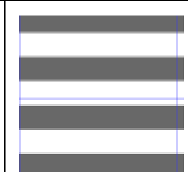


Figure 21. Example of a deposit sequence graph: a standardized and simplified representation of the order of deposits (grid-size: 50 cm).

The table below is a general classification of the deposit types found in the *Dunnu* of Tell Sabi Abyad.

	Description	Name	Mode of deposition	Interior/exterior	Symbol	Examples
1.	a. High amount of recognizable mud brick debris – complete or large parts of broken mud bricks. Patchy with lenses of different loams.	Collapse deposit.	a. Fast decay / demolition – collapse of construction materials.	Predominantly interior	Uniform:  With internal stratification: 	Rooms of residence and tower. Rooms in the northern wing.
	b. With burnt or carbonized construction materials. Ash or carbon lenses.	Collapse deposit with fire.	b. Fast decay – conflagration - collapse			
2.	Low amount of recognizable mud brick debris – mostly broken bricks. Largely uniform soil matrix, some stratification. Strata are over 20 cm in thickness.	Fast decay deposit.	Fast gradual decay due to erosion and occasional brick fall amounting to voluminous deposits. Early state of degradation. May follow on, or precede deposit type 1.	Exterior and formerly interior areas, e.g. after main collapse phase or roof removal.	Uniform:  With internal stratification:	Most low, e.g. single floor buildings

						
3	a. Loose homogeneous deposit of loam without recognizable mud brick debris. Some patches of ash/charcoal/white mineral.	Backfill deposit	Deliberate backfill (most probably)			Room NW-3d,
	b. Same as 'a' but dense/more compacted	Dense backfill deposit				
4.	Sequence of strata 10 – 20 cm with some debris. Cultural material and ashy layers in varying concentrations. Irregular surfaces: 'wavy'. Some more level. Varying thickness of strata.	Medium fast decay deposit.	Medium fast decay – nearby buildings erode fast but do not collapse. Advanced state of degradation. No or little maintenance, but human use takes place.	Exterior, and formerly interior areas, e.g. after main collapse phase or roof removal.		The fosse. The large court after it lost its original function. Unpaved exterior areas in the eastern *Dunnu*.
5.	Sequence of strata 2 – 10 cm. No or very few recognizable mud brick fragments. Cultural material in varying concentrations. Wavy and	Slow decay deposit.	a. Slow decay – human use and maintenance. 'floors' ie natural surfaces.	Generally exterior, possibly formerly interior areas, e.g. after main collapse		Generally, in smaller outside areas, such as the alleyway in the southern part. Sloping areas in the east, during advanced state of decay of the fortification wall.

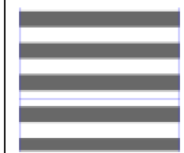
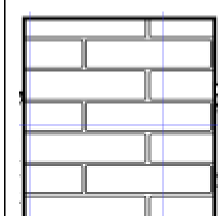
	patchy. Occasionally more level. Varying thickness of strata.	Slow decay deposit, advanced state.	b. Very advanced state of degradation. Not much material left to deposit. Or sheet deposits in sloping areas.	phase or roof removal.		Also most areas in later phases, in level 3 and 2 exhibit such sequences.
6.	a. Sequence of strata < 6 cm. Level surfaces. Uniform thickness of strata.	Very slow decay deposit.	Very slow decay. Regular maintenance. Floor renewals?	Uncertain. If completely open, one would expect greater accumulation of material.		
	b. Same as a, only the colour of strata alternates between just two colours.	Very slow decay alternating deposit.	Very slow decay. Regular maintenance. Uncertain interpretation. Floor renewals?			
7.	Single hard and compact layer of loam or calciferous material. May be integrated in layered deposits type 5 or 6.	Constructed floor.	Floor construction activity	Mostly interior. Exterior uncertain.		
8.	Bonded stacking of mud bricks.	Constructed wall.	Wall construction activity.			

Table 3. Deposit types in the Dunnu related to architecture

The interpretation of deposits as suggested in Table 3 above is based on the general theory of deposition as outlined in the former part of this chapter. Based on this we assume that during use more material is deposited in open areas than in covered spaces during the use phase. Gradual accumulation indicates absence of cleaning and formation of deposits under influence of erosion and gravity (decay), air-based sediment, and human trash producing and construction activities. The thickness and morphology of the individual layers within a gradual deposit tell something about the speed and conditions of deposition. So, we may see slow gradual accumulation of fine and regular layers in less dynamic areas: either in a more sheltered position, less used for refuse producing activities, or both. Thicker layers with irregular morphology indicate a more volatile mode of deposition: moments of rapid decay and absence of cleaning/maintenance. This can be seasonally based, as in winters more water-based erosion and sedimentation will occur, while in the dry summers wind contains many airborne particles.

Whether these deposits will remain depends on human cleaning activities or conditions for further transportation of sediments over ground. Typical places within the *Dunnu* where we can see gradual accumulation of deposits are the narrow alley running along the southern side of the central buildings, and the large courtyard after it fell out of use as high social status area. It is indicative of both absence of maintenance, rapid decay, and refuse disposal, or sediment producing activities such as small domestic constructions. In other open or semi-open spaces we see also some gradual accumulation but on a much slower rate.

This is even the case in an area in the south-western corner that is intensively used for oven-based activities, which involves regular demolition and rebuilding of loam constructed ovens. The accumulation of sediments is clearly observable, but its rate is relatively slow in comparison to the alley that runs alongside it. In fact, some of the architectural modification seen here, the closing of some doorways into this alley, or the construction of new retaining walls, may be a response to the asymmetrical rise in ground level. It is interesting to note, that the fast-rising deposits inside the *Dunnu* are very similar in terms of layer thickness and morphology to what is found in the fosse.

The infill in the fosse, is a good benchmark. It is a good example of the rapid development of deposits in conditions where walls enclose an open space. Unless a rigorous maintenance and cleaning regime is in place, open spaces will fill up. It is therefore notable how little this happened inside the walls of the *Dunnu*, and when it did occur the *Dunnu* had clearly entered a different phase of use (e.g. post *Dunnu*) or in an area associated with intensive food production and other domestic activities. Elsewhere in open spaces we see modest accumulation of thin deposits resulting in limited ground level rise, which indicates that these areas were kept relatively tidy and that the surrounding architecture was maintained. However, a natural influx of deposited material will always occur. Although these are sometimes referred to as series of floors (e.g.

'constructed') in the excavation documentation, they are more likely surfaces created by natural sediments, compacted and levelled through regular usage. That such 'floor series' usually occurs outside, is a good indication for the latter hypothesis.[33]

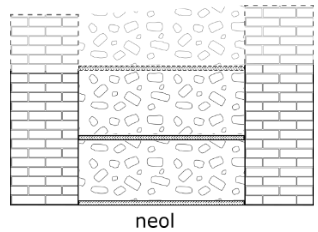
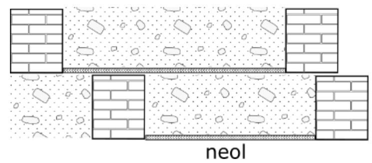
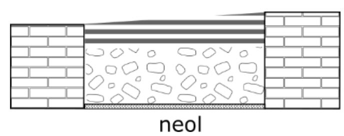
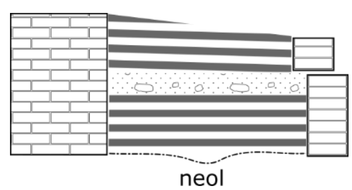
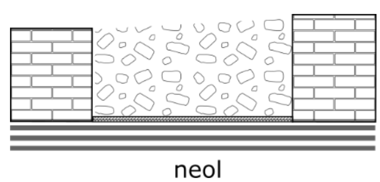
A lot of the deposited material, if not most of the excavated volume, originates from the surrounding architecture, either as products of weathering and erosion or by instantaneous collapse. The debris deposits form the largest volumes of all, especially inside buildings. They occur in a couple of varieties: as unstratified deposits between floors, limited in thickness, or as more massive volumes, often stratified implying multiple moments of deposition. As will be argued below, in the first case, there are good indications these are evidence of controlled demolition and levelling preceding a new construction activity. In the latter case, the deposits are caused by proper collapse, either natural decay or with some human help. The fact that the primary settlement phase is ended by a fire that affected half of the *Dunnu*, clearly implies the purposeful destructive action behind it. Further demolition of the building may have followed it. In a few cases large pieces of bonded brick, fallen wall fragments, were found (Figure 22), which is suspicious since the natural tendency of heavy walled mud brick buildings is not to collapse, but to gradually disintegrate. These wall fragments are always found on top of a debris layer, so the event occurred after the initial destruction. And in many cases the intact walls fragments occur after or just prior to the secondary use-phase, which indicates that if they represent further demolitions, it was instigated by the later inhabitants of the ruins. In buildings where clear phasing in the collapse is recognized, we can detect a gradual decrease of mud brick content towards the top implying the transformation from a more collapse mode of deposition to one with a higher contribution of erosion and sedimentation. The diagonal orientation of the layers allows us in some cases to tell from which wall they originate.

[33] And where they do appear to occur inside, there are good indications that this is because a later roofed space was unroofed at an earlier point in time. See below, deposit sequence pattern 6.

Figure 22. Wall segment found high up in the fill of a room in square L08 (photo: Tell Sabi Abyad project/Peter Akkermans).

IV.3.2 Deposit sequence patterns

The mapping of deposits revealed a regularity in the order or stacking of various deposit types in relation to the architecture. This means that larger parts of the site, multiple buildings, or groups of rooms, share similar stratigraphic and architectural chronologies. These are called deposit sequence patterns, combined sequences of deposit types that reoccur in the stratigraphy of the site. This is the basis for the model of settlement adaptation proposed at the end of this chapter. Seven deposit sequence patterns have been distinguished, and summarized in the table below. For each we will discuss an actual example.

	Description	**Interpretation**	**Graphical representation**
Pattern 1	Walls + floor > Debris > secondary floor inside still standing construction (+ repeat) Instead of debris also homogenous loam layer possible (backfill)	Construction phase > partial demolition and rebuilding > re-use of same walls Possibly indicates vertical expansion of building	
Pattern 2	Walls + single floor > Debris > new construction over old + new single floor Instead of debris also homogenous loam layer possible (backfill)	Construction phase > [decay and] deliberate demolition > new construction phase and use of new building	
Pattern 3	Walls + single floor > Debris > surface sequence	Construction phase > decay and (violent) destruction > re-use but no renovation of original architecture, roofless	
Pattern 4	Walls + surface sequence	Open area in between buildings or walled courtyards or enclosures	
Pattern 5	Surface sequence > walls on top + single floor > debris	Open area > construction phase covering the area > collapse/fast decay	

5a

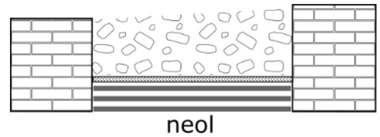
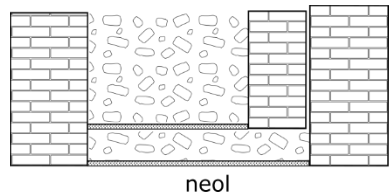
Pattern 6	Walls > surface sequence inside > single floor > debris	Construction phase of open area > area is covered > collapse/fast decay	 5b
Pattern 7	walls + single floor > debris > new floor + new interior wall > debris	Construction phase > partial demolition > construction phase with modifications to upper structure (roof or ceiling) > collapse/fast decay	

Table 4. Common deposit sequence patterns in the Dunnu.

The first deposit sequence pattern is seen on just a few locations in the *Dunnu* during the main use phase, and in the transition to levels 4/3. It is exclusively found in thick-walled architecture, whose walls were re-used in a secondary or tertiary use-phase. In all other deposit sequence types, debris can be clearly connected to architectural renovation or replacement. However, in this case the demolished and renovated part of the architecture could have been above the level of preservation, or the debris does indeed indicate a phase of temporary absence of maintenance and decay. As elsewhere, this absence of maintenance and decay is indicated by wall erosion after the *Dunnu's* main use phase, into the third use-phase. Earlier in the use-cycle, no such erosion could be proven, and it is likely that the debris represents intentional activity, e.g. construction.

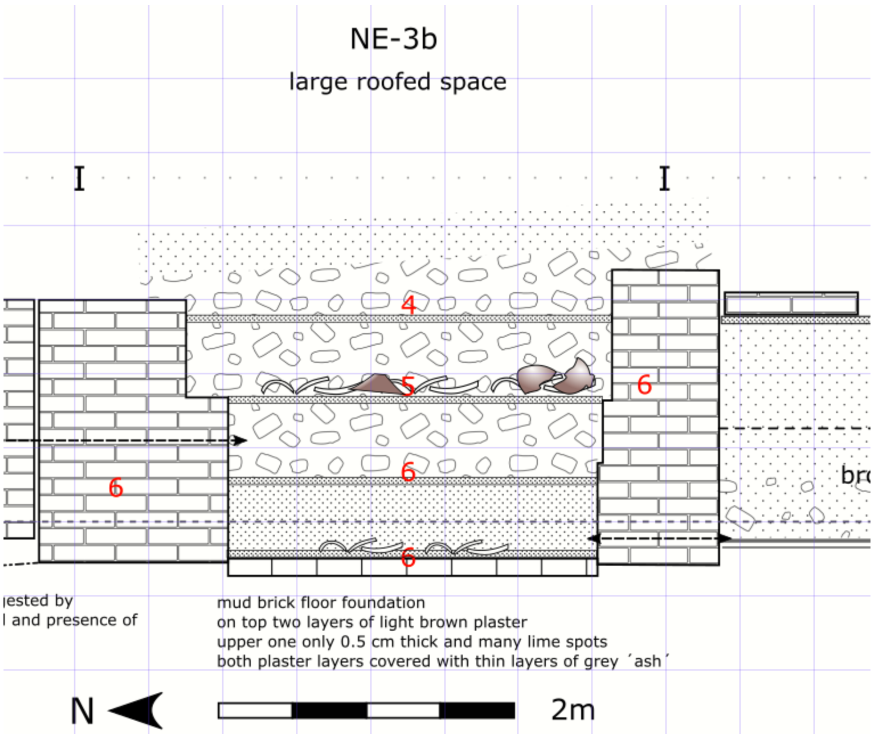


Figure 23. Deposit sequence graph of room NE-3b, example of pattern type 1: multiple floors separated by debris or backfill and re-use of walls.

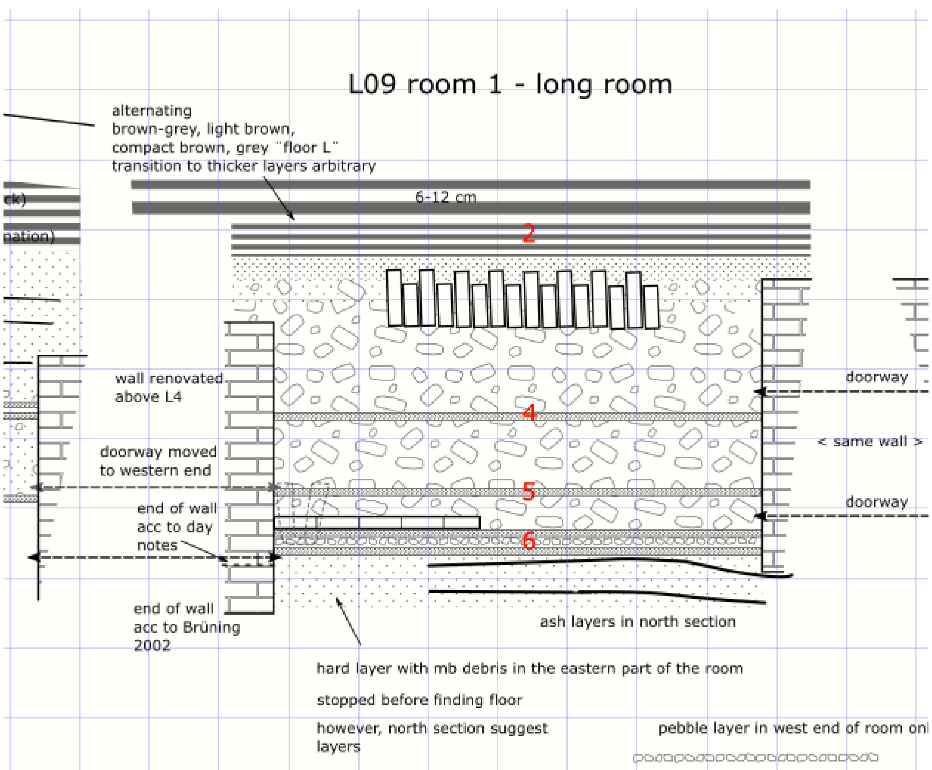


Figure 24. Deposit sequence graph of space NE-3a (L09 room 1), example of pattern type 1: multiple floors separated by debris or backfill and re-use of walls.

The second deposit sequence pattern represents demolition and rebuilding. The debris layer is meant as backfill and is levelled before the construction of new walls and floors. This pattern is found in the tower at the transition from pre-Assyrian to Assyrian (Figure 25). The building is expanded towards the north, and although much of its walls is left standing, the norther wall and connecting interior walls are demolished and rebuild on a different location. It is also found in the south-eastern *Dunnu* during the main Assyrian phase (Figure 26) and in the north-eastern corner of the *Dunnu.* Here, the expansion of the fortification required the demolition of some extra-mural structures.

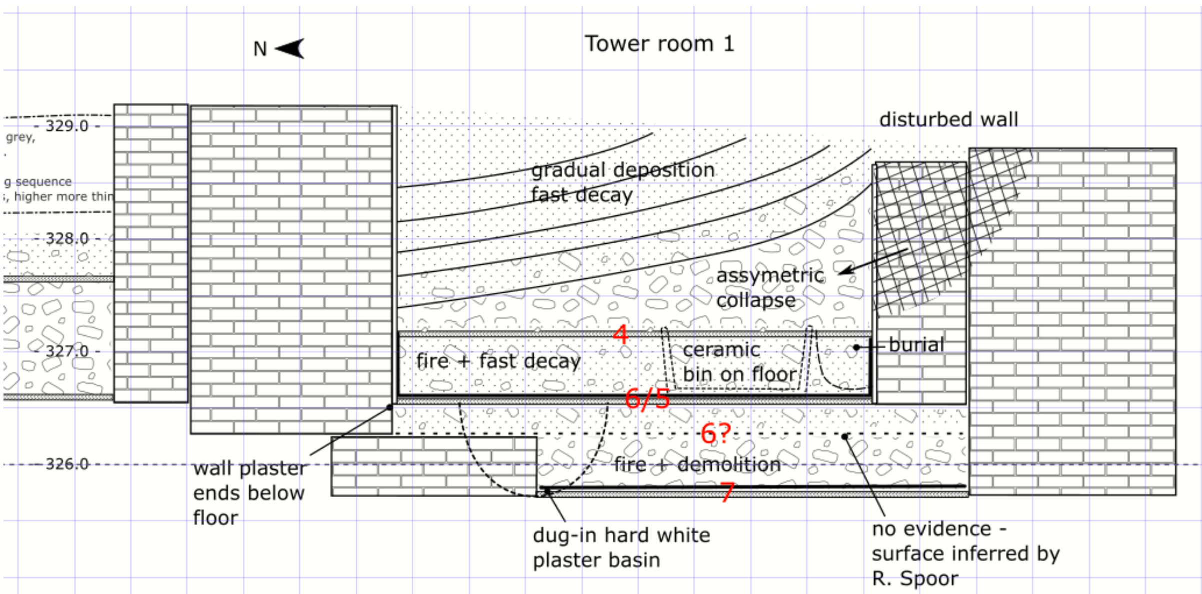


Figure 25. Deposit sequence graph tower room 1, representing deposit pattern 2: controlled demolition and rebuilding. In contrast, the final phase shows different types of deposits, reflecting uncontrolled infill process associated with fast decay.

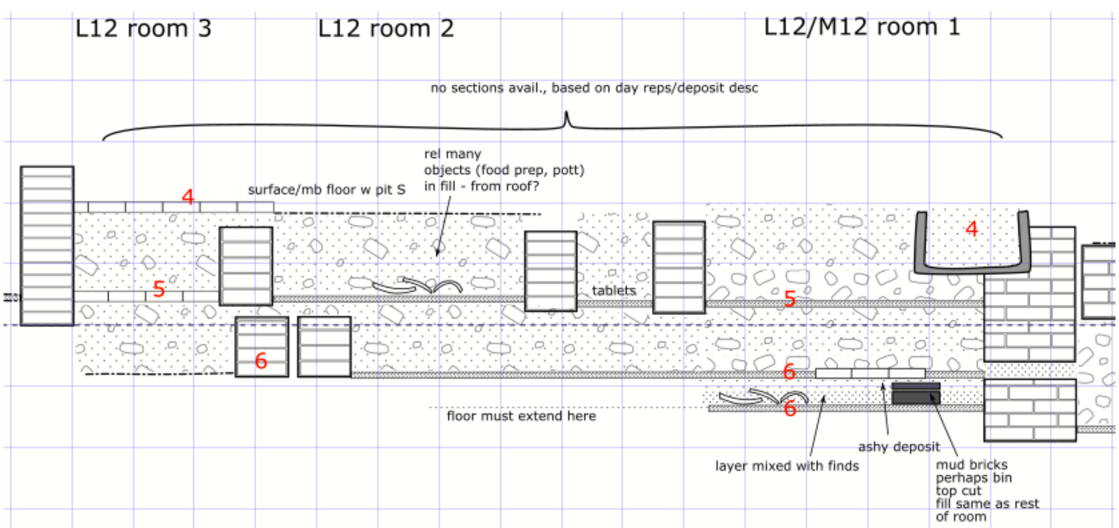


Figure 26. Deposit sequence graph of light walled structures, SE-4 (lower) and SE-5 (on top) found in L12, representing deposit pattern type 2.

The third deposit sequence pattern generally marks the transition from the main Assyrian use phase to the post-*Dunnu* use-phase. A floor is constructed, and used, after which a debris layer closes the floor deposit. On top of that a thin layered deposit initiates, which is ended by a fast decay phase. The most likely interpretation is that an area was in its initial phase covered or uncovered and kept clean, after which demolishment took place and a new use-type with corresponding cleaning-regime initiated causing the stacking of thin layers. If the area was initially roofed, then this is certainly not the case in the later phase. The deposit pattern type is generally found inside heavier walled architecture in the northern *Dunnu* (L08 room 1/Figure 27), and western *Dunnu* (NW-4d/Figure 28, NW-3c, NW-3d, NW-1a).

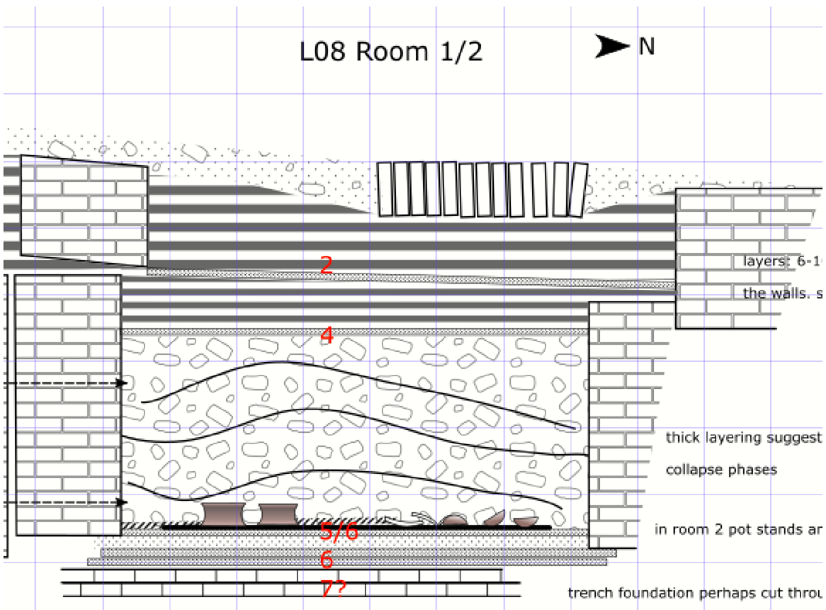


Figure 27. Deposit sequence graph of space NE-2 (L08 rooms 1 and 2), representing type 3: floor and main use phase, collapse, and re-use as open area. Change of maintenance/cleaning regime.

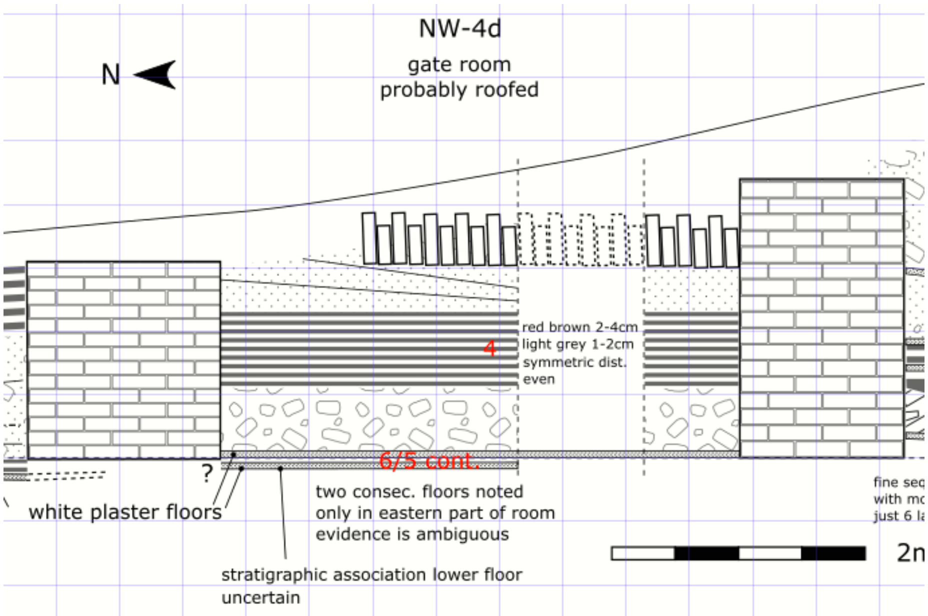


Figure 28. Deposit sequence graph of room NW-4d, representing type 3: floor and main use phase, collapse, and re-use as open area. Change of maintenance/cleaning regime.

The fourth deposit sequence pattern is a typical open-air infill deposit sequence. It is characterised by a sequence of layers, sometimes more constant in thickness, sometimes less. The layering is caused by continuous deposition of cultural (refuse) and natural (sedimentation) origin. Sometimes series of thinner deposits are alternated with thicker deposits containing more debris, representing moments of phases of accelerated decay. At other times concrete use-surfaces are recognizable within these sequences. These are also largely uncleaned areas. During levels 6/5 these are mainly found in the southern *Dunnu*. Here we find a number exterior or semi-exterior areas that had multiple superimposed use-surfaces within the entire time span of levels 6 and 5 (Figure 29). Especially the alley that connected these spaces forms a prime example of such infill process. It shows that from the start of the *Dunnu*, one "phase" seems to have transitioned gradually in the other without clear indication of an abandonment phase in between, at least prior to large site-wide abandonment and the start of the secondary use-phase. Also, there is no clear indication of architectural renewal during this long period, apart from some small adaptations and reinforcements. This is an important observation, because it implies there is no abandonment and decay phase that was used by the excavators to distinguish between 'level 6' and 'level 5' in this area of the *Dunnu*. The light-walled architecture found here would be the first the decay, and in need of rebuilding on return. Since this is not the case, it strengthens the hypothesis that rebuilding activity elsewhere was part of the continuous adjustment of the settlement, rather than a reflection of an abandonment and resettlement phase.

In general, this pattern of gradual infill is very common in the secondary Assyrian use-phase, when architecture seems to have been left to decay and continuous use of exterior areas takes place without too much cleaning. The use of the area of the former large courtyard is a good example of this. As has been indicated above already, it is similar to the gradual infill processes that filled the fosse over time, which also is likely the result of natural sedimentation and cultural refuse disposal.

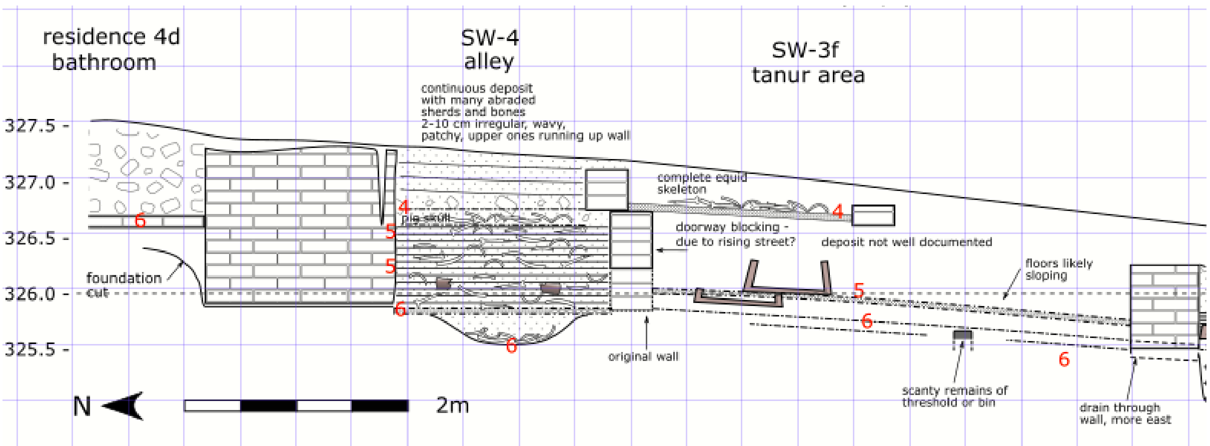


Figure 29. Deposit sequence graph of spaces SW-4d and SW-3f, representing type 4: continuous deposition, little cleaning. On the left the residence with its terraced wall foundations and mud brick collapse fill.

The fifth pattern represents an exterior area with continuous use and deposition, transitioned into an interior area due to new construction. It occurs when a new structure is simply built on a previously unbuilt, but used, exterior area. Example are the rooms of the residence, built against the western side of the tower (Figure 30) and space SW-3g (Figure 31). The case of the residence also shows us there was a considerable period between the construction of the tower and that of the residence, proving the primacy of the former. The pattern is also found in other locations dispersed over the *Dunnu.* L08 rooms 1 and 2 and NE-1a are both spaces constructed in front of the old gate. These show a deposit sequence of relatively modest thickness, reflecting the phase that the area was open during the functioning of the old gate. And in the southern *Dunnu*, space SW-3g reflects this pattern.

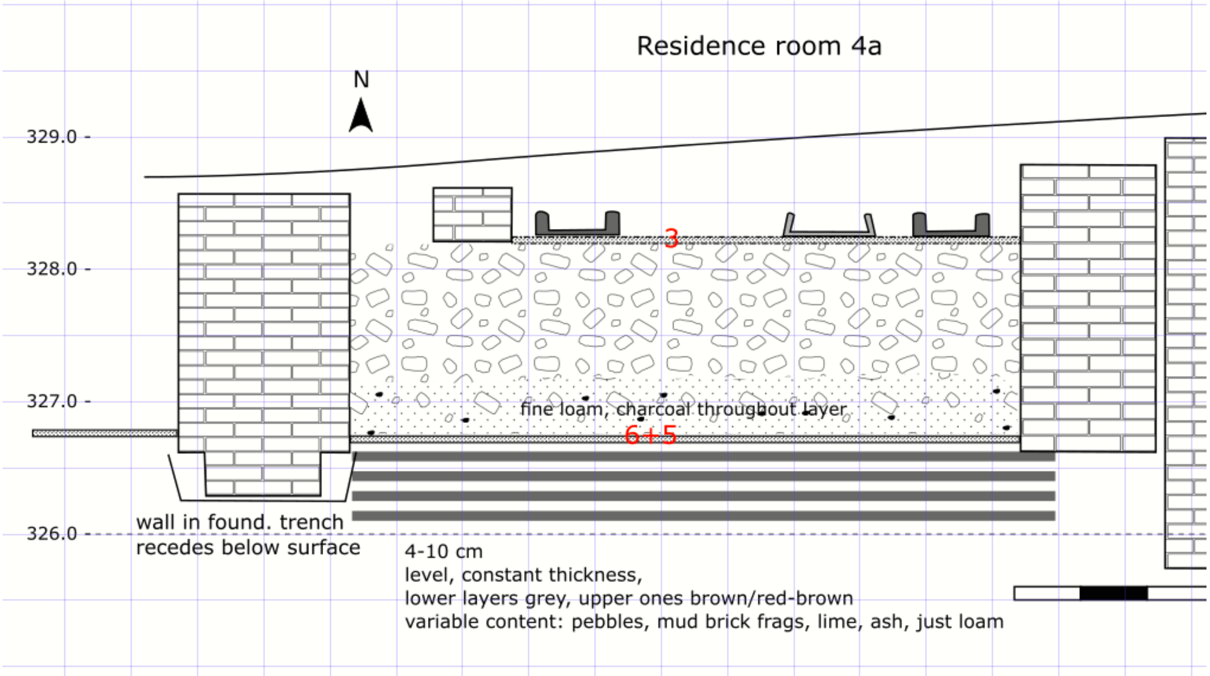


Figure 30. Deposit sequence graph of space Residence 4a, representing type 5: construction in formerly open area. The lower part of the collapse deposit is likely the collapsed roof. On the right side the exterior wall of the tower.

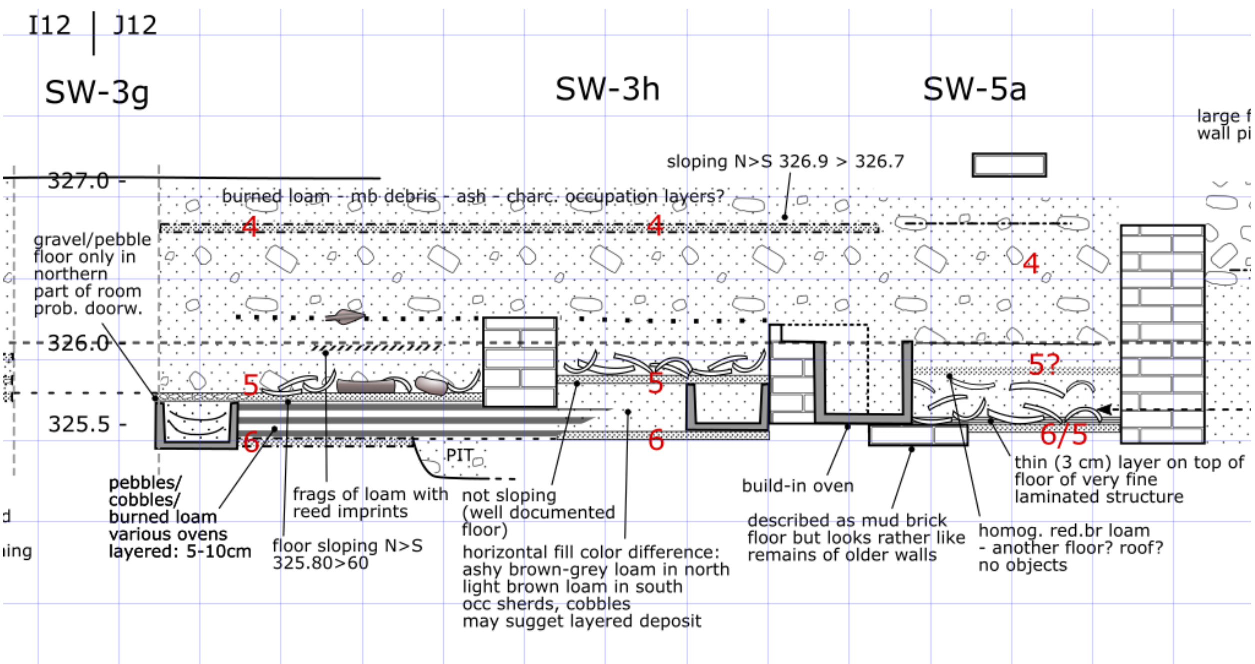


Figure 31. Deposit sequence graphs of spaces SW-3g, SW-3h and SW-5a. SW-3g is an example of a sequence characteristic of a formerly open space with gradual deposition, halted by the construction of a roofed structure.

The sixth pattern is represented by a single example, but remarkable and clear enough to justify its own type. Room 5 of the tower shows a layered deposit with thin regular layers, indicating gradual deposition at a constant rate and use-surfaces (Figure 32). A thin debris deposit follows, on top of which walls are constructed and a new floor. The gradual deposition does not return. This seems to suggest room 5 of the tower started out as an open area, a courtyard, and was subsequently turned into a roofed space. The new walls on all sides of this room also indicate exactly this, as the most likely interpretation for their construction is as roof support.[34]

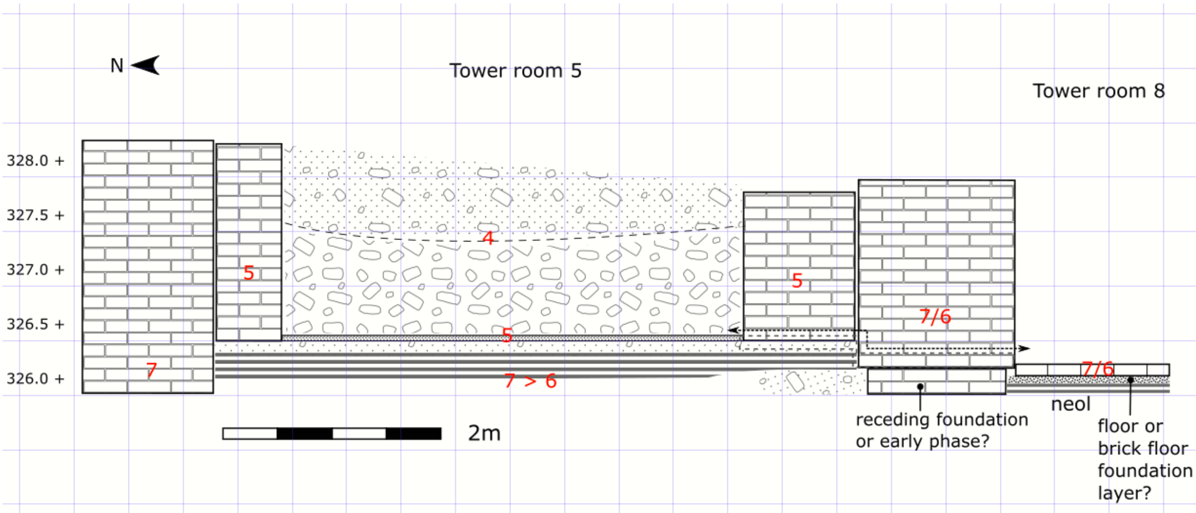


Figure 32. Deposit sequence graph of tower room 5, representing type 6: open area turned into closed area.

The seventh pattern represents cases where interior architectural modifications took place after partial demolition. The sequence starts with a building, followed by a levelled debris deposit on the ground on top of which another floor is constructed, associated with a newly constructed interior wall. The pattern is found in rooms 1, 4, and 7 of the tower. In room 1, discussed before, the debris deposit has already been associated with partial demolition and rebuilding (Figure 25). But besides the replacement of the northern wall, a wall was constructed as an abutment against the old southern wall. In room 7 the debris layer could be associated with the demolition of an older partition wall that had cut the room in two separate rooms. On top of this levelled debris layer the abutting wall was constructed. In room 4 there is no clear indication of demolition, but a similar abutment along its northern wall was constructed. These abutments are a hint at the type of architectural modification that may have taken place during this time, which is discussed later on. There is just a single example outside the tower which shows a similar deposit sequence and that is M11 room 2, which has a similar abutment on its western wall. Another interior modification preceded by either a homogenous backfill or a mud brick debris fill is found in spaces L09 room 1 and NE-3b. Surprisingly,

[34] And not as the excavators suggest 'wall reinforcements or repairs'.

this is the sole case were an interior modification involved the partitioning of a larger space by a new partition wall.

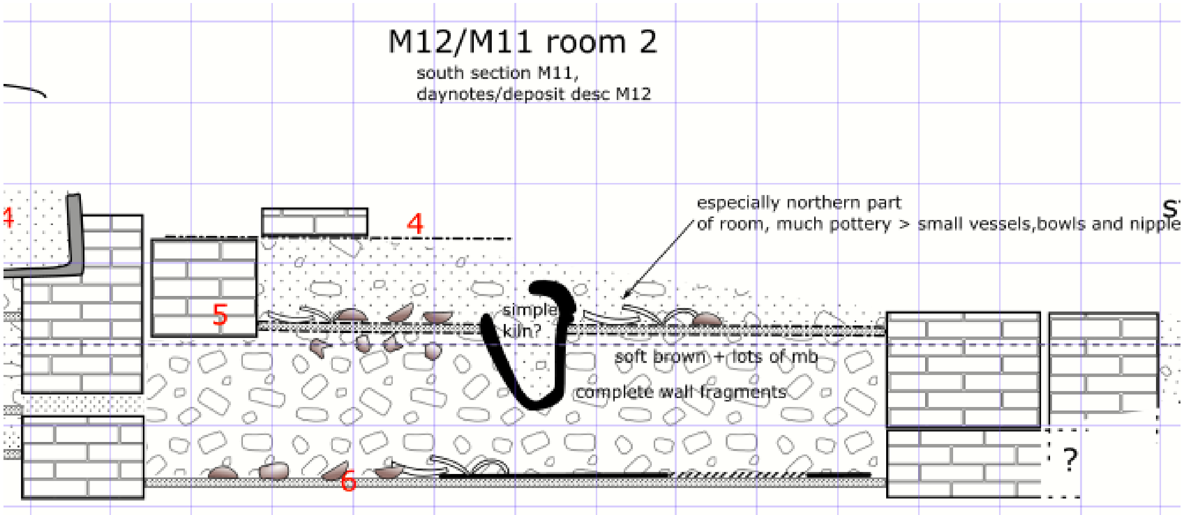


Figure 33. Deposit sequence graph of space SE-2c (M12/11 room 2), representing both type 2 (demolition and rebuilding on top) and type 7 (interior modification).

IV.3.3 Collapsed roof deposits

Occasionally, collapsed roofs may be identified archaeologically. Generally, this is the case when the roof material is easily recognizable, such as in collapsed vaults. In other cases, fire may have preserved also less well identifiable structures such as flat loam terrace roofs. A recent study shows that with finetuned archaeological methods and observation it is possible to identify also less obvious contexts (Friesem, Tsartsidou, *et al.*, 2014). The methods as proposed by Friesem *et al.,* including micro-stratigraphic, were not used during the excavation of the *Dunnu.* Nonetheless, the descriptions of stratigraphy in the day reports do contain some evidence as to the presence of roof collapse deposits. Two types have been identified. One case is space SW-6b, which is destroyed by a catastrophic fire (Figure 32). In this space, the excavators documented large slabs of burned loam in the fill of the room, in one case with a still observable layered build-up. In addition, the contents of the room, large storage vessels, generally with only the bottom half preserved, indicate that something heavy had come down that crushed the top half. The other type of evidence of roof collapse deposits is represented by a thin layer of white fibric material, found in the deposit just above a floor level (Figure 35, Figure 36). This is most likely a phytolith layer, the remaining silica structures of decayed plants, probably straw or reed. It is possible that these are remains of roof construction material, although in theory it could also originate from matting on the floor or walls. However, the field descriptions seem to indicate that such material is often found intermingled with other objects and deposits found on the floor, rather than underneath them, implying that it more likely came from above. It is possible that the top of such roof or floor collapse layers have been misidentified as intentionally constructed new floor levels. An example of this is room SW-8a (Figure 35), which appears to show a thick roof collapse deposit, on top of which a walk surface is created. Here, the context of the collapsed second floor or roof walk surface and the new ground floor walk surface may be intermingled. Above all, in this case the new walk surface has been assigned to level 5, which has considerable historical repercussions. It is possible, like in various other buildings in the *Dunnu*, that the use of the first ground floor surface spans the historical period covered by both construction levels 6 and 5. The surface created on the collapsed roof deposit, may therefore just as well be part of a later phase after the demise of the original *Dunnu*. Considering the stratigraphical sequence in the neighbouring buildings, for instance SW-6b or SW-6a (Figure 34 & Figure 36), this may be a more likely course of events.

The concrete examples cited above all come from the southern *Dunnu*, which probably tells us something about the processes of decay and abandonment in this area. Although ‘whitish fibre’ or ‘plant fibre’ material has been mentioned elsewhere, the stratigraphic context often does not allow for the identification of a potential roof collapse. In fact, many of the deposits in the *Dunnu* are probably roof collapse deposits, but due to the documentation methods used in excavation, these are hard to distinguish from any other type of building collapse.

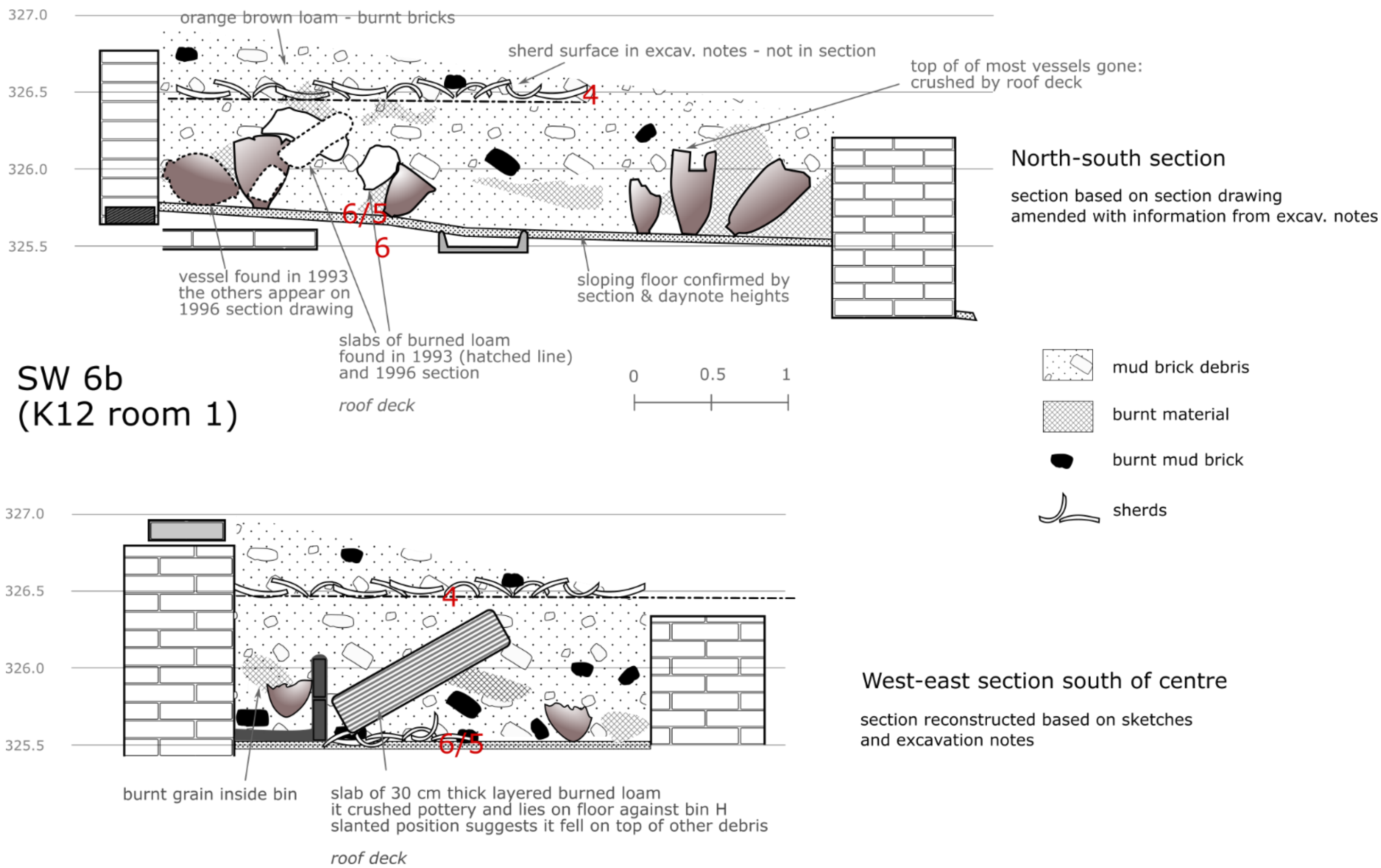


Figure 34. Sections through the burnt room SW 6b.

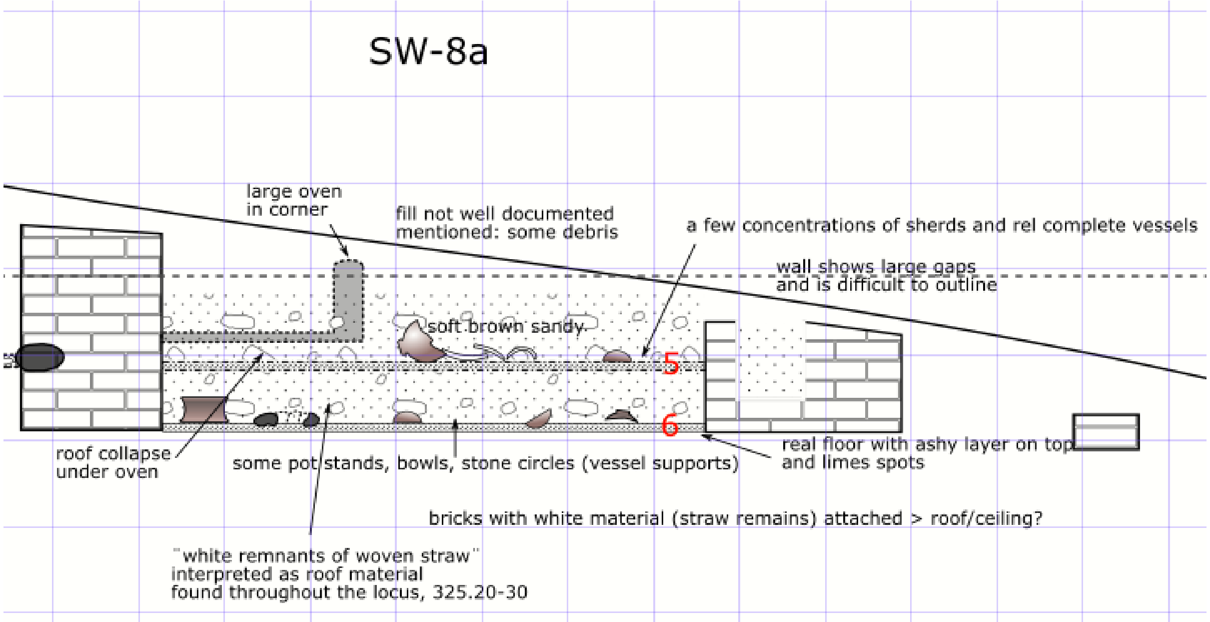


Figure 35. Deposit sequence graph of space SW-8a, showing possible evidence of remains of decayed roof construction material on top of the floor.

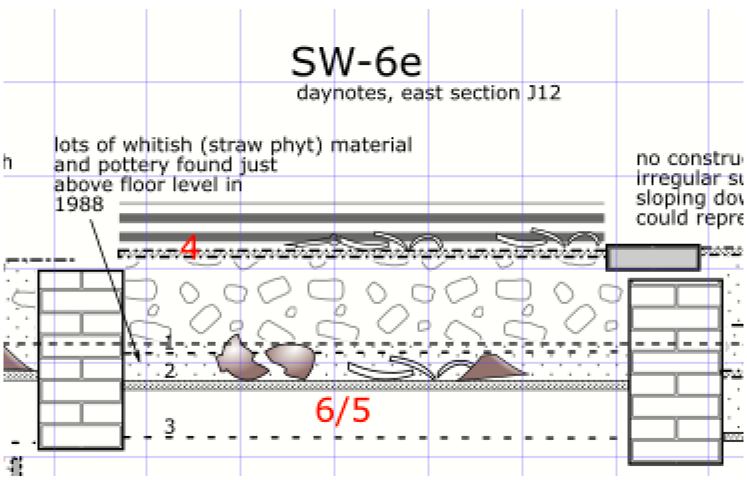


Figure 36. Deposit sequence graph of space SW-6e, showing possible evidence of remains of decayed roof construction material on top of the floor.

IV.3.4 The *Dunnu*'s deposit patterns and architectural development: concluding remarks

The analysis of deposit sequences reveals some important patterns. First, the deposits reflect the difference between in and outside quite well. Exterior areas generally show a gradual accumulation of cultural and natural deposits, even if it is just in very small amount in areas kept relatively clean, or in more sheltered locations or smaller spaces (Figure 37). Interior spaces on the other hand generally show large amounts of mud brick debris. These observations correspond to the general theory of deposition which indicates gradual deposition in exterior areas, and construction collapse inside buildings. Although we may expect some debris to end up on the outside of buildings, the tendency is that it falls to the inside as result of the instability create by the roof collapse (Figure 14, top left). Also, when people demolish a building on purpose, it is most practical to have the debris fall on the location of the building.

The difference between gradually developing stratified deposits on the outside, and clean floor deposits on the inside, makes it also possible to identify some of the chronological differences. For instance, it reveals that the tower and the residence are indeed constructed in a different layer and therefore date to a different phase. The residence was constructed on top of a series of exterior surfaces of an actively used area that had already developed next to the tower. In a few other cases, this helps us as well to identify a relative sequence of events with some certainty. Such patterns are not always clear, since very little material may have been deposited in between the construction events. A problem is that we do not always know for certain whether this was caused by a short period of time between the construction events, or by the fact that cleaning and erosion has kept an area on more or less the same level.

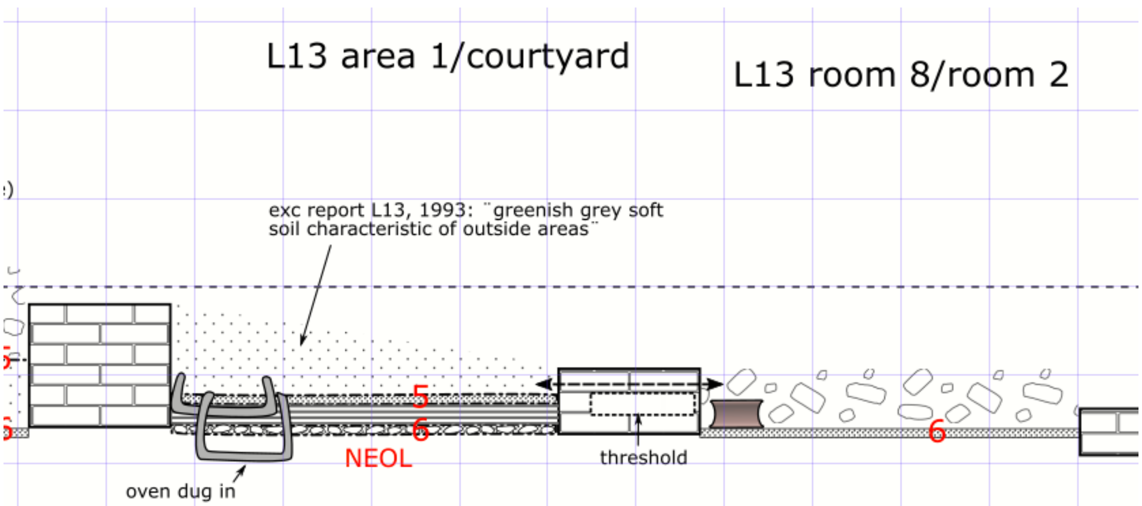


Figure 37. Deposit sequence graph of space SW-4f and SW-8d (L13 area 1 and L13 room 8), illustrating the difference between in and outside deposits.

Another important observation is that debris deposits of the earlier phases, before the larger site abandonment and contraction, can be associated to architectural change. It is highly likely that these deposits were created intentionally and were the effect of a demolition activity. In parallel to general development of mud brick settlements elsewhere, people demolish, level and construct again. In the *Dunnu* this pattern does not reflect a cyclical generational rebuilding of the same house. In all cases the spatial layout or structural properties of the buildings change after the demolition phase. This suggests that buildings were demolished not primarily because they were in a state of dilapidation, but because the occupants of the *Dunnu* required a new type of building. Something about the spatial distribution of functions, or how circulation needed to be managed, had changed, so the built environment had to be adjusted. Exactly how, will be analysed in chapter 5.

In contrast to the debris deposits of the earlier phase, debris deposits of the later *Dunnu* reveal a different mechanism. In many spaces we see the effect of a big fire, and debris deposits in these areas also contain burnt fragments. The gradual nature of these debris deposits is also clear as towards the top, the amount burnt materials decreases. Moreover, in many sections of these debris layers a clear layering is visible indicating multiple collapse moments, or gradual collapse periods. Moreover, the asymmetric distribution of these layers within a space indicate the uncontrolled nature of the mechanism behind it. Another interesting feature of the collapse deposits higher up, that means during or at end of the post-*Dunnu* phase, entire wall segments were found in the fill. Both the condition they are found a flat surface, and the fact that walls generally do not fall over until an earthquake or human pushes them, seems to suggest that the last of the still standing ruins were actively demolished. Some of it can be associated to a rebuilding event in the post-*Dunnu* phase, some of it can be associated with its abandonment.

The last important conclusion of the systematic study of the deposit patterns, is that there is no evidence for a synchronous *Dunnu* development. There is synchronisation, defined as the same sequence of deposits, but this is not global, but localised. That means that sections of the *Dunnu*, share a similar deposit sequence. As has been argued above, this is connected to the construction and demolition cycle of a particular building or group of related buildings. Although at times construction events seem to have covered a large part of the entire settlement, even the larger events did not affect all buildings. It means that some buildings saw continued use without a break or modification, while other were modified or demolished. This conclusion may seem quite obvious, but it is important to confirm this here because it is in conflict with the idea of levels and of building events connected to historical events.

IV.4 Deposit sequence patterns per area

In the map below, the *Dunnu* has been segmented in areas which have a shared deposit sequence until the occurrence of the collapse and decay deposits that introduced a new archaeological level representing the farmstead phase. A notable difference is apparent between the western and eastern *Dunnu*. Also, the two large buildings in the centre have their own depository sequence, and even showing different sequences for their northern and southern parts.

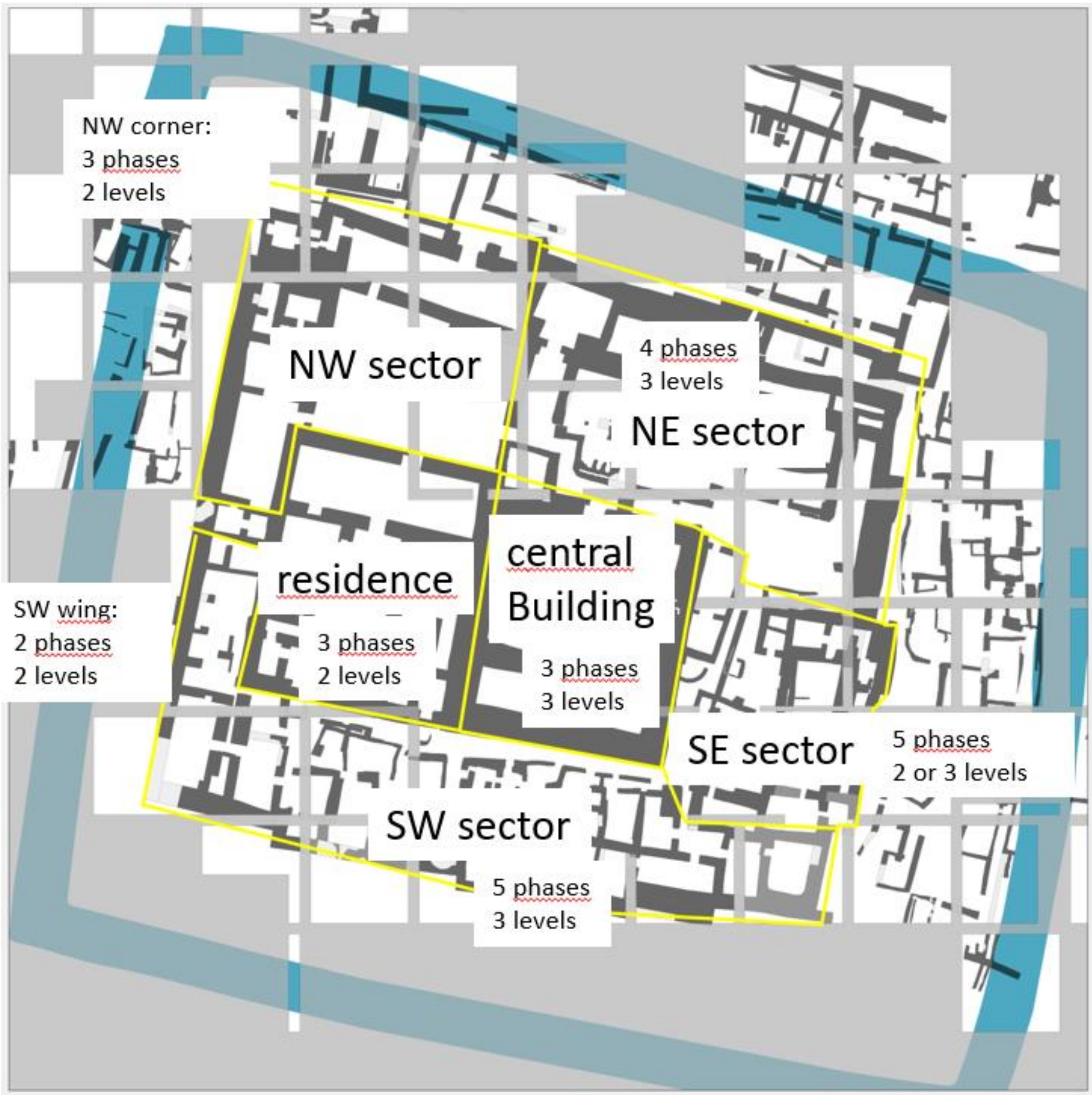


Figure 38. The Dunnu subdivided in areas of similar deposit sequences. 'Levels' refers to construction levels in which (parts of) the area was demolished and rebuild or left open. 'Phases' refers to stratigraphical layers inside the building or open area that indicate different use phases.

IV.4.1 Northeastern *Dunnu*

The northeastern *Dunnu* is the area north and northeast of the central building, starting with the old gate until the eastern fortification wall. The depository evidence shows a higher number of construction, collapse/demolition, and new construction phases than anywhere else in the *Dunnu*. Due to this, it is the most confusing and difficult to interpret architecturally and above all to establish the chronological links internally and to other sections of the *Dunnu*. But in terms of deposit patterns, it offers also a highly instructive case to help our understanding of the relation between physical structure and deposit patterns, and construction processes and deposit patterns.

Characteristic of the northeastern *Dunnu* are that within the walls of buildings we see a sequence of floors separated of each other with rubble or other mixed deposits. As we will come to see, elsewhere architecture generally has one distinct floor level, and perhaps a second surface related to a secondary use-phase. Part of the explanation for this phenomenon must lie in the fact that we are dealing with massive architecture that stood for a long while and saw multiple phases of repurposing.

The stacking of floor and rubble deposits is nowhere as noticeable as in space NE-3b, a large room adjoining the older fortification wall. Within this space we have evidence for 4 cumulative floors or temporary surfaces, including the level 4 floor that can be connected to level 4 surfaces in surrounding rooms. Rubble is found between the second and third and third and fourth floor, indicating thorough demolition or collapse. There are no indications of deposits caused by gradual decay/building erosion, thus we may suggest that rebuilding activity quickly followed upon these phases. It is likely that the first phase of collapse may have been intentional, and consequence of rebuilding related to a repurposing of the area. Between the first floor, a neat mud brick floor coated with loam plaster, and the second, which is an ephemeral horizon or surface of some sort, no rubble deposit is found but a thick homogenous deposit with smaller fragments of mud brick and lime. This deposit must have been put into this space rather than naturally developed and can thus be classified as backfill. This occurrence may be related to an architectural transformation of the surrounding spaces and structures.

Other spaces, such as NE-2a/b, show a somewhat different deposit pattern, related to their architectural history and context. These spaces are part of a building that is appended on the outside of the fortification wall. Since it stands snugly against the eastern pier of the old gate on one side, and against another exterior expansion on the other, it is clearly constructed within the given limitation of space, and hence to be chronologically later than the structures it abuts. This is visible in the deposit pattern as well. It starts with what seems to be the start of a layered deposit with at least two floor levels, and beneath that a badly understood mud brick structure of at least two layers. At the height of the floor levels, photo's clearly show a thinly layered deposit. This depository sequence and the presence of ovens and a kiln indicates that this was an outside area in front of the fortification wall just around the corner from the old gate. A new floor was laid when the actual building was constructed, and this floor keeps being in use during the entire remainder of the primary settlement phase. Many remaining objects on the floor and high concentrations of charred wood indicate abandonment, which was followed by a massive collapse deposit. With a thickness of 1.5 meter, this belongs to the thickest collapse deposits found in any building of the *Dunnu*. The collapse deposit is roughly stratified, which indicate a phased collapse rather than a single large one. On top of this, still between the same walls, a new surface is deposited, which is where level 4 starts. However, as a layered deposit indicative of an open area now initiates, we can infer that the use of the space had changed, and that the roof was likely never restored. The exact same deposit sequence is found the neighbouring room NE-1a, a space created in front of the old gate when this gate went out of function. The massive volumes of the collapse deposits here are almost certainly related to the vicinity of the two phases of fortification wall and the old gate. That it has been preserved so well here, is because during later post-*Dunnu* phases, new architecture was constructed on top adding massive amounts of new material that protected the layers underneath.

Another typical feature of the northeast was already alluded to, namely that of external architectural expansion. To the northern fortification wall, various buildings were added. Twice a new outer fortification wall is constructed, each time extending the surface area of the *Dunnu* a little bit. These expansions form an interesting case to test the hypothesis that over time deposits form near standing walls, due to both natural and cultural processes as outlined in the general model of deposition in the beginning of this chapter. Hence these new walls, should be on a stratigraphically higher position, if there has been no excavation prior construction. The cross-sections, one already made in the field for this purpose and one reconstructed, do indeed confirm this stratigraphic relation. In fact, observation and interpretation is greatly helped by the fact that older LBA structures that apparently stood in front of the fortification wall are demolished and overbuilt by the expansions. This is the case with the first addition, the long building along the fortification wall in the northeast which is very likely a supporting structure for a staircase (see V.5.7.2). And it is the case with the second addition, which extends the area of the *Dunnu* significantly. As said, the main reason for their elevated position in relation to standing architecture seems to be a case of architectural demolition of the smaller structures these expansions overbuilt. Gradual accumulation did not make an obvious impact, but it must be said there are no good field drawn sections available that pertain to these early phase structures.

Layered deposits were however also discovered in a test trench along the fortification wall in room NE-1a, the room in front of the old gate and below the previously discussed rooms NE-2a/b next to it. It thus shows that while the old gate was in function, a slow gradual accumulation took place here slightly raising the surfaces. Part of these surfaces are high in lime/gypsum content, which may indicate regular whitewashing of the northern fortified façade of the *Dunnu,* including the floors (see V.5.3.9). Likewise, from the big section through the fortification wall that was made during excavation, it seems also clear that the latest phase of expansion was preceded by a layered deposit, then a rubble deposit and then a new buttressing wall. This rubble deposit may very well be related to the toppling of structures in front of the fortification wall, as seen elsewhere.

In conclusion, we have observed that including level 4 there are at least 4 floor phases separated by backfill or demolition deposits, in the eldest architectural structure in the northeastern *Dunnu*. A lesser number of such phases suggests that a structure has been added at some later point in time, in which case we find demolition or layered deposits belonging to a previous phase underneath. In other cases where not 4 distinct phases are attested, such as NE-1b and NE-4c, we must assume that the architecture did not see the same number of modifications. In yet other spaces not discussed here, such as NE-3d and NE-3c, excavation never went deep enough to uncover the entire deposit sequence. At the same time there are at least 3 distinct construction phases expanding the *Dunnu* northwards. Including the initial phase of construction, the number becomes 4. As will be argued in the chapter on construction, these exterior expansions and other observed interior modifications must in some way be related to the floors and rubble deposits in NE-3a and NE-3b.

IV.4.2 Southeastern *Dunnu*

In the south-eastern corner the architecture is somewhat lighter in nature, which may hence explain the pattern observed here. There are at least 3 recognizable floor phases including level 4, during which phase everything seems to be an outside surface. Again, there are well defined collapse/demolition deposits, with floor deposits separating them. But what is very characteristic and typical for this area, is that after the first architectural phase the buildings are filled with collapse/rubble deposits of various thickness, and than a completely new architectural phase follows. These new walls are constructed over the old ones. This is different from the north-east as we have just discussed, where the same architecture remains to be used with new floors within the same walls, while new architecture is added on the exterior of the fortifications. What took place in the south-east is that buildings were demolished completely but for the base of the walls. What is noticeable is that the different volumes of rubble deposits within these older walls correlate with the slope of the ancient tell, the deeper it goes, the more rubble is found. Hence it seems that it was a conscious effort to get the entire sector up to the same level, prior to rebuilding. The previously standing buildings may have been in a state of decay or not, the rebuilding itself, which turned out to have a new architectural layout, clearly indicates that this area had been repurposed. Hence, we should not assume that this phase of rebuilding, as is often suggested, necessarily reflects a *dunnu* in a state of decay.

On two places surfaces or floors have been recovered that seem to precede the older architectural phase discussed here. Hence, there was a phase during which some of the lighter walled architecture in this case, may not have been constructed yet. The deposits on top of these surfaces seem to be gradual decay deposits, hence developed under outside conditions and normal use, or possible backfill. If we include this phase, we may set the total number of distinct depository phases related to architectural modification at 4, like in the north-east. Some issues exist with how this relates to modifications directly to the exterior of the fortification wall, but that discussion is left for the chapter on architecture.

Layered deposits are found in a few places only. They are found where expected in in-between-area or courtyard SE-1c, where we see gradual rising of surfaces. They are also found in the large open courtyard area NE-4a. Although a large part of this area is left to be excavated, a few soundings on its northern side leave no question: the area filled up with a layered deposit characteristic of exterior conditions and some domestic use. Other areas that have always been considered courtyards or other unroofed spaces such as SE-3b and SE-2d contain no evidence of such deposits. Hence we must assume these spaces were either roofed after all, or simply kept clean. Considering the spatial position, near the back entrance of the *Dunnu*, they might have had some social or economic significance which may be related to the absence of gradual decay deposits prior to the large collapse deposits that afflicts the entire area, and *Dunnu*. Layered deposits do however again appear on top of these collapse deposits, as the architecture is rapidly eroding, while people are still also using the surfaces. Another great example of how in- and outside conditions result in distinct deposit patterning is the difference in infill between alley SW-1c and the adjoining spaces SW-2g and SW-1f. The alley reveals a layered deposit, while inside the adjacent buildings massive collapse deposits develop. It is clear that these buildings had started to collapse inside themselves, as is often the case, while the area outside it quickly fills up with eroded building material. The large difference in layer thickness within the layered deposit indicates an erratic process of occasionally less or more material deposited at once.

Concluding, the southeast is perhaps the most strongly spatially modified area. Its construction phases are clearly represented in the demolition deposits that were intended to level the area after the first building phase. Its end comes as everywhere with massive collapse deposits followed by layered deposits caused by eroding ruins and small-scale human activity.

IV.4.3 Central building

The large central building, or tower, has its own depository and thus constructional history. That does however not mean that what occurs here, is completely independent of what happens directly outside its walls in the eastern half of the *Dunnu*. Particularly interesting is that although we seem to deal with one large building, deposit sequences vary between the rooms, which indicates varying constructional and decaying histories. Interpreting it from this perspective, a somewhat different picture emerges than has been concluded in the extensive documentation relating to this building. In the final stratigraphy reports, the stratigraphy of the tower has been somewhat forcefully pressed into the three-level mold: level 7, level 6, level 5. Thus, each of the rooms was given a floor related to each of these levels, even when no floor was observed or if floors were so close they are likely part of the same continuous use-phase. The suggestion of a uniform construction and use history is not warranted by the re-analysis of the documentation. Nevertheless, it is equally unlikely that each room went through a construction and decay history completely independent from the next, since they are part of the same larger structure. The deposit model in combination with the constructional logic model can clarify matters.

Rooms 1 and 2 have similar deposit sequences, caused by a shared construction history. Room 3 is related to them since it follows the same construction history, but since it is a staircase, collapse and decay processes act differently causing a different stratigraphic pattern. Rooms 1 and 2 both have 3 distinct floor deposits including level 4. Room 3, the staircase just 2. That means that prior to the great collapse and decay deposits that preceded level 4 floors, there are just 2 floor phases in rooms 1 and 2, and 1 in the staircase. What is most interesting is what caused the large rubble deposit between the eldest and second floors. This becomes immediately clear when looking at the deposit sequence graph of room 1. The north wall is moved northwards at a certain point, and the remaining cavity between the old north wall and the south wall of the room is filled with rubble. This is likely demolition rubble, intentionally left here to cover up the stub of the elder wall. Constructional analysis reveals that in fact the entire north wall of the tower is a later addition, hence causing in all three rooms the need to cover up the remains of the older wall. In room 2 this resulted in a similar rubble deposit. In room 2 however, the top of the old wall became the floor of the corridor that led to the stairs. There is also an important difference between rooms 1 and 2 in type of floor deposit, which indicates different use and architectural conditions.

Room 5 is a completely different story. On top of Neolithic remains, it starts with a thinly ‘layered deposit’, interpreted as a series of floors, but what is in fact a naturally rising surface under influence of domestic/industrious activity, slow decay and possibly some eolian sedimentation. Its thickness, 20 cm, and number of layers suggest an extended period over which these developed. To put it briefly, this was an open space within the large building, a kind of central courtyard. The development of this deposit stagnates when a relatively thin rubble deposit covers it, on top of which a new floor deposit, and new walls on all sides are constructed. All the evidence suggests that from now on, the space is covered.

Rooms 6 and 7 also share a similar deposit sequence. This is caused by the fact that both these rooms once had a separation wall. The demolition of these walls caused again a rubble or backfill deposit to fill the cavity between the wall stubs and the other walls of the room, to create a sufficiently stable and level basis for a new floor. Again, the thickness of the deposit is dictated by the amount of wall left standing that needed to be covered up.

Both rooms 8 and 9 have a relatively simple deposit sequence. Both just have evidence for one floor deposit, in both cases a mud brick floor. Loam layers interpreted as ‘floors’ right on top of just beneath these floors are very badly preserved and could be part of its continuous use, or part of the mud brick floors' construction and do not really indicate architectural modification.

Neither of the six southern rooms, room 4-9, has evidence for significant activity after the great collapse/fast decay deposits. There are no level 4 surfaces as there are in the three northern rooms.

In conclusion, the deposit sequence patterns of the rooms in the tower are most likely interpreted as particular architectural modifications occurring in each of the rooms. In rooms 1-3 there have been two such phases, one with the extension of the northern wall, and one with the small modifications in level 4 when activity took place on top of a significant collapse deposit. Some of the other rooms also show one large modification, and a deposit related to construction/levelling activities or a change of mode of deposition turning from open to roofed conditions. The remaining rooms show no modification and related deposit at all. Their architectural structure remained unchanged throughout their entire existence, whatever their – likely changing – use was. How all these architectural histories combine in one history of construction and demolition of the large central building will be discussed elsewhere.

IV.4.4 Northwestern *Dunnu* and residence

The northwestern *Dunnu* includes the entire intramural area west of the old gate, including the residence, but not the area directly south of the residence. What is typical of the deposit sequences found here, is that before the large collapse/fast decay phase that ended the primary settlement phase, there are no thick deposits of any kind. In a simplified representation of what happens here we can state that a building is constructed, including floor, it is used continuously, and then the large fast decay/collapse deposit is formed. There is no evidence for large-scale architectural modifications, but for two new walls in the long western wing running along the fortification wall, and some minor modifications in the residence (that by the way do have significant implications to access patterns). In the mean time, it seems that some open areas like the large paved courtyards and the roofed architecture are kept clean, while in others some gradual deposits can accumulate. A large part of the western wing falls into the last category, suggesting this was largely an open space. Accumulated height is modest and measures between 10 and 20 cm, which probably means that it is relatively well-maintained area. However, some of these layers might be related to backfill but it is hard to say as the documentation on these layers is limited.

Most of these architectural foundations are found directly on the Neolithic tell. The residence however, diverges from this pattern. In soundings below the floors of the residence in rooms 9 and 5, various features are found that indicate use of the area before the residence was built. The deposit type is a layered deposit, a combination of constructed and naturally accumulated surfaces that indicate an outside area. The deposit seems to gradually merge with the Neolithic, and it is possible that some intermixing had taken place. It is certain that during the construction of the residence significant digging and levelling activities had taken place (see chapter on construction) which could be responsible for the muddled picture.

The deposit patterns of the decaying residence hold another prime example of how differing architectural conditions cause diverging deposit sequences. After the fire, the residence collapses, and fast decay and collapse deposits follow. In most of the spaces, these deposits fill the room until the top of the remaining walls. However, the large east-west oriented paved space, filled in a different way. Here, some collapse deposits are formed, primarily on the south side, the area that is near to the main building. The building's collapse may have spilled somewhat in the forecourt. But the thickness is not nearly as thick as elsewhere. Above that collapse, a layered deposit initiates that closely follows the pattern also seen in the great court, with occasional walls, ovens and bins being constructed. The explanation for the difference with the rest of the residence may be clear by now: this was originally a paved open courtyard, and thus did not fall victim to massive collapse of building materials. The walls surrounding it were not so much affected by the fire, but simply gradually decomposed over time, causing the surfaces within this ruined but inhabited structure to raise.

In the northwestern corner of the *Dunnu* the interpretation in this study diverges significantly from that of the originally proposed sequence of settlement plans (Akkermans and Wiggermann, 2015). In terms of deposit sequence pattern, there is no good evidence for a long drawn phase before construction of the office building in the northwestern corner, the new gate and related fortification walls. There are no layered deposits, backfill deposits, fast decay or demolition deposits that indicate that an area was modified. Since such deposits are found everywhere else where construction happened, indicating that the formation of such deposits is part of the customary working methods of the bronze age builder, it seems that the entire northwestern sector was planned and built up in a single phase of construction. In addition, there are multiple constructional arguments and pieces of evidence that also point in this direction (see V.5 and V.6).

Most of the spaces in the northwestern *Dunnu* thus have little evidence for construction activity within the primary use phase. There are no secondary floors within the same building which point at repurposing or renovation. As noted earlier, there are some instances where there are multiple floors near to each other, but these must be seen in the light of a layered deposit, hence a continuous use-phase. The only space with good evidence for another floor phase during the primary use-phase of the *Dunnu* is space NW-1a directly south of the office building. Initially it is part of the large elongated area that runs along the western fortification wall, with which it shared the same floor or exterior surface. Some accumulation occurred over time, although the documentation does not allow us to establish the manner of deposition. Than a wall is constructed, cutting off NW-1a from the larger space, and it receives a pavement with the same kind of tiles found in the great court. Hence, a secondary floor within the same space separated by the original floor is only warranted by the architectural modification, the construction of a separation wall. Also one room of the office building has a secondary floor, however, as will be argued next, this floor is of later date belonging to the post-abandonment phase of the *Dunnu* and not to the primary use-phase.

The office building is an especially interesting case in terms of depository patterns, and how these reflect the architectural context. In its original construction it is a three-roomed building (on ground floor), accessible from the great court. A narrow corridor leads to a square room to the right and a bathroom to the back. Construction-wise it all looks quite neat, with tiled floors and a proper double-spaced bathroom for some privacy. As said, all these constructions are found near the Neolithic layers of the tell and seem to be part of the first LBA constructions on this particular spot. The deposit on top of these floors is especially interesting, as it contains many cuneiform tablets relating to the administration of Tammitte, the last steward (hence the label of the building "the office"). In his thesis, Victor Klinkenberg has convincingly argued that these tablets do not lie on the floor, but are randomly spread inside the deposit above the floor. The deposit contains little debris and is otherwise relatively homogenous, which may indicate that we deal with a backfill deposit. The architectural context would also make collapse deposits less likely. For instance, the corridor was certainly vaulted, which collapsed much later, as can be observed in the sections. An additional argument in favour of the idea that the deposit was placed there rather than naturally developed is found in the relationship with architectural modifications. The corridor was in fact blocked at its western end, closing off access to the former bathroom while the former bathroom was now made accessible by cutting a new passage in the southern wall. The bottom of this new passage as well as the bottom of the blocking are found on the same level as the top of the deposit containing the tablets. Moreover, the thickness of the deposit exactly covers the tile 'base board' of the bathroom hiding just from view all indications of this room's previous function. The deposit is therefore put there as part of the modifications of the spaces, and not the result of random collapse.

What happens next is in fact a pattern of deposition that has been observed repeatedly. The former bathroom, in use for a short while as servicing room for a pottery workshop, starts to collect sediments and cultural refuse. A layered deposit is formed indicating that the "room" was unroofed henceforth.

The former corridor is different. The infill here also indicates a layered deposit, but without human interference. As said, this space was vaulted, and after the deposit with the tablets, it became very low. Perhaps significantly, an unusually rich cremation burial was placed in the room the corridor used to give access to, although the passage into this room would now have been very difficult. It is thus unlikely that it was used a lot. The deposits found inside distribute asymmetrically in the width of the corridor but are reasonably thick, which indicates instanced natural sedimentation, like fast decay rather than slow gradual accumulation of sheets. It may belong to a much later phase during which the vault had perhaps started to fall apart and developed a gap through which debris could fall into the corridor. It is also possible that some of it came through the eastern doorway, which had never been blocked as far as we know, although it was narrowed at the same time as the blocking on the other end.

The square third room of the office also fills up in an unusual way in view of all the other spaces discussed so far. Again, no collapsed rubble is found here. The layering indicates a layered deposit, and considering the thickness of the layers, possibly a fast decay deposit. As the layers contain reasonable amounts of sherds, bone, charcoal and lime it is also possible that it was used as a dump at the same time, which is the excavator's hypothesis. Fast decay and dump deposit often go together since it indicates a neglect of architectural maintenance.

The limited amount of debris found in all of the rooms of the office may suggest that the building was never really that high to begin with. But above all, it indicates that the surrounding fortified architecture stood solid for a very long time before it started to crumble. If real collapse ever occurred, the evidence for it has been removed by erosion long ago. This is in stark contrast with observations near the old gate, where the fortifications had started to collapse soon after abandonment.

There is one building remaining that we should discuss for its particular deposit sequence pattern. This is the long space behind the new gate. We will not discuss the phase preceding it, or the main floor phase, which is pretty straightforward. Its infill process is more interesting as it is unusual in the sense that it contains a collapse deposit of some thickness, e.g. 50-60 cm. This deposit is fairly evenly distributed throughout the room, but gradually rises toward the eastern and western sides of the room, indicating that it is no backfill deposit or levelling layer. On top of this, the mode of deposition changes into a finely layered deposit seen with for the deposits observed in the *Dunnu* unique properties. It consists of interchanging red-brown and light grey layers, the first averaging 2-4 cm, the second 1-2 cm in thickness. The excavator interpreted it as a series of floors, although this is quite unlikely considering that nowhere else floors are found in such a sequence with these properties. The main evidence for human occupation and use, some walls and other structures, is found at the lower part of this layered deposit, and in fact seems to stand on the collapse deposit. The layered deposit thus developed around these features, possibly during or after their primary use. In other words, it seems to be layered deposit like elsewhere, a natural raising of the surface under influence of human occupation and gradual decay. However, the relatively fine lamination, regular morphology and systematic colour switching remains to be explained. One possibility is that we should seek the explanation in the characteristics of the surrounding architecture. As noted, it did only collapse partially, and we must imagine a relatively narrow but high-walled space. This space was open to the sky, but relatively sheltered and perhaps this is the explanation for the development of sediments with such a fine and structured lamination. In that case, these sediments indicate abandonment, because as we have seen when human use and interference takes place, the deposits take much more irregular forms.

The typical pattern of deposition of the great court has been described before. It serves as a prime example of how a domestically used area naturally raises under the influence of minor wall and feature construction and decay, trash disposal and sedimentation due to building decay.

In conclusion, the northwestern sector was a place that must have been kept quite clean because the lion share of the finds everywhere come from the abandonment deposits on top of the floors. These are characterised by a very messy layers with spread out remains of a big fire that concentrated on the north side of the residence. The presence of burnt construction wood in the courtyard may indicate it had been moved there which can thus be taken as evidence for scavenging activities. Other indications are broken tiles and stones neatly separated from each other on piles against the side of the court, indicating that people have been selecting materials. The great court thus seems to have acted as a centre point of this activity. The only area in the northwest where surfaces are allowed to rise, albeit very minimally are in the area west of the residence (NW-1a/b). This is not related to domestic use and would simply be the result of slow sedimentation, or perhaps floor construction for some other reason. The collapse and fast decay deposits found on top of the floors in the residence – which has some interesting patterns not discussed here – and northwestern sector indicate variable effects of abandonment. This may for a large part be related to architectural conditions, such as whether a space is covered or the size of a room.

IV.4.5 Southern *Dunnu*

The southern *Dunnu* again has its particular deposit sequence patterns that reflect closely the architectural conditions and type of use. Architecturally, a large part of the south seems organically planned and consists of light-walled architecture, e.g. walls of 1 or 1.5 brick-width. There is also heavier architecture here, that is unfortunately less well preserved, but it does again reveal some interesting differences in deposit formation processes as compared to the lighter architecture.

The first aspect that is important to note is that the deposit sequences already starts before the large part of the light-walled architecture has been put in. This shows that the area was used, that material was brought in, discarded and sediments of decaying loam features and surrounding architecture could develop. It is similar in character to what has been tentatively found below the residence on some places, and we may reconstruct a phase during which such activities took place near to the central building, in an open environment.

This type of use, and the related cleaning regime or absence thereof, continued also after the light-walled architecture was constructed. In several spaces mainly concentrating in the southwestern half, the formation of layered deposits, or raising surfaces continues. These are open or semi-open spaces, e.g. with partial cover and large openings in their walls, permitting a dynamic interaction with exterior conditions. Also in this part of the *Dunnu* we can point at one example of where the increased thickness of the deposits is related to architectural modification. Like elsewhere, backfill has been used to cover up the stub of a demolished wall, effectively levelling the area to create a new surface. In all these areas there is at some point a moment that the mode of deposition changes significantly, and a thick fast decay or collapse deposit forms. On top of this we see again activity, including construction, which sometimes uses previous walls and at other times superimposes previous walls. It is typical of the level 4 type of use of life between the ruins, as has been observed in the north of the *Dunnu*. Although stratigraphically disconnected from the north, this pattern of fast decay and reuse is typical enough to assume contemporaneity.

Now returning to the main use-phase, we may note that nowhere do surfaces accumulate as quickly as in the long "alley" that runs along the southern walls of the tower and residence. The alley must have been the main passage giving access to most of these structures and leading the way out of the neighbourhood. The type of deposit is a thick layered deposit with layers ranging from 2-10 cm and irregular interfaces. Much sherd and bone material has been found throughout this deposit, which has undoubtedly to be explained as discarded trash. Until the fast decay deposits start appearing, with which we see an increase of the thickness of the layers to over 20 cm, the surface in the alley rises about a meter. What we see in the alley is very similar to what may be observed in the great court after its demise, only the deposit in the alley had certainly been formed during the primary use-phase of the *Dunnu*. What happened is that one finds a narrow space next to a large eroding surface – the massive south walls of the residence and tower – that is used additionally as a trash disposal area. Hence, it rose much quicker than the areas it gave access to, even if they were open and domestically used. There is additional evidence that this rise occurred during the primary use-phase of the *Dunnu*, as there are several architectural modifications that seem to have explicitly dealt with the problem of raising surfaces and the difference in floor levels that it caused between alley and architecture. Openings were closed, and steps were created on several places. This pattern of deposition thus resembles a common feature seen in the archaeology of urban settlements, in which architectural compensation for raised surfaces is a common dynamic (see IV.1.1). This tells us much about the nature and function of the southern *Dunnu* which is the most 'town-like' of all sectors.

But there are also spaces in the south without evidence for raising surfaces. These spaces concentrate more towards the eastern half of the south. The same as elsewhere, there is the occasional indication of pre-architectural activity, that was at some point overbuilt. But as soon as the architecture is constructed, and a floor is deposited, there is no additional deposition taking place but for a massive mud brick collapse deposit. In some of these cases we have even good evidence for collapsed roofs (see IV.3.3). These spaces contain noticeably more dense mud brick rubble in the collapse deposits. All these facts indicate that these structures were roofed buildings, potentially with a second storey. The deposit patterns indicate that they were constructed, used and destroyed. The massive amounts of large complete vessels – but broken – that have been found on these floors underline the permanent effect of the last event. Note that although in the documentation pertaining to the excavation and analysis of these structures, often additional floor constructions are inferred, suggesting a kind of architectural phases. While carefully draughting and summarizing the evidence all these inferences had to be dismissed and it is now clear that these buildings simply had one ground floor phase throughout their existence.

Now turning to the heavier walled architecture in the south. This architecture is built against the southern fortification wall and forms the southernmost extend of our archaeological evidence. There is one 24-meter-long building located against the fortification wall consisting of the series of spaces SW-7a (actually two spaces), SW-7b, and SW-7c. As far as we can tell this building is part of the original construction of the *Dunnu*, as it is structurally well integrated with the fortification wall. The original and earliest floors, proper loam floor constructions, have been uncovered everywhere. There is no evidence in the deposit sequence for a phase preceding the architecture, as floors and architecture lie directly on Neolithic layers. The deposit sequence on top of that seems to vary. In room SW-7c, a dense rubble deposit is recorded. In rooms SW-7a and SW-7b, a lighter rubble/collapse deposit follows. However, various object horizons are found inside it with many broken sherds and small objects. Although interpretations found in the documentation assigned these horizons ‘floor’ status, the evidence is shaky. It is for instance remarkable that the excavators could never for sure determine a floor associated with the sherd scatters, but for the initial floors of the building. Rather than that we deal with a layered deposit formed under outside conditions, the fact that occasionally roof materials in the form of reed phytoliths and imprints are found within these layers as well, suggests that these are rubble layers with collapsed material from the second floor. On top of these, new activity takes place and a large oven for instance is constructed in SW-7a. In the official interpretation, this phase was allocated to level 5. However, for the reasons just cited, it seems that we have already entered a phase during which habitation of ruins took place. What the deposit sequence pattern seems to reveal is that this medium heavy and probably tall building did not suffer the massive demolition/collapse seen elsewhere. Rather, it decayed relatively quickly after abandonment, perhaps as a result of roof and floor beam dislodgment and removal, but did not collapse right away due to its stable construction and support of the fortification wall.

Also, in the heavier architecture in the southwestern corner, comprising spaces SW-2a, SW-2b, SW-2c, SW-2d, and SW-2e, no evidence for additional floor levels is found above the first floor belonging to the construction of the architecture. Underneath these floors, specifically those of spaces SW-2c and SW-2d, Neolithic layers start immediately. However, this is only valid for the northern half of the floors, as some bronze age rubble and layered deposits and even a burial is found underneath the southern half of these floors nearer to the fortification wall. It is possible that these are part of construction activities aimed at raising the surface on one side to create level floors. Alternatively, it is possible that this architecture is later than the fortification wall, allowing layered deposits to develop prior construction, but only in the local depression near the fortification wall. In that case it mirrors the process seen elsewhere in the south, where we have evidence of a considerable pre-architectural phase of activity. The rooms are filled with rather homogenous compact loam layer which indicates fast erosive decay rather than collapse. However, that no brick fragments are recognizable is perhaps also possible due to the vicinity of the tell surface. The layer may already have been within the influence of the weathering zone of the surface causing otherwise recognizable mud bricks to disintegrate. Burnt construction wood is found on several places in the lower regions of this deposit as well, which would be more in line with a sudden collapse phase.

What is especially important regarding this context is that the end of the main floor level can be dated quite accurately since the floor was covered with cuneiform tablets, which were part of the administration of baker Paja. The termination date of this group of tablets corresponds with the termination date of the other groups, and hence refer to the end of the written administration of the *Dunnu*. That we have them on a floor that is found directly on Neolithic remains, proves that within the primary use-phase of the *Dunnu* this floor was used throughout the entire existence of the *Dunnu*. It means that in this corner, there is no evidence for a level distinction between 6 and 5, except if we want to maintain that these rooms and floors were only constructed during level 5. This causes all kinds of other issues of correspondence, but more importantly there is no evidence for this.

Recuperating, in the southern *Dunnu* (sector SW) deposit sequence patterns indicate that there were several outside or semi-covered areas where surface levels slowly rose, as is evidenced by the layered deposits. The most rapid rise of surface levels were observed in the alley, both due to its use as thrash disposal area and its natural propensity for sediment collection. Other spaces were clearly roofed, and had one single floor throughout their existence. There are indications that some of the deviating deposits are caused by roof and second floor collapse. All spaces quickly filled at some point with homogenous fast decay or collapse deposits. Previously roofed spaces containing in general more dense brick rubble. New activity surfaces developed on top, with some rebuilding of architecture and some reuse of ruined walls.

What is above all remarkable is the continuity and stability of the architecture that has often been described in the reports as ‘bad quality’ or ‘haphazard’. When looking at the depository sequences, and the architecture itself there is very little evidence for adjustments after the basic structure had been put in. One wall and a few blockings to prevent the piling thrash and wall decay sediments of the alley to flow into the adjacent spaces is all there is. Otherwise, it survives the entire existence of the *Dunnu.* This contrasts starkly with the areas in the northeast and southeast where we have evidence for thorough ‘renovation’. This strengthens the hypothesis that the main reason for rebuilding was not renovation per se, e.g. a situation of disrepair, but repurposing due to changing spatial demands of the people using the *Dunnu*.

IV.5 Conclusion

In this chapter formation of deposits were discussed, and what these tell us about the conditions of the architecture and how human (building) activity and deposit formation are closely intertwined. It was established that deposit sequences are not synchronised across the entire settlement, but certain larger sections show synchronic development (Figure 38). This could be explained by at least four main factors: architectural conditions (open or roofed), cleaning regime (cleaned or waste disposal), maintenance regime (maintained or left to decay) and phases of construction activity. Regarding the last factor, the hypothesis is offered that the main debris deposits found during the ‘main use phase’ of the *Dunnu*, are evidence of localised demolition prior to functionally motivated modifications. This is contrary to the interpretation of these deposits by the excavators, who consider them as evidence for temporary lapse of maintenance and following decay.

V. Constructing the *Dunnu*

For a good understanding of excavated architecture, we need to approach it from both an archaeological (depositional, post-depositional and stratigraphic) perspective as from an architectural (material, constructional) perspective. This chapter focusses on the second by discussing the architecture of the *Dunnu* from the point of view of construction materials and methods. This starts from an overview of construction practices in West Asian historical cultures, and general mud brick construction methods. The archaeological evidence it considered both in its own local context and the wider context of construction practices. The archaeological data from the *Dunnu* as found in the field documentation is used in a detailed re-analysis. All the standing interpretations, were verified in this way, often leading to new, improved interpretations.

Analysing the structural and material properties of the architecture, forms the basis for the reconstruction of remains. The final aim is to understand the degree of deliberation that went into the construction of the *Dunnu*. This ultimately helps to answer the question of the interaction with the built environment and the intentions of the builders.

V.1 The social and cultural context of construction

V.1.1 The nature of architecture

Architecture is the outcome of a complex interplay of natural and cultural factors (Figure 39). The climate and geology determine the presence of building materials. The climate, against which people seek protection, also determines the choice of materials how they are put them together to make a building. The choice of building materials, then again influences architectural form as is has certain structural possibilities and limitations. At the same time other factors interact with these, such as social structure, social process, cultural values and ideas, and individual choice. Furthermore, construction may also be a response to certain more sudden changes in social, political and military circumstances. All these aspects come together in construction and architecture and should be considered relevant in its study. Construction and architecture are deeply embedded parts of a society, but have been as far as we know, always been recognized from the point of view of ancient society as a class distinct from other elements of their world. Building was incredibly important and the act of building as well as the building itself also had symbolic meaning. This was also true in ancient Mesopotamia.

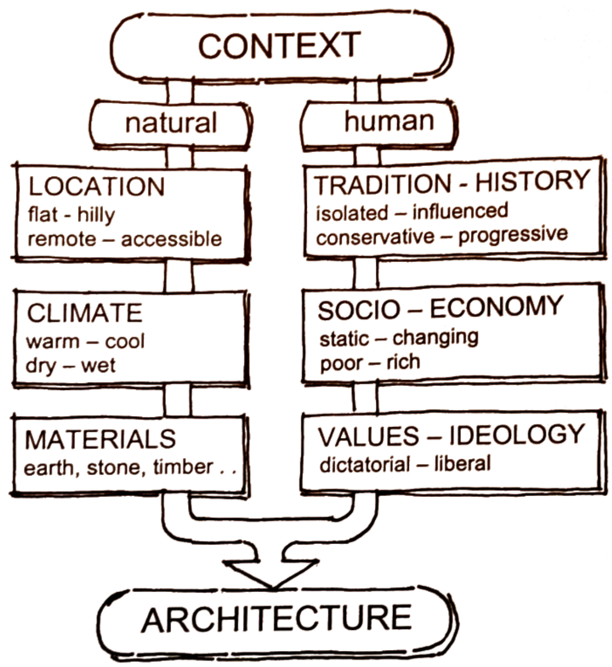


Figure 39. Model of architecture by Friedrich Ragette (after Ragette, 2003, p. 10).

V.1.2 The place of mud brick architecture in ancient Mesopotamia

Although expelled to the fringes of modern society, mud brick construction was in much of human history a significant element of the architectural, social and cultural realities. Today, mud brick construction is often romanticised, considered a heritage building tradition that requires protection, or as a type of "architecture for the poor" (i.e. Fathy, 1976). But in the pre-modern world, it was everyone's building material, applied in the construction of simple houses until the king's bedroom. Therefore, the mud brick can be considered one of the cornerstones of society. Kings were depicted carrying loam baskets and builder's tools, and at the third month (our May/June) was named the month of the king's brick-mould, when brick production rose high (Salonen, 1972, p. 10). Earth was omnipresent and a fact of life taken for granted.

The manufacture and acquisition of mud brick and other building materials was thus of prime importance, a significant part of the economy and a business that needed the attention of the king and high administrators alike. Everything was meticulously managed and administrated. Besides the archaeologically very visible parts such as mud brick production and construction, the organization of the timber and reed industries, closely related to construction, was equally important. Furthermore, it involved the acquisition and production of auxiliary construction materials such as lime, gypsum, bitumen and fired brick. From the perspective of the present, these are traditional, low-tech construction materials. But that assessment fails to appreciate the fact that these are all activities that require specialist knowledge, and a significant amount of labour investment (Moorey, 1994).

V.1.3 The profession of master builder

Ancient Mesopotamian society had specialised master builders. These were responsible for state architecture, but – at least in the cities – were also hired by private house owners to repair or build houses. At least by the time of Hammurabi (18th century BCE), there were laws regarding safe and sound construction of houses (laws §228-§233). These laws give the impression that house construction was left to professionals, and that these were supposed to deliver quality, and were held accountable. The Sumerian word for builder is *šidim* and appears in texts starting in the early third millennium (Neumann, 1996). Neumann translates *šidim* as master builder, and assigned to the *šidim* a high level of specialization, professional education and high social status. But the *šidim* found in the Ur III (21st century BCE) Garšana texts discussed by Heimpel (Heimpel, 2009, pp. 47–48) seem of more common background, and in fact most builders here are slaves. However, that does not disqualify them for receiving some form of training.

In later periods, we know for sure that there is a ranking of builders, which is reflected in the fact that there are different words for them. Perhaps we see some specialisation of tasks. In official texts of the Middle Assyrian empire we find the professions of *etinnu*, master builder, and *šalimpāju*, probably architect or engineer (Jakob, 2002, pp. 453–465). Again, the suggestion is given of a highly specialised professional. Although for the second there is little proof of its actual activities, Jakob argues it is reasonable to assume this individual was involved with the design of the plan, decided on dimensions and performed the necessary calculations while the former managed the practical execution of the work. Nevertheless, much overlap existed between the activities of the two professions. Salonen (1972, p. 11) interprets the existence of different words in Neo-Assyrian sources as the presence of a hierarchy between lower master builders (e/*itinnu*) and supreme master builders (*šitimgallu* or *šitimmāhu*).

That there were builders of different kind and social status is clear, even if they were referred to with the same word. For example, as opposed to other builders, the builders of Garšana seem not to be involved with the planning and surveying at all. They are purely executers of the work. The suggestion of the aforementioned Jakob, that the builders may have been a kind of engineer as well does not seem to correspond to the evidence from mathematical texts, which suggest that preparing of 'engineering' work (e.g. surveying, calculating labour and materials) are specialised task that scribes do, who learned to do this in scribal schools (Robson, 2002).

It is interesting to see how the builders at Garšana had different social status. Besides builders that were part of the possession of the household[35] (which therefore had three fulltime builders at its disposal), there were builders that came from elsewhere, probably also slaves. Apparently, they did not like the work too much, because several of them were registered as runaways. Other builders still were hired. Although this all suggests that builders were in lesser high regard than Neumann proposes, the builders had nevertheless important roles to play in the workforce, since they were the ones doing the actual construction. They were assisted by the many common workers that were part of this workforce as well, who had such tasks as moulding bricks, carrying building materials and handing mortar, plaster and bricks to the builders.

V.1.4 Who built the *Dunnu*?

Builders do not occur on the preserved payrolls of the *Dunnu.* For initial construction, master builders had to be brought in. Interesting in this respect is the mentioning of 14 Elamite master builders at Tell Chuera in this period (Jakob, 2002, pp. 458–459; Brown, 2013, p. 109). Such people fell under the command of the king of Hanigalbat (see II.8). They travelled for almost 1000 km and brought their building practices with them. It is likely that the *Dunnu* was not built by local builders, but by builders that could have come from anywhere.

V.2 Building materials in mud brick architecture

This section introduces the characteristics, acquisition and procurement of common building materials associated with mud brick architecture. In a later section (V.4), the specific evidence for building materials used in the *Dunnu* is dealt with.

V.2.1 Loam, water and straw

The base material of mud brick architecture is loam. Loam is a mixture of mineral elements consisting of clay, silt, and sand. The proportions in which these elements occur in a deposit determines the suitability for use in mud brick manufacture. Nevertheless, the range for an 'acceptable' mixture is quite large (McHenry, 1984; Houben and Guillaud, 1994). Clay is the main binding agent, while sand give the brick compressive strength and prevents shrinkage. A surplus of clay may cause shrinkage and cracking while too much sand creates a brittle brick. It is interesting to note that the proportion of sand that is suggested to be ideal for mud bricks (at least 30%), is much higher than found in most loam samples from river deposits analysed by Sauvage (1998, p. 18). This means that not all river deposits are automatically suitable: either good deposits must be actively searched for, or sand must be mixed in. Water is required in great quantities

[35] Garšana was the possession of the household of an important general.

to be able to properly mix and soak the ingredients, which also determines that mud brick manufacture must take place near a water source. Last, a vegetal binder, often chopped straw or chaff is added to the mix to reinforce the brick mechanically and chemically.[36] To chemically improve the building material, loam may be left to rot for a one or two days (Wulff, 1966; Salonen, 1972, p. 72). Bacterial activity causes the excretion of lactic acid, which may be responsible for improved structural properties of the loam when dried. However, it may also be used immediately after preparation. Precise loam procurement practices vary significantly between regions and historical epochs.

In addition to the brick, loam is also the main ingredient for other construction materials: mortar, plaster, wattle-and-daub and pisé (beaten earth). The proportional quantities of the materials, sand, clay, water and straw/chaff, varies according to application (Figure 40). The significance of this for building practices is reflected by the ancient naming and classification of many different types of loam-based construction materials.

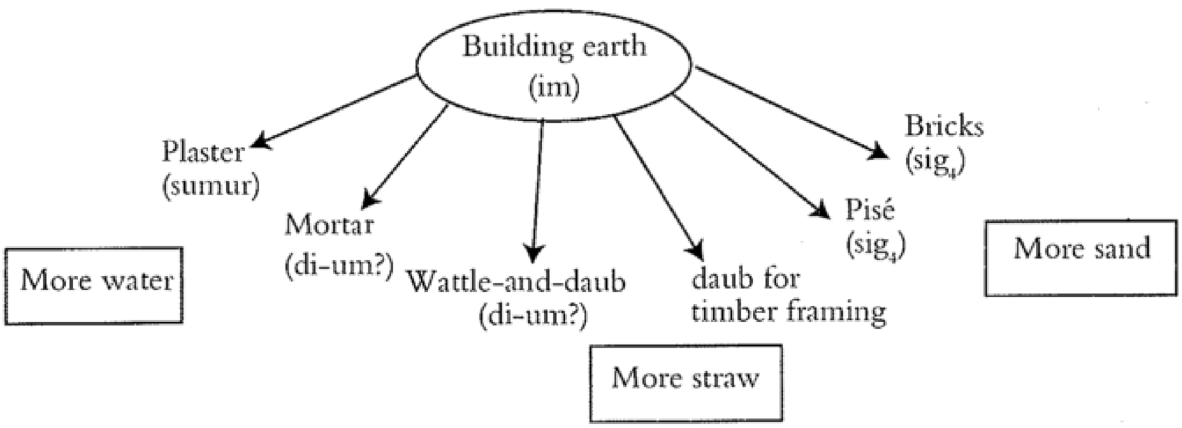


Figure 40. Different terms found in the Garšana texts, hypothetically connected to different mixes of loam (after Sauvage, 2015, fig. 4)

V.2.2 Wood and reed

Besides the base material of loam, water and straw, other materials are used in the domain of mud brick construction. Among these are wood, reed, stone, baked brick, lime, gypsum, and bitumen. Regional availability of these have strongly impacted building traditions. In dry Mesopotamia, timber is relatively scarce so it is used were most necessary in construction: for the roofs and often for door posts and window

---

[36] Fibre decomposition products may act as a chemical binder, or 'biopolymer'. There are other organic compounds known to be added to loam as a kind of biopolymer such urine, dung or blood (Winkler, 1956; Eires, Camões and Jalali, 2013).

frames. Commonly used tree species are poplar, willow and palm. Although the latter is not ideal due to its softness, it is common to see them being used even for roof construction. Reed, which grows abundantly on the riverbanks include *Phragmites australis*, or common reed, and *Arundo donax* or Giant cane. Reeds are used to create fences, doors, partition walls and in roof construction. In combination with loam, it is used in the Mesopotamian version of wattle-and-daub. Although rarely preserved, such walls must have played quite a big role in the partitioning of architectural and exterior space.

Figure 41. A rare example of a partition wall made of reed and loam unearthed at Nuzi by Starr (after Starr, 1939, Plate 24B).

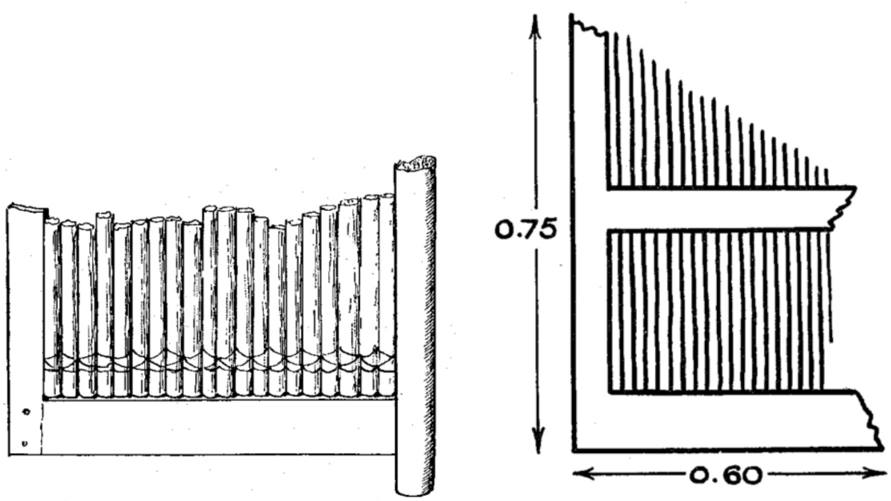


Figure 42. Reed panel doors found in Ur. Left: example found in the Nin-subur chapel of Old babylonian Ur (Woolley, Mallowan and Mitchell, 1976). Right: example found in Kassite Ur (15th-12th centuries BC). It belonged to an internal doorway between rooms (after Woolley, 1965, fig. 2).

V.2.3 Stone

The use of stone in mud brick construction shows significant regional differences. It plays a relatively unimportant role in the architecture of lowland Mesopotamia. It may be occasionally applied in base courses of walls, to form a barrier against water in the same way that baked brick is locally used to this end. However, most of the time no stone is used in wall construction. It has some limited additional use, in the form of pebbles to reinforce floors and to manufacture pivots for turning door posts.

V.2.4 Gypsum and lime

Gypsum and lime are both used to reinforce loam plasters, bricks or mortar, or to create hard floors. Both limestone and gypsum rock need to be burned, or heated. To turn limestone into quicklime (calcium oxide – CaO) constant heating is required for three to four days at temperatures around 900 ˚C, a chemical process called calcination. It is then hydrated by mixing it with water. The calcium hydroxide thus formed can be used in lime plaster and applied in construction. Reacting with CO2 in the air, the calcium hydroxide turns back into the extremely hard material calcium carbonate, or limestone. Gypsum rock on the other hand just needs to be heated to about 120 ˚C for a period of at least an hour. The purpose of the heating is to drive off chemically bound water.[37] It can then be used directly. Lime and gypsum are usually mixed with sand, straw, pebbles, pieces of limestone before or during application. The production of gypsum is much more fuel and labour efficient and easier than lime, which was a significant factor in ancient building practice. To produce a ton of quicklime, an estimated 1.8 tons of limestone rock and two tons of wood is required (Kingery, Vandiver and Prickett, 1988). Another disadvantage of the lime production process is that special care must be taken when working with quicklime as it is caustic and reacts with water, causing heat and forming a danger for skin and respiratory systems. In return for a higher and more specialised labour input and the expense of more resources, lime offers superior water resistance and durability. In villages in the Middle East, production of both gypsum and lime takes place on a small scale, often using limestone or gypsum rich deposits rather than quarrying the rock directly (Horne, 1994, p. 137; Moorey, 1994, p. 330; Pütt, 2005, p. 247). It is uncertain to which degree recent village material procurement practices are representative for ancient practices, as the scale of production may differ significantly.

Bitumen or natural asphalt has been used extensively in the past as waterproofing agent, adhesive, and to make sculpture and jewellery (Connan, 1999, pp. 34–38). It was frequently used to waterproof objects like reed baskets and boats. In construction it was used in mortars and plasters to increase the strength and

---

[37] Burned on this temperature for an hour and 'plaster of Paris' is formed. Burning longer results in the removal of more water and the formation of anhydrite, which makes slightly stronger plasters.

durability of the material, and to seal walls and floors in areas of water-use. Bitumen was generally not used in pure form, but used to fabricate a compound material: it was mixed together with sand, lime/gypsum and organic materials like straw, rushes, leaves and reeds. Archaeological samples contain typically no more than 30% bitumen, the rest being made up by the mineral or organic component (Connan, 1999, p. 39). When used as mortar, bitumen is mixed with much sand and straw just like loam mortar.

V.2.5 Baked brick

For the largest part of Mesopotamian (pre)history, baked brick saw relatively limited use, which may be attributed to the fuel expenses needed for firing (Moorey, 1994, p. 306). For brick production, scove kilns were probably used (Moorey, 1994, p. 306). A scove kiln is made of piles of stacked bricks with some space between them, which serve as firing tunnels, and covered with loam. Firing occurs inside the stack at the bottom. In the Ur III Garšana archives a kiln is mentioned that probably is a scove kiln, as the activities related to it seem to indicate a high stacked structure (Heimpel, 2009, p. 185). Such kilns are quite inefficient, so no high temperatures can be reached, which explains why many bricks found archaeologically are not very hard baked. Also, baking occurs very unevenly, with the result that those bricks close to the fire are likely to become over fired, while those on the outside are often under fired (Woolley, Mallowan and Mitchell, 1976). Archaeologically observed bricks are generally of poor quality, and estimates are that they are often not fired to higher temperatures than 600 ˚C, which classifies them as half-baked. Matson (1985) estimates a firing range of 800-900 ˚C based on his study of relatively hard baked Neo-Babylonian bricks, which is a range of temperature in which clays just start to vitrify, and a ceramic material is produced.

Baked brick would have been an expense, due to the need for fuel to produce them, and are therefore somewhat of a status material. It is most frequently used on those areas which were in contact with water, and as pavements for courtyards. However, in dense urban environments, conditions rose where baked brick was used more extensively. Although the picture is far from clear, it seems that baked brick sees increased usage in the architecture of Southern Mesopotamia during the Middle Bronze Age (Miglus, 1999, p. 85), and later also in Northern Mesopotamia.

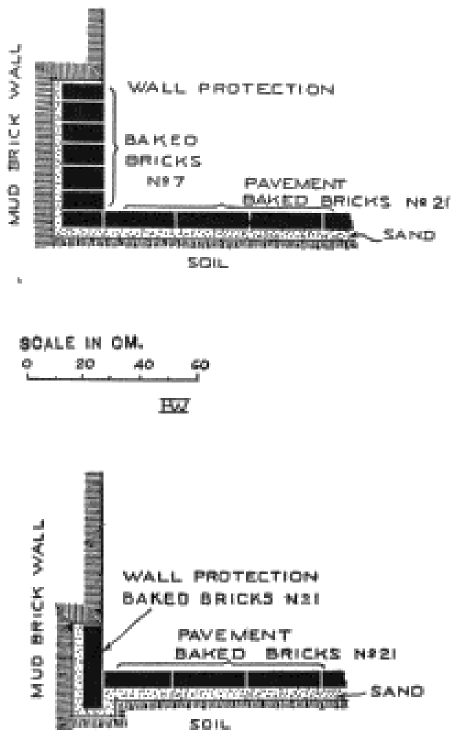


Figure 43. Tile floor construction and two methods of wall protection in house of Shilwi-Teshub in Nuzi (after Starr, 1939, plan 37A).

V.3 Building principles of mud brick architecture

This section introduces common construction techniques and methods known in antiquity, specifically the mud brick building methods used in Bronze Age Mesopotamia and the Levant. In a later section (V.5), evidence for techniques and methods found at the *Dunnu* will be dealt with.

V.3.1 Surveying and planning

There is ample evidence for the careful planning of construction, and calculation of labour and material costs. Well-known are the examples of building plans inscribed on tablets, known from various periods in Mesopotamian history (Heinrich and Seidl, 1967; Wiseman, 1972). Heinrich & Seidl (1967, p. 45) consider it unlikely that these represent actual building designs. On them we find commonly represented the dimensions of walls, and in some cases the name or function of certain rooms. It is therefore believed that these may have been used in legal contracts or measuring exercises. What they do tell us is that the basic unit of measurement used for buildings is the *kuš* or cubit, approximately 50 centimetres. Most walls are strictly dimensioned as whole numbers of *kuš* in length on these building plans, only for the longer walls fractions are used as well. It may therefore be possible to deduct the length of a *kuš* from archaeological building plans, or perhaps rather establish whether it was used. With this methodology the use of the *kuš* has been suggested on sites pre-dating the earliest drawn plans such as mid-4th millennium Habuba Kabira, where spaces had been dimensioned using a base unit of approximately 49 centimetres (Frank, 1975). Babylonian mathematical texts bear much evidence of surveying (Robson, 1996). Curiously, these texts are almost all exercises for learning the trade, and little in the form of calculations for real buildings have preserved. Nevertheless, they give us information about what kind of units that were used, how totals of materials were calculated, and how labour was calculated. We know thus that bricks are counted in groups of 720, or the brick-šar[38]. As different brick types have different total volumes in a šar of 720, the exercises train the students to convert these brick-šar's in volume-šar's in order to accurately calculate the number of bricks used in a wall of certain given dimensions. Especially interesting are the coefficients or standard work rates used to estimate labour time. These include work rates for digging canals, razing buildings, carrying bricks, water, reed etc, making bricks, building walls and so forth. These allow us to compute labour investment the same way as it was done in the ancient past. This may in fact be more accurate than currently common approaches that use potentially unrepresentative and unreliable ethnographic accounts (i.e. Burke, 2008; Richardson, 2015).

Figure 44. Nanna handing a measuring rod and a line partly on a coil to king Ur-Nammu on the Ur-Nammu stela. These were the basic instruments to mark the outline of a building.

[38] The *šar* is used for surface units (1 *šar* = 36 m^2), volume units (1 *šar* = 18 m^2), and brick numbers (1 *šar* = 720 bricks *of any size*).

V.3.2 The mud brick production *chaîne opératoire*

Nowhere in the ancient world, the series of activities involved in mud brick construction has been more beautifully illustrated than on a famous Egyptian painting, found on the wall of a chapel constructed in the memory of a vizier named Rekhmire (Figure 45). It shows in detail the activities of the brick makers, carriers and builders. Water is collected from a pond, and carried on large vessels on the shoulder to the heaps of loam where other workers mix it using hoes. From there it is carried in baskets to the brick makers, which are shown with their brick molds for single bricks. A stack of finished bricks is visible as well, from where carriers get the bricks and transport it using a shoulder pole to the construction site. Also mortar is carried. At the end, builders are busy constructing. One is shown laying bricks, another probably adding mortar. The entire process is followed by the controlling eyes of overseers with small sticks in the hand.

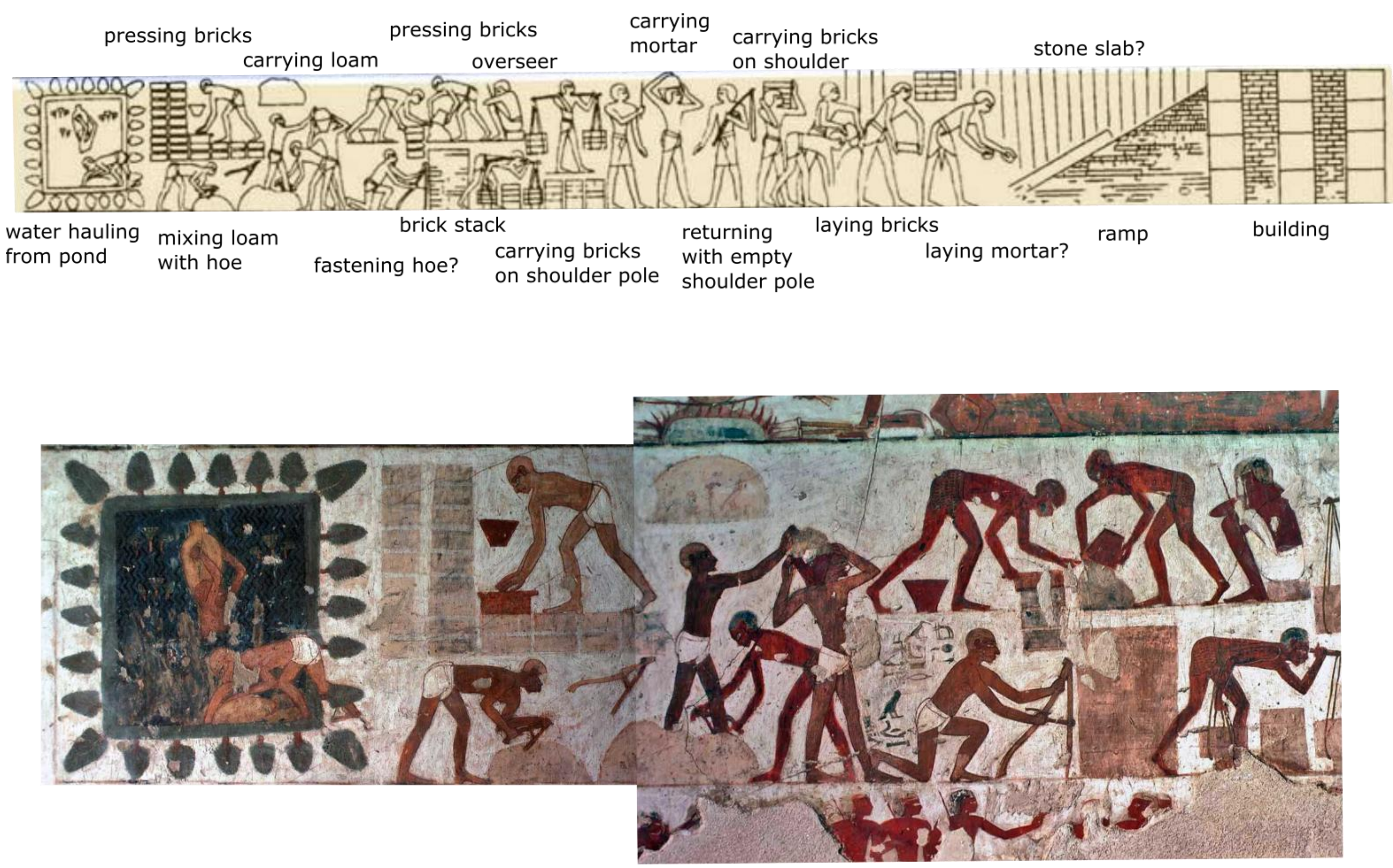


Figure 45. Painting in the chapel of Rekhmire showing brick molders, carriers and builders. Late 15th century BCE (after www.osirisnet.net/tombes/nobles/rekhmire100/e_rekhmire100_07.htm with annotations made by author).

Not all steps in the process are represented. For example, there is no straw being cut or added to the loam and water mix. Neither are the later stages of the building process shown: the plastering and the construction of the roofs. Also excluded is the acquisition and procurement of the other building materials: reed and wood for example, which must have been integral part of the entire undertaking.

In ancient Mesopotamia, mud bricks were preferably made just after the spring rain, during the 'month of the king's brick-mould'. The summer is therefore 'the building season'. But bricks were probably being produced during the entirety of the hot season, responding to the fluctuating demands of construction works, as happens today.

V.3.3 Transport and lifting

Transportation of building materials must have been done mostly by humans. It is remarkable that so little use was made of donkeys or mules. At least, not in the Ur III and Old Babylonian mathematical texts concerning labour rates, which usually assume human based transport (Robson, 1999), nor in the wealth of cuneiform labour texts from Garšana (Heimpel, 2009), animal transport plays a large role. However, for the Neo-Assyrian empire, donkey-transport is well attested for as it is referred to in the Assyrian State Archives.

Materials were sometimes transported in carts. The two-wheeled human powered cart, is referred to in texts and depicted on Neo-Assyrian reliefs (Salonen, 1972, p. 107), but this may not be representative of the earlier periods. Shorter distance transport of bricks was done by means of the shoulder pole shown on Rekhmire's painting, which is also known from Sumerian and Akkadian cuneiform texts (Salonen, 1972, p. 112). Taking a regular brick size from Egypt – which is smaller than the Mespotamian one, the weight of the mud bricks the workers carry on the shoulder pole must have been around 23 kg. This is close to the weight of one large Northern Mesopotamian mud brick, and not coincidentally the standard mud brick carriage rate for a worker in the Babylonian mathematical texts. The consistency reflects the weight a human being can reasonably carry over some distance, and implies a significant degree of accuracy for the Rekhmire tomb painting. However, since a single brick cannot be balanced on a shoulder pole, it is likely that brick carriers in Mesopotamia carried them in baskets on their heads, the way they also carried loam (figure 47), or on the shoulder.

Bulk transport of building materials over longer distances was common. Boats or rafts were used to transport bricks and wood over rivers and canals. The larger irrigation canals were probably important for the transportation infrastructure, and the many smaller canals could have been used as well to get the building materials quite near to where they are needed. The Garšana texts give ample evidence of bulk transport of construction materials over water. Boat towing was also done by people.

The transport of large heavy objects is also clear thanks to depictions of it. Sledges on rollers were used to transport heavy objects such as is famously illustrated on a relief from Senecharibs palace in Nineveh. For this sort of task, ropes were used to stabilize, and to pull the massive object. Extra force was used to push the object by means of massive beams as lever. The entire contraption rolled on beams. The one other construction problem that must have strained the technical capabilities of people using mainly ropes and poles, was to lift heavy beams that were used to cover large rooms. As such heavy items can easily cause damage to the loam walls, it seems not practical to push and drag them over the walls. They must have lifted them and laid them in the right position from above. One possible way is that they used an upsized version of the shadoof, the counter weighted water hauling device, which is also proposed as lifting device for heavy stones in ancient Egypt (Molyneaux, 2006).

V.3.4 Tools

The tools shown on Rekhmire's chapel painting are various sizes of hoes, the brick mold, carrying basket and shoulder pole. Miniatures and full-size copies of such tools have been found in Egyptian tombs as burial gifts, and they look exactly as depicted. The hoes are wooden hoes and consist of two parts: the handle and the blade. The blade is removable so it can be replaced when it breaks. It is fastened by means of rope, fixed behind a right-angled bulge found on the handle. It is probable that the man sitting next the brick stack is fastening his hoe, seemingly using the stack to push the blade against to increase the tension in the hoe (Figure 45). Comparing this to the only Mesopotamian depiction of construction works, there are some interesting differences.

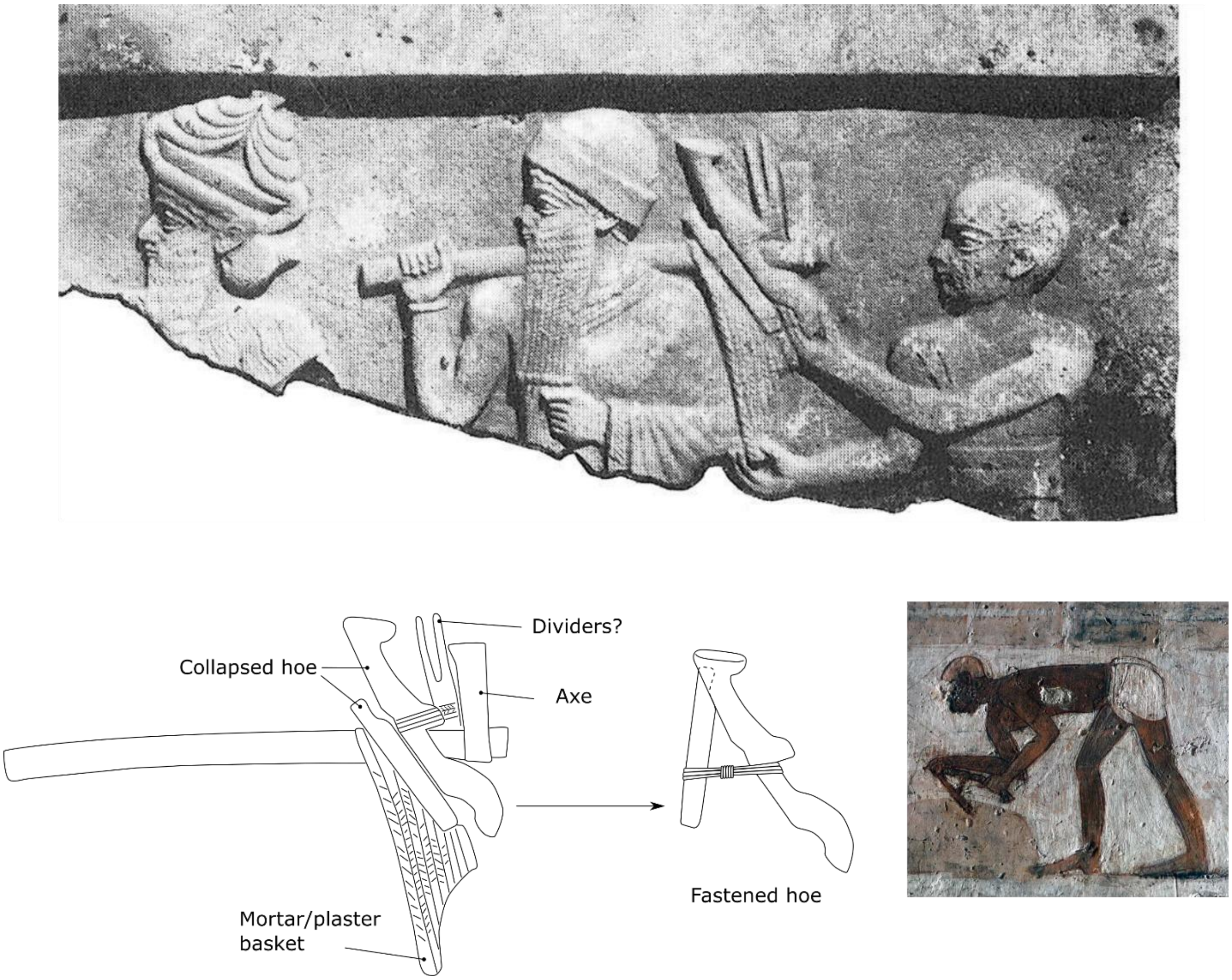


Figure 46. King Ur-Nammu with tools of construction. Below the interpretation of the tools depicted on the relief by the author (photo on top after Woolley, 1974, PL. 42d).

The only Mesopotamian depiction comes from the reign of Ur-Nammu, king of Ur in the 22nd century BCE, who has depicted himself as a builder on a stela that is appropriately named Ur-Nammu's stela (Woolley, 1974, chap. XII) (Figure 46). Assisted by a servant, he seems to carry five items on his back. No single scholar has identified exactly the same set of tools, which is in some cases due to a misnomer or misidentification (Salonen, 1972, tafel XIV.2; Woolley, 1974, p. 77; Moorey, 1994, p. 303). In my view, the most likely interpretation of what we see, is a collapsed hoe of the small type used for mixing loam on the Rekhmire painting. The object hanging underneath the typically shaped handle, is most likely the blade (and not a wooden trowel). The rope for fastening the blade is wound around the bulge on the handle. When fastened, it will sit below this bulging part. The large tool that he carries on his shoulder is an axe. Such an axe would have been used for razing walls and cutting ground, roots and digging. Razing the walls of standing buildings is a common task preceding associated construction work, just like levelling and digging (Heimpel, 2009, pp. 230, 240). There can be no doubt about the wickerwork basket, used to carry bricks and raw material in. It is also depicted on another, heavily reconstructed, part of the Ur-Nammu stela, where we see workers carry buckets of mortar on their heads up a ladder (Figure 47). The Rekhmire painting shows workers carrying the baskets on their shoulder. The only tool whose identification is not completely certain, is the forked object behind the axe. It has rope wound around its base.[39] It may indeed be a pair of dividers as suggested by Woolley and Moorey, although the fact that it seems to be rigidly fixed with a rope argues against this hypothesis. It is hard to see how this would work as an easily adjustable divider. Woolley and perhaps Salonen suggested it to be the forking end of a fork-hoe, but such tools are not known from antiquity. It is furthermore unclear how a forked hoe would be of use to a builder, neither is the way it is depicted very convincing. A curious absentee is the brick mold, which on other occasions was important enough to have month named after. One would expect it to have some symbolical status and therefore represented. Perhaps it is left out because moulding bricks is a separate task from building, done by regular workers.

Salonen (1972) mentions still various other tools used in construction that he identified in the cuneiform sources. He enlarges the toolset with a spade, which was apparently for scooping loam into the mould, and dig out the loam pit. This would have been associated with the brick moulder, not the builder. The spade is not used by the workers on the Rekhmire painting, nor is the spade commonly used today in mud brick manufacture. Salonen also finds mention of straw cutters, which is interesting since we were still lacking this essential tool. Other objects used in the building crafts is a specific type of bucket for pouring water (which may refer to a pottery vessel as seen on the Rekhmire painting), a large basket for carrying clay, and a large bitumen sealed basket for carrying loam.

[39] Not visible on the photograph published by Woolley, but clearly visible on higher resolution images found on the internet. Also Moorey (1994, fig. 19) includes a line drawing which shows this rope.

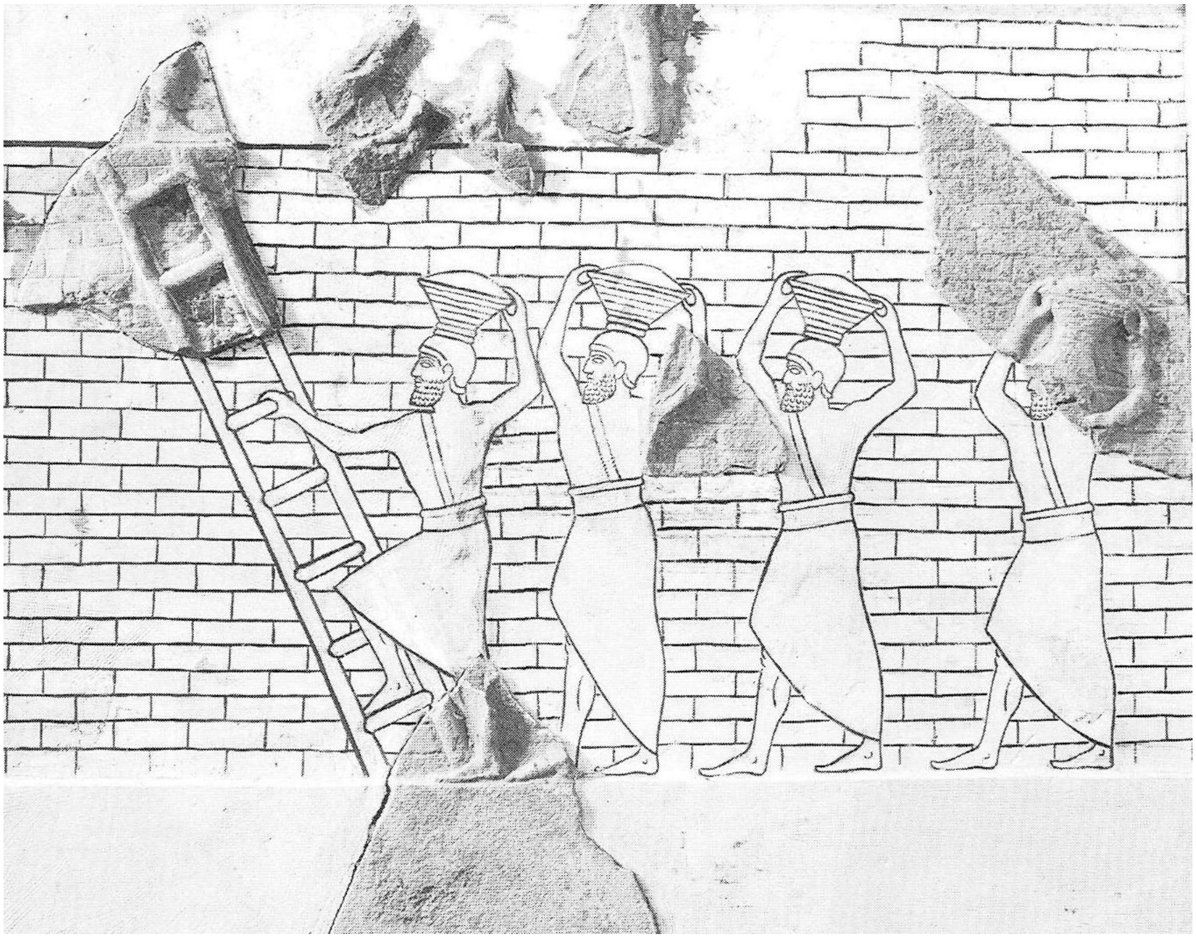


Figure 47. Part of the 3rd register on the obverse side of the Ur-Nammu stela. It is heavily reconstructed, but the subject seems clear: workers walking with baskets of loam mortar in front of a large wall (after Woolley, 1974).

V.3.5 Scaffolding

With masonry structures, one expects that scaffolding is used. But there is very little evidence that this existed or used frequently. Some would attribute this to the general scarcity of wood, which is also proposed as an explanation for the use of vaulting techniques that can be executed without the need for timber support also known as centring (Oates, 1990). However, simple scaffolding does not require that much wood when using a system with beams and planks that is moved while going upwards. Characteristic 'putlog holes' would be the remaining evidence of this type of scaffolding and indeed such evidence has been found in some walls of the bronze age palace in Mari (Margueron, 2004) (Figure 48). But putlog holes are not often found in excavations, but that may be due to difficulty of detection in the absence of specifically targeted archaeological investigations. But there is another explanation, and that is that builders stood on walls while doing masonry work. The walls, at least 50 cm thick, would allow for such a way of construction. From personal experience in mud brick construction, walls are easily constructed by standing on a wall even if it is only 36-38 cm wide (1,5 brick) (Figure 49). Also Heimpel (2009, p. 254) supports this theory as no scaffold was ever used in the construction of the Garšana compound. In fact, no Sumerian word for 'scaffold' is known to him at all. It therefore seems that generally, ladders were used to climb on top of walls and construction took place right under the feet of the builders (Figure 47).

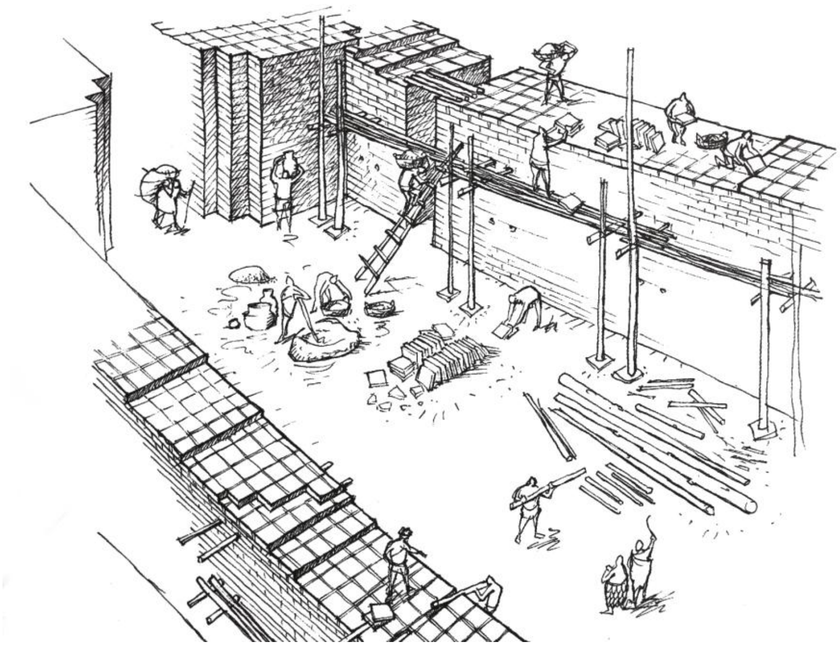


Figure 48. Reconstruction of scaffolding in Mari based on the discovery of putlog holes in the wall (after Margueron, 2004, fig. 204).

Figure 49. Bricking up a wall while standing on top of it. No scaffolding needed. Scaffolding was however regularly used on this project. This approach developed by coincidence while looking for an efficient way to finish the last part of the wall without having to adjust the scaffolding. Photo made by author during a loam construction workshop near Agdz, Morocco.

V.3.6 Foundation methods

Construction starts with preparing the ground. Foundation techniques vary, but in general the builder's approach towards foundation is very pragmatic, which is true for ancient times as well as in more recent traditional practices (Aurenche, 1981, p. 103; Gasche and Birschmeier, 1981, pp. 15–17; Dunham, 1982; Ragette, 2003, p. 29). One important observation is the general absence of deeply dug foundations. Moreover, foundations are rarely wider than the walls due to the already broad dimensions of mud brick walls, which gives these walls an inherent stability (see V.5.3). Foundation trenches are rare, but if soil conditions require, earth is dug out until stable earth is found. In densely populated settlements, preexisting walls are often used as the foundation for the next generation house (Figure 17). The main concern of the (ancient) builder was that the wall stood on a flush surface, to minimize the chances of wall shift or sag. As construction often takes place on sloped or irregular terrain, level ground is the minimum requirement for construction. Not surprisingly, various forms of ground levelling are the most common method of foundation (Loud and Altman, 1938, p. 18; Gasche and Birschmeier, 1981; Dunham, 1982). On sloped terrain, terracing is the most common form of levelling. Levelling might involve the construction of mud brick platforms, but excavated terraces are more common. Terraces can be constructed for individual walls, or for entire buildings, or parts of the settlement. The activity usually involves both removal and addition of soil.

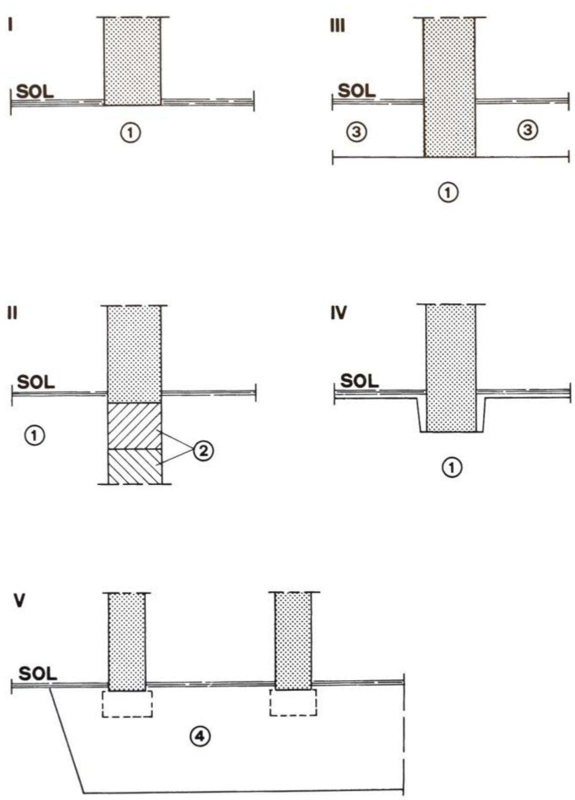


Figure 50. Common foundation practices found in the archaeology of Mesopotamian mud brick architecture. I. On surface. II. On previous walls. III. On surface, then soil dumped against wall. IV. Shallow trench. V. On sand or gravel (used occasionally for monumental architecture) (after Gasche and Birschmeier, 1981, fig. 4).

V.3.7 Wall construction

In mud brick construction, running bonds are most common. Since brickwork is generally covered by a loam render, there is no incentive to apply elaborate and decorative brick bonding patterns. Variations of brick bonding techniques have been observed in monumental architecture, but the reasons are functional and related to effectivity and efficiency (Oates, 1990; Sauvage, 1998; Wright, 2009). When the main brick unit is square (i.e. 30x30 cm or 40x40 cm), as is the case in most Bronze Age architecture, there is no difference between headers and stretchers. This therefore requires a different approach to bonding than in cases where rectangular bricks (i.e. 10x20 cm) are the base unit. With square bricks, rectangular 'half bricks' are applied to attain the required offset at the beginning of a brick course, or to construct walls with half brick widths or a multiplication of this (i.e. 1.5, 2.5 brick width etc.). If halves are used in the latter fashion, quarter bats are required again for proper offsetting at the beginning of a brick course. So that means that at least 3 types of brick are needed if the base brick unit is square: squares, halves, and quarter bats.

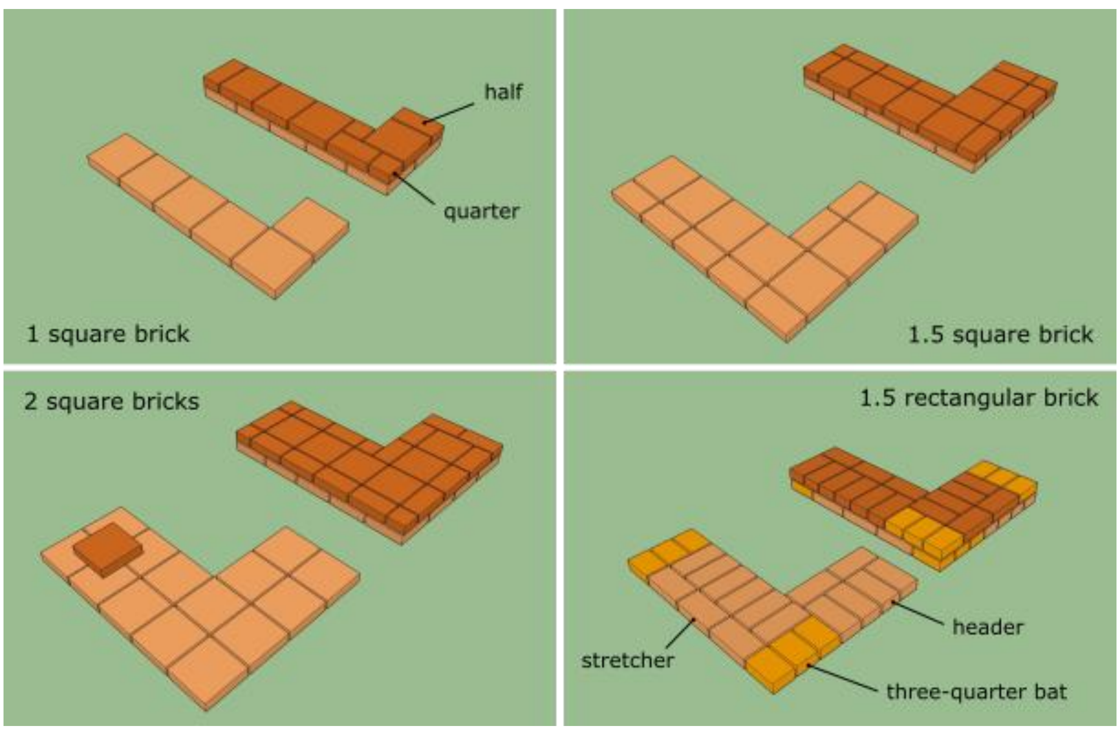


Figure 51. Illustration of some common bonding patterns with the square brick as base. For comparison, a common brick bond for rectangular bricks is illustrated on the bottom right.

Walls that are load bearing or important for the stability of the entire structure, must be bonded at the corners or at T-junctions. Different corner bonding patterns are possible. Various corner/junction bonding patterns found in the *Dunnu* of tell sabi abyad will be discussed later. The corner/junction bonding pattern applied appears to be determined by the width of the wall: i.e. a 1 brick width wall requires a different approach than a 1.5 brick width wall. The wider the wall, the more potential variations in corner/junction bonding are possible. Moreover, to create a sufficiently strong connection, it is not required to bind every brick layer, but some may be skipped.

The width of walls is proportional to the size of the base brick unit. Generally, the minimum width is therefore equivalent to the size of a single brick, e.g. 30-40 cm, although half brick walls are possible for light constructions such as enclosures. On average, single floor houses of traditionally constructed houses have wall thicknesses of 40 to 60 cm, and about 80-100 cm if there is a second floor[40], but if more building types are included, wall widths vary immensely. This is for a large part a consequence of the height or size of the building, as a minimum wall 'slenderness' has to be observed to maintain a certain stability (Yeomans, 2009, p. 84) (Table 5). It has been claimed that mud brick walls are often "unnecessarily" wide (Heinrich and Seidl, 1967, p. 5; Wright, 2000, p. 40).[41] However, considering the general practice of constructing directly on levelled ground without advanced foundation methods, wall stability is probably attained by constructing on a wide base. Another factor is that ancient builders stayed on the safe-side, and probably constructed 'earthquake proof' (Table 5). Last, a wider wall at the top also helps to better distribute the weight of the heavy mud terrace roof and prevents damage caused by beam sagging (Figure 55). The reasons for the dimensioning of walls is therefore a combination of structural necessity and safety. Suggesting that walls were unnecessarily wide disregards the pragmatic and rational approach to construction by the ancient builder. This means that we can read differences in wall width as a rough reflection of differences in wall height, taking into account the possibility of intermediate floors and their influence on the stability of walls.[42] If the distance to intermediate floors or ceilings is high, thicker walls are required to attain the same wall stability.

Another important factor contributing to building stability is interior wall or space configuration (McHenry, 1984, p. 84). Interior walls at regular intervals, supporting the exterior walls, creates a much stronger structure than very long uninterrupted stretches of wall. Enclosure and fortification walls naturally suffer

---

[40] Some examples of traditional village architecture wall widths: Gazira, Northern Syria: 35-50 cm for regular walls, 60-70 cm for 'stronger' walls (Pütt, 2005), Tauran, Iran 70-90 cm (Horne, 1994), Aliabad, Iran: 50 cm for single floor, 100 cm for two floors (Kramer, 1982).

[41] It must be said, they refer to monumental architecture: palaces, large residences and temples. Heinrich and Seidl (1968) have suggested that this is because the thickness of walls plays a symbolic role in monumental architecture.

[42] The slenderness of walls is offset by the presence of rigid floor frames at higher levels. The floors used in traditional mud brick constructions are in many cases not completely rigid, as the beams are placed on the walls without binding them. This type of floor will have some effect on the stability of the walls, but not the same as a completely rigid frame.

from this problem, and are therefore constructed very wide, with buttresses, or deviate from the straight line by building sections with corners.

Wall thickness (cm)	Slenderness aspect ratio (thickness:height)		
	8	10	15
	Max wall height (m)		
30	2.40	3.00	4.50
40	3.20	4.00	6.00
60	4.80	6.00	9.00
100	8.00	10.00	15.00

Table 5. Maximum wall heights (in meters). These are common aspect ratios applied in loam construction nowadays. A slenderness ratio of 8 (left) is advised for earthquake prone regions. A ratio of 10 is generally considered safe (middle), while a ratio of 15 reflects the maximum, only to be used on solid soil, and in conjunction with well-designed foundations and masonry of good quality (after McHenry, 1984, table 13.1).

V.3.8 Flat roof construction

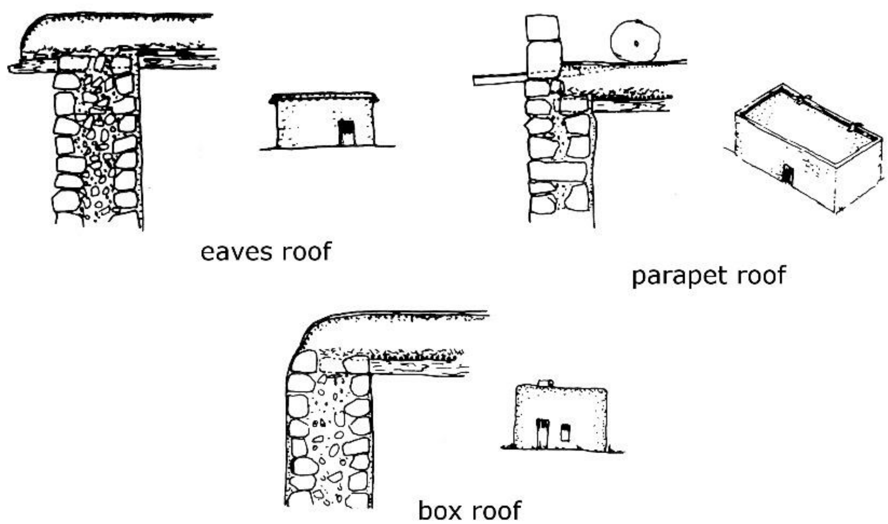


Figure 52. Three common roof types: eaves roof, parapet roof and box roof. The examples show dry stone walls, but the principle of loam terrace roof construction is the same (after Wright, 1985, fig. 363).

Although roofs are seldom found archaeologically, archaeologists commonly make the assumption that roof construction in the ancient Western Asia differed not from traditional practices found today (Delougaz, 1940, p. 133; McCown, 1967, p. 37; Moorey, 1994, p. 355). The roof type found throughout the Middle East, North Africa and far into the Asian continent is the loam terrace roof. This type of roofing is still used in modern village houses in the Western Asia today (Krafeld-Daugherty 1994, 166-172), and is the most common in traditional Northern Syrian roof constructions (Pütt, 2005, p. 243). There are three main forms of this roof: the eaves roof, the box roof and the parapet roof (Figure 52). Generally, the box roof is found in the driest areas, alongside various vaulted roof types (see V.3.9). The eaves roof is used in areas with slightly more rainfall, which is also evident from its distribution in Northern Syria (Pütt, 2005, p. 243). The parapet roof has a raised edge of up to 0.5 meter high (Aurenche, 1981, p. 154). Its occurrence is related to use rather than climate: in some areas it indicates the roof is used for sleeping, giving privacy and protection (Pütt, 2005, p. 246). In addition, more generally, it forms a safe barrier for people and things to fall off, allowing for other secondary uses of the roof. It also helps in controlling the flow of rainwater, channelling it to specific locations with discharge spouts. Control over the flow rainwater may explain its common occurrence in urban environments. Looking at roof construction and specific buildup in more detail, the degree of variation is very large with local building traditions playing an important role.[43]

All flat loam terrace roofs are a layered construction applying a various plant or loam based building materials. The structural support is formed by the timber frame, for which two options are common in traditional practices in Northern Syria (Daker, 1984; Pütt, 2005, p. 249). The first is to simply lay a number of beams across the width of a space. The second is to use one long central beam and place rafters covering the space from this beam to the wall. Although the difference may seem trivial, this is a significantly cheaper option than the former as it requires one single long and heavy timber and a larger number of smaller ones (Pütt, 2005, p. 249). In either case, across these beams or rafters, smaller timbers or purlins are placed. These are in turn superimposed by matting, straw or reeds, or even bushes of twigs or grasses are used. Finally, several layers of loam of coarse and fine consistency, are dumped and distributed on the structure, and compacted. A waterproof surface can be obtained by mechanical compression (rolling) and by using lime plaster or bitumen enriched plaster for the outer coat. The proportion of the roof construction made up by loam or by other materials differs quite significantly. The roofs documented by Pütt (2005, p. 244) contain a thick layer of straw, and relatively thin layers of loam. In a certain variation of the eaves roof, the thick layer of straw forms a roof that is dome like in appearance, which is up to 1.5 m thick in the middle. Adding thick layers of straw will increase the insulation value of a roof, while it may also create a lighter, putting less strain on the beams and walls.

The roof beams carry the entire weight of the roof, which is considerable at about 500-600 kg per m^2 roof, if the structure has a high proportion of loam. This weight is a main factor in roof and wall decay, as it causes sagging and edge pressure on locations where the beams are supported by the wall (Figure 55). In

---

[43] See for instance the documented roof construction types for Anatolia by Dalokay (1966) or for North Syria by Pütt (2005, p. 244).

some cases, wall plates are used, wooden planks or round timbers running over the top of the wall to support and distribute the weight of the beams. However, this is not standard practice. Thicker walls also help in distributing the weight of the roof better.

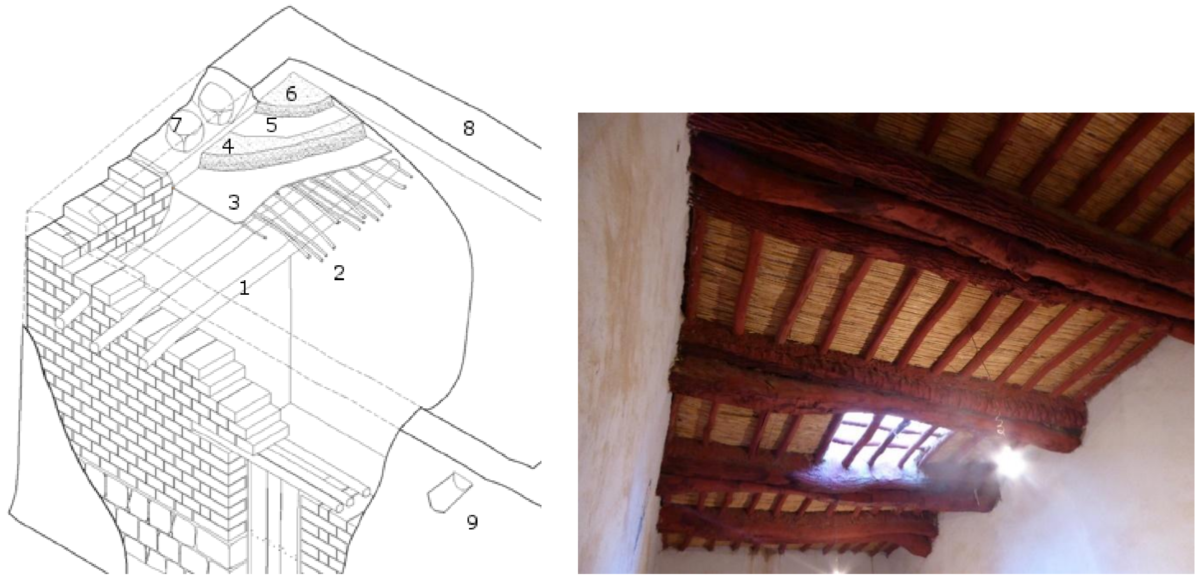


Figure 53. Roof construction methods. Left: common roof construction of houses in northern Syria. 1. Joists of poplar. 2. Purlins of brushwood. 3. Matting. 4-6. Layers of loam mortar with plastic sheet in between. Final layers mixed with dung or very fine clay to increase waterproofing. 7. Stone reinforcement. 8. Low parapet. 9. Water discharge. (after Dipasquale, Onnis and Paglini, 2009, fig. 63). Right: roof construction for a room with a larger span. The joint beams are a combination of trunks of date palm and tamarisk. It is a construction method that can be used when strength is required, but proper timber is not available. Top floor in a fortified building in south-eastern Morocco (photo by author).

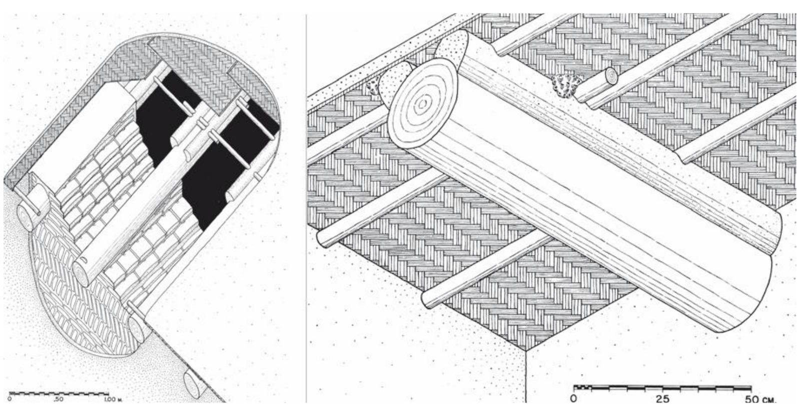


Figure 54. Khafajah/Ancient Tutub, 3rd millennium. Reconstructed roof based on charred beams and imprints in burned clay. It is curious that Delougaz chose to depict woven reed mats instead of a plain reed cover, because as far as his reports show, of these actual evidence was found in imprints, not of the herring-bone pattern mats. Diameters of beams and rafter could be determined exactly (after Delougaz, 1940, p. 133).

During the 20th century the most common tree species used for roof construction were poplar and date palm. In wooded areas of Anatolia, there would be more options, but in the drier low-land, poplar and palm are the types of timber that are more readily available (also see V.2.2). Larger trees were imported from far distances, but these would only have been used in monumental and state architecture mainly.

The variables important for timber roof construction are span, beam diameter, wood quality, interspacing, and wall thickness (Figure 55). The ancient builder had to assess these variables, and relied for this on expert knowledge. The thinner the beam, the closer they had to be put together, and the more beams would be needed. Conversely, when increasing the size of the room, either the beam-spacing had to be reduced or the beam thickness to increase, to be able to carry the weight of the roof.

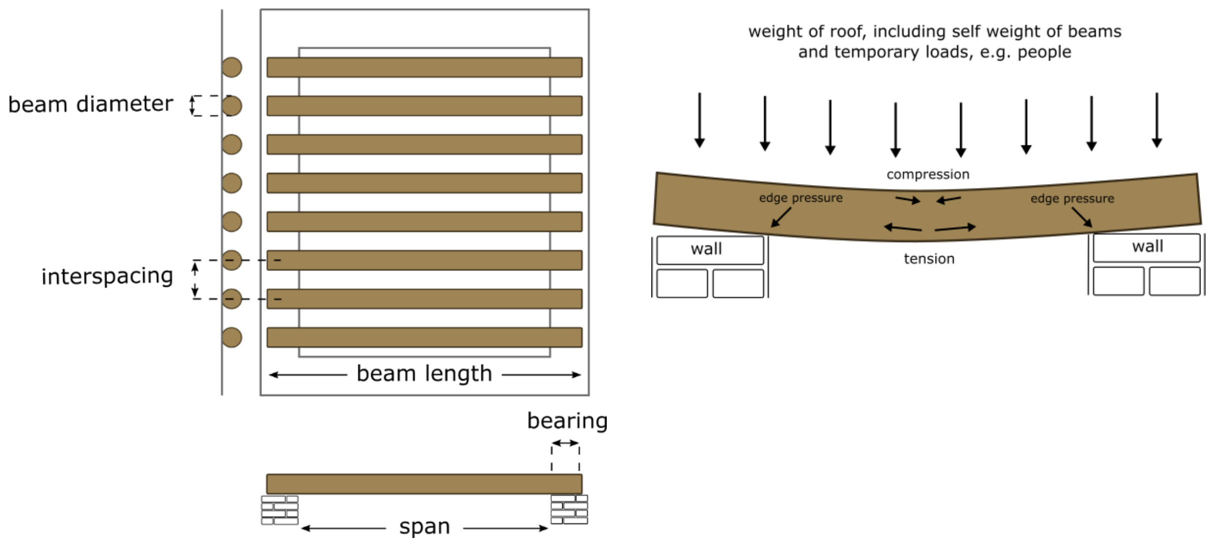


Figure 55. Left: variables important to roof construction. Right: forces acting in a horizontal beam structure.

Generally poplar beam diameters range from 15 to 25 cm (Dalokay 1969, 37; Margueron 1992, 89) although the use of beams with diameters below 15 cm have also been reported.[44] With such small diameters, they need to be placed very close together: Reuther (1910, 99) observed that town houses in Basrah and Baghdad had poplar beams only 10-12 cm in diameter, placed 5 to 10 cm apart. Other ethno-archaeologically attested placement distances gathered from the literature go up to 1 meter.[45] On average the interspacing seems to be around 30 to 70 cm.

[44] E.g. Krafeld-Daugherty (1994, 170) states that trees are usually judges to be of sufficient thickness when they had reached 12 to 15 cm in diameter.
[45] See for example Krafeld Daugherty (1994, p. 167) who cites several sources in which the beam spacing ranges from 30 to 70 cm, and Aurenche et al. (1997, p. 81), who report 20-30 cm interspacing between beams of traditional houses at Cafer Huyuk, Turkey. Reuther (1910, p. 99) states that the town and city houses in southern Mesopotamia have roofs and floors of poplar beams spaced only 5-10 cm from each other. Also Woolley and Mallowan (1976, 161) report that the beams were laid “at intervals not much greater than the diameter of the poles”.

Various ethnoarchaeological studies agree that no more than 3 to 3,5 meter is usually spanned with either poplar or palm (Hall, McBride and Riddell, 1973; Koyunlu, 1982; Friedl and Loeffler, 1994; Krafeld-Daugherty, 1994).[46] Covering larger spaces than this normally requires the use of columns or wooden supports, or to import different species of trees. In villages in Turkey and Syria, the use of wooden posts to support the roof beams is common. But no spans larger than 6 m have been observed (Krafeld-Daugherty, 1994, p. 167). However, in arid non-mountainous Northern Syria the use of wood is more constrained due to the limitations of the environment (Pütt, 2005), and wooden posts are not recorded to have been used in this way. According to Moorey's overview of wood use in ancient Mesopotamia (Moorey, 1994, p. 355) the use of timber for columns was a highland phenomenon until the Achaemenid period, but he cites relatively little evidence.

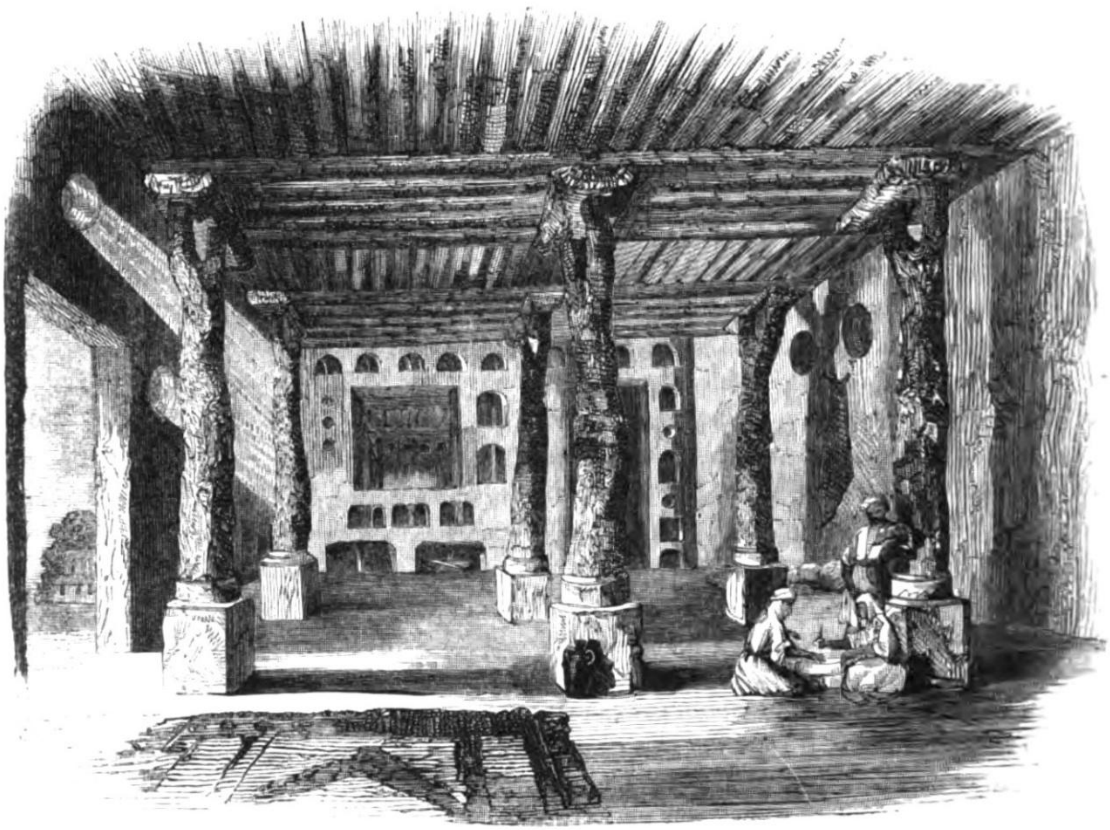


Figure 56.Drawing of the inside of a Yezidi house by 19th century archaeologist Austen Henry Layard. A lot of wood was used for the roof, supported by heavy timbers on stone bases. The plentiful use of beams is perhaps not just an demonstration of affluence, but considering the size of the room, could be a structural requirement as well (after Layard, 1882, p. 214).

[46] The total length of the beams needs to be another 80 cm or more longer.

The most valuable part of houses has until recent times always been the roof beams, which is shown by texts recording the transfer of houses to new owners (Stone, 1981, p. 20). It also explains why roof beams are often removed and re-used.

The flat faced loam terrace roof is not the only type of roof commonly found. Looking specifically at traditional architecture in Northern Syria, saddle roofs are in fact quite common as well, as are domed, or part-domed structures (Pütt, 2005; Mecca and Dipasquale, 2009). The domed houses are a very old phenomenon and are even recorded on a Neo-Assyrian relief. The domed roofs are usually associated with the driest and timber-scarcest regions. Some of these houses are round structures with the dome starting at the wall base. But some are found on rectangular wall structures, which would be less apparent, archaeologically.

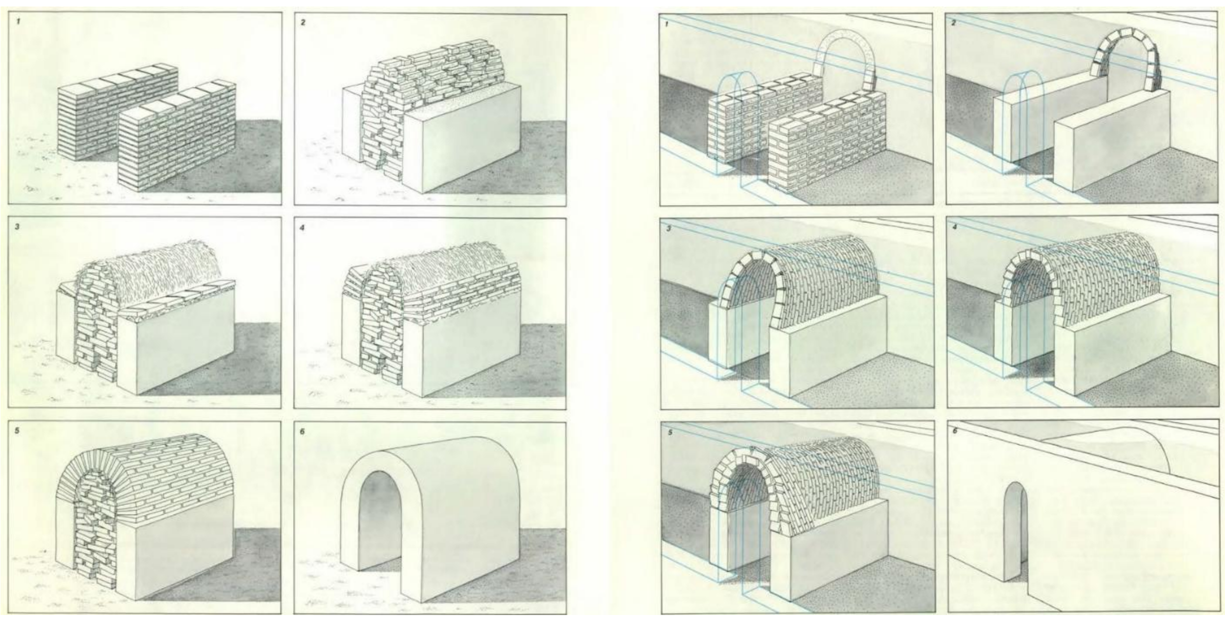


Figure 57. The execution of the two most used vaulting methods used during the Bronze Age in the ancient Western Asia (after Van Beek, 1987, pp. 84–85). Left: radial vaulting using a rubble fill as centring. Right: Pitched-brick vaulting, which requires no centring but relies on a back support of a wall.

V.3.9 Vaulting

As an alternative to timber based lintels and roofs, vaulting techniques were commonly applied to span rooms, doors and windows, long before the famous examples of Roman and Byzantine architecture (Besenval, 1984; Oates, 1990). Aside from ceilings and doorways, it is also employed in stairway construction. Two of the most common vaulting techniques are radial vaulting and pitched brick vaulting (Figure 57). The first requires centring, or support, during construction of the individual archivolts. The centring can be made of timber, or a rubble fill that is removed when the vault is set. Perhaps the most common technique is pitched brick vaulting, which does not require centring during construction. The archivolts are constructed against a wall on one side and at an angle just so the bricks do not slide or fall.

When dry, it has similar structural performance as a radial vault. The structural limit of mud brick masonry vaults with a single archivolt is about 4 meters. To better distribute the downwards forces, multiple archivolts can be employed, but this also requires more massive walls. Hence, when a structure is expected to carry great weights or large spans are needed, for instance with city gates, multiple archivolts are common. A famous example is the completely preserved mud brick city gate of Tel Dan, Israel (Frances, 2013). Recognizing arches and vaults in archaeological context is not as easy as it seems. Collapsed vaults resemble general mud brick collapse, as vaults often disintegrate gradually or fragment completely on hitting the ground.

V.4 Building materials used in the *Dunnu*

In this section, we will look at the building materials available to the builders of the *Dunnu.* It is based on both an environmental analysis and data available from the documentation of the excavation. It should be emphasized, that very little in terms of specific sampling and analysis of building materials has occurred. Therefore, many important questions cannot be answered. The main purpose of this section lies therefore in painting the general picture of the material and physical bounds that the builders of the *Dunnu* had to deal with.

V.4.1 Loams in the Balikh valley

The Balikh valley depoits are suitable for mud brick production are found on the recent and older river terraces formed by alluviation. These loamy alluvial deposits contain varying amounts of pebbles, gravel, sand, silt and clay. Outside these river terraces deposits are very shallow and consist of the weathering products of the bedrock, mostly limestone and gypsum. These have no use in mud brick production, which is thus confined to the river terraces. The deposits of the Balikh river terraces contain relatively little sand (on average 10-30%), although large variation is recorded in geographical distribution and sample depth (Mulders, 1969, table 30.1-30.10). Thus, deposits with the advised minimum of 30% sand are available, but must be looked for.

The proportions of different types of clay minerals is also of some importance to the fabrication of bricks, mortar and plaster. Clays are classified as either expanding or non-expanding. Expansive clays swell if a large amount when water is added, and shrink proportionally when drying out. Too much of these clays may cause mud bricks or plaster to crack. On the other hand, these clays are also the stronger binders. Without them, the material is weaker. The clay minerals occurring in highest amounts in soils of the Balikh valley are illite and palygorskite (Mulders, 1969, table 20), which are both non-expansive. The fraction of expansive clays is generally negligible. However, higher amounts of expansive clays such as montmorillonite are found locally as well. Again, this suggests that the best soils for construction must be searched for. Another possibility is that they are taken from preexisting mounds.

A last interesting fact about the Balikh valley is that due to the vicinity of calcareous bed rock the deposits contain high amounts of calcium carbonate. In theory this is good, because it may act as a binding agent, cementing particles together when dissolved and hardened on drying out.[47] However, due to changing relative humidity of the air and bricks, calcium carbonate and other salts may travel to the exterior of the brick and form encrustations that will flake and damage the wall (Bruno *et al.*, 1969). It is unclear whether the high amounts of calcium carbonate are therefore advantageous to loam constructions in this region.

V.4.2 Loams in the *Dunnu*

Unfortunately, none of the *Dunnu's* mud bricks or loam renders and plasters were analysed so at present it is impossible to compare their mineralogical composition with the soils of the Balikh. Therefore, we do not know whether specific loams were selected for construction. It is clear however that the Neolithic tell was quarried for loam as is suggested by the fact that prehistoric sherds that were occasionally found in Bronze Age mud bricks. The fosse that was dug out probably provided a large volume of the raw building material, although volume calculations show it was sufficient only for a part of the initial construction works.

A little more can be said about the loam used for the mud bricks of the *Dunnu*. The texture and colour of the mud bricks in many walls were documented during excavation, although not systematically and based on subjective descriptions. It does however show that a variety of mud brick textures and colours was present, possibly indicative of various loam sources (Figure 58). A notable difference has been observed between reddish brown mud bricks, often of a crumbly composition, and greyish mud bricks, often harder and compact and just plain brown mud bricks. The use of mud bricks of differing consistency and colour is a commonly observed archaeological phenomenon (Oates, 1990, p. 489; Sauvage, 1998, p. 18). In the ancient sources as well, two different names for two classes of mud brick are used: those of good (*ukurrum*) and of bad quality (*zarinnum*) (Sauvage, 1998, p. 18). Oates reports on builders saying that grey earth coming from former settlement earth produces stronger bricks than 'fresh' earth from the fields. The reason

[47] Calcium carbonate dissolves in water enriched with carbon dioxide, forming calcium bicarbonate. Hence, the degree to which it dissolves depends on the presence of carbon dioxide, which is generally higher in rainwater than in ground water.

is that ashy occupation material is a source of carbonates and able to act as a binder (Wright, 1985, p. 382; Miller Rosen, 1986, p. 75).[48]

The presence of the use of bricks of multiple colours is a common archaeological observation. It is probably a conscious decision to mix bricks of different stacks and sources. Some have suggested a symbolical meaning related to the performance of construction (Love, 2013b). However, a structural explanation may also be proposed. In that case, if bricks were of variable quality, a more or less equal distribution of the weaker and the stronger ones would be logical. The common occurrence and use of bricks of different quality has also been suggested by some ancient sources, which refer to ordering certain quantities of good and of lesser quality bricks (Sauvage, 1998, p. 18).

---

[48] If this is correct, then Sauvage (1998, p. 18) suggestion that bricks described in the texts as bad quality were produced from 'archaeological earth' and the good ones of newly acquired earth cannot be correct, and it should be the reverse.

Figure 58. Brick colour, texture and size of the two largest buildings. No colour means no data. Light brown: brown crumbly brick. Darker brown: brown medium compact brick. Dark brown: compact brown. Grey brown: brown and grey compact bricks. Brown with red stripes: greyish brown compact and reddish brown crumbly bricks.

Red loams are found in bricks throughout the *Dunnu*, but a couple of examples stand out because of their specific application. Interestingly, the walls of one of the most prominent building on the site, the large residence, are made of interchanging courses of reddish brown and greyish brown bricks (Figure 59). As for all these cases, a functional explanation is likely, but a symbolical one should not be excluded. Hypothetically, the act of combining the old and the new earth seems quite susceptible to attachment of symbolic meaning.

Another significant amount of reddish-brown loams was used in walls that were part of a reconfiguration in the south eastern corner of the *Dunnu*. However, different than from the walls of the residence, these were completely built out of red earth, probably from one source. Therefore, no deliberate choice was made to combine the red with the grey type of mud bricks. Since this reconfiguration took place in a phase while the *Dunnu* was used actively, perhaps it simply reflects the fact that they had moved the production of these bricks out to the plain in order to not interfere with the daily activities of the *Dunnu*.

Figure 59. The use of interchanging courses of crumbly reddish brown and denser brownish grey mud bricks in the residence. 'Interchanging courses' may be a slight exaggeration of reality. It was not applied this neatly in all walls of the residence, and even this photo of the 'best example' shows quite some randomization in the placement of mud bricks of different colours.

V.4.3 Bricks

The walls of the Assyrian *Dunnu* are made of large quadrangular mud bricks of a type that had already been a standard size for a long time: they are already used in Akkadian architecture of the late 3rd millennium and seem to have become a regional standard around this time or a little later (Sauvage, 1998, p. 157). These are large and heavy units of construction, measuring about 40 cm x 40 cm x 10 cm and weighing about 22.5 kg each, a size and weight that can only be handled by one person if using two hands. Bricks in later periods (Achaemenid or today) are usually half this size or even smaller, allowing easier or single-handed handling. Based on this average size, the *Dunnu* brick can be classified as a 'type 10 brick' in Powell's brick types, for which a standard size of 39.8 x 39.8 x 8.3 cm is given (Powell, 1987). However, the *Dunnu* brick clearly is thicker on average and shows considerable variation in length and width dimensions.

The brick sizes of the *Dunnu* were not measured systematically and no reliable statistical or exact locational information for them is available. Measured examples taken from the day notes and field drawings show a remarkable range from 34^2 to 42^2 cm, suggesting no strict standard sized moulds were used. In a relatively neatly constructed building like the residence this variation of sizes is a little lower (38^2 to 42^2) then in the neighbouring central building (34^2 to 40^2) (Figure 58). This variation is not solely the result of various building phases using different bricks, but occurs often in one and the same wall of one building phase.

V.4.4 Straw

Although the straw content in the mud bricks of the *Dunnu* has not been subjected to closer study, the perceived amount of straw imprints found in mud bricks during excavation is low (Brüning, pers. Comm.). This would be in accordance with the use of rational amounts of straw applied to improve structural performance of a brick (chapter 3). Straw supply is dependent on local availability. Agricultural fields growing barley and wheat are a precondition for large amounts of straw. If these were not present prior to the founding of the *Dunnu*, they must have been acquired from further away, which has quite some implications for the cost of construction. Considering the historical context of conquest and population decline in the preceding period, it is possible that the builders of the first *Dunnu* had a hard time finding enough straw supply.

V.4.5 Wood

Charred wood remains have been found throughout the *Dunnu.* The excavated charred wood is generally very fragmented, and pieces that preserve the entire diameter of the original timber show that these were not part of larger beams. The few measured pieces are only 5 to 8 cm in diameter. The common practice of removing roof beams after abandonment, possibly even when partly burned, may be the reason for the absence of evidence.

The charred wood remains have been sampled and botanically analysed by Fantone (pers. comm.). Although some of the analysed wood samples may have been used as fuel, it seems a fair assumption that a large amount of charred wood found in the burnt layer originated from roofs or upper floor constructions. This is moreover supported by the fact that much wood is found in the collapse deposits. The analysis shows the predominance of poplar/willow and ash. Regarding the latter, this must have been the narrow-leaved ash, possibly a variation called syriaca. Like willow and poplar, this is a tree common to riparian habitats, and requires wet soil. The absence of imported species mirrors the observations made at Middle Assyrian Tall Šēẖ Ḥamad (Frey, Jagiella and Kürschner, 1991).

Although timber transport over long distance was common in antiquity, even for species like poplar, the location of the *Dunnu* is not particularly favourable for long distance transports over water. One of the main sources of the Balikh is just 25 km north. Another branch leads towards Harran in modern day Turkey, which hardly flows any water today as it is used for agriculture. However, in theory, it may have been possible to seasonally transport trees from highland Turkey. Nevertheless, it seems more reasonable to assume that these trees were felled locally. As has been described in chapter 1, parts of the Balikh valley were a marshy area during long periods of its history. Even if some of it was drained and used for agriculture, it is likely that riverine and marsh forests still existed in the Bronze Age. The identification of the species based on the charred wood samples seems to confirm that.

Figure 60. Identified wood species based on analysed charcoal found in the Dunnu. Left: poplar/willow. Right: relative quantities of fraxinus against willow/poplar (figures produced by Federica Fantone).

V.4.6 Reed

Reed must have been acquired from nearby as well. The Balikh riverbanks and marshland are an obvious source for reed, but it could also have been harvested from the banks of drainage and irrigation channels, where it would have grown plentifully.

Evidence for the use of reed stalks, primarily for roofing, has been found in the *Dunnu* of Tell Sabi Abyad. Although it is regularly mentioned by excavators, the only saved and photographed specimen of reed imprint from a roof is from a Neolithic context. Reed imprints are mostly found in the debris that fell into a room, so we may assume that these belonged to roofing material. No evidence for woven structures has been recorded. Archaeobotanical analysis being absent, the species of reed or constructional features could not be determined. No evidence has been found for the use of reed as structural reinforcement of walls, a feature occasionally found in mud brick architecture.

V.4.7 White plaster

The Tell Sabi Abyad field notes frequently use ‘white’, ‘brownish white’ or various other descriptors for whitish plastered walls or floors. In the reports they are commonly referred to as ‘lime’ based floors and wall plasters, but in theory they could be gypsum based instead. Without chemical analysis it is not possible to distinguish between lime or gypsum plasters (Moorey, 1994). Because of the high occurrence of gypsum deposits in the surroundings of the *Dunnu*, it is possible that the floor and wall coatings were gypsum based. The differences in manufacturing process and their consequences on material cost have been noted above (V.2.4).

The material is applied in outside spaces as well as in inside spaces. The evidence is summarised in figure 61 - figure 63.

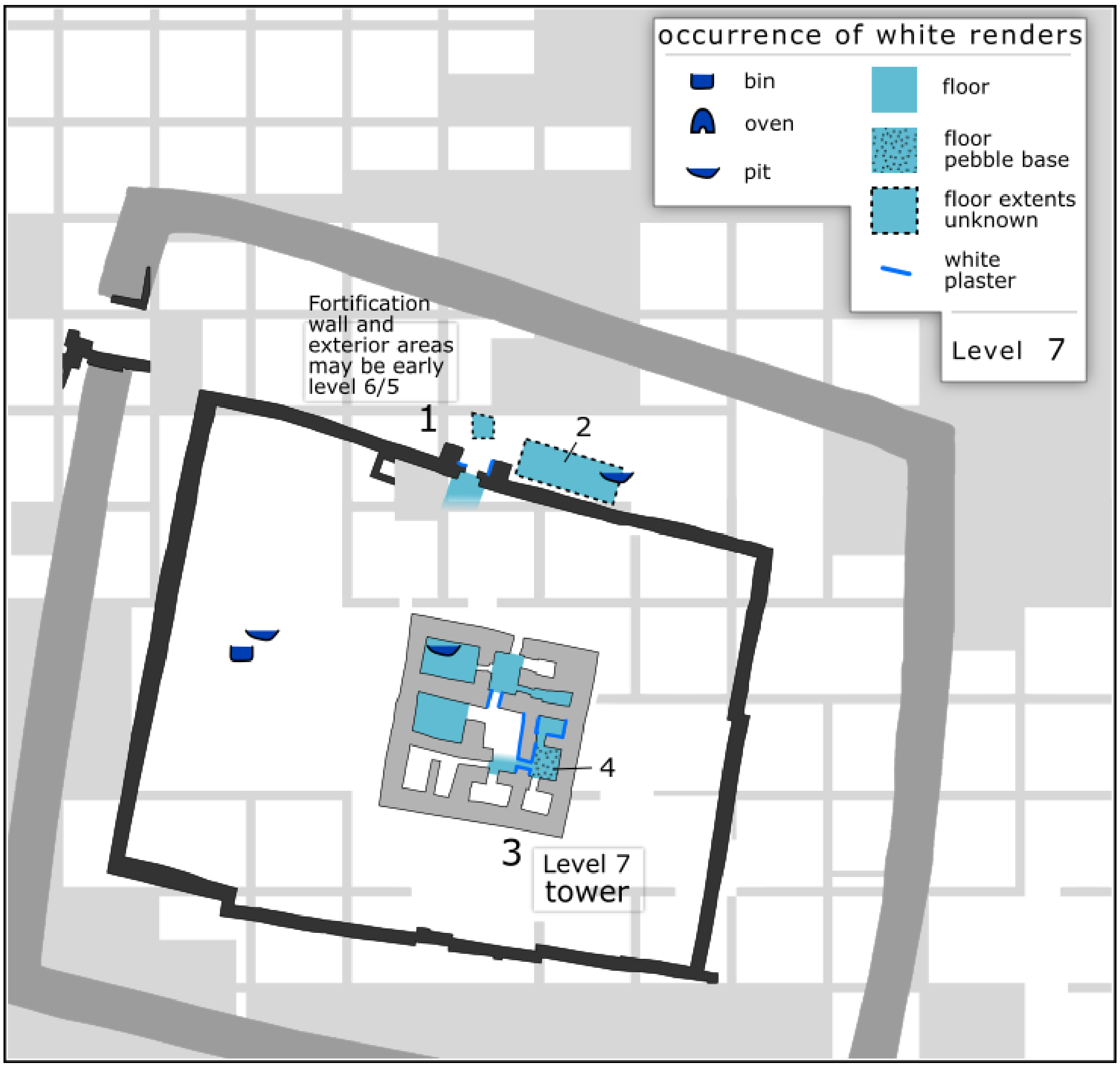


Figure 61. Level 7/early level 5/6 evidence for white renders in the Dunnu.

Figure 62. Early level 6/5 evidence for white renders in the Dunnu.

Figure 63. Late level 6/5. Evidence for white renders in the Dunnu. For some areas indicated on the figure, already rendered in early level 6/5, it is uncertain whether the white render was maintained also in late level 6/5.

Both floors and wall plasters are in some cases described as a thin layer (3-5 mm) on top of a loam plaster, and at other times as a thicker layer entirely made up of a 'limey' material (1.5-3 cm). This may suggest that pure lime/gypsum plasters as well as lime/gypsum enriched loams were used.

Alternatively, the thickness may have been the result of multiple plaster coats. However, in most cases no multiple coats of plaster were recognized, but there are a few exceptions (see next).

A special treatment was given to room 5 of the residence, were a 3 cm thick pinkish-white to pinkish-orange-white plaster was found. Perhaps these are traces of pigmented plaster. The plaster was applied in multiple layers (**7**).

A few floors are described as cobbles or stones embedded in white plaster. Some are in the heavy-duty areas referred to above. Another is found in level 7 phase room 6 of the tower, which use is unclear and somewhat enigmatic due to various other special finds (**4**).

There is a pattern in the spatial and diachronic distribution of white plasters. White plasters have been used on walls and floors in the core of the settlement within the confines of the perimeter wall, as well as in the extramural area. But most white plastered spaces are found in the northern half of the intramural *Dunnu*, likely related to the fact that representative spaces are found here (see also below). White plastered walls and features are not only found during the most 'prosperous' period of the *Dunnu* proper. They are also very common during the later 'domestic' period (levels 4, 3 and 2, not depicted).

The evidence indicates that the area around the new front gate, walls as well as ground surface, was whitewashed, possibly in correspondence with age-old practices related to doorways (**5**). The same held probably true for the old gate (**1**). Multiple whitish floors found below the floors of room 1 in L08 and rooms 1 and 2 in L09 probably belong to the phase of the old gate (**2**), rather than being old floors of the buildings they were excavated in (as suggested by the documentation regarding this area). Their elevation and the fact that the area around the new gate was completely plastered as well, makes this conclusion plausible. Also the front part of the residence and great court bear traces of white plaster (**6**). Since white wall plasters are a relatively rare phenomenon in the *Dunnu*, it is hard to ignore the suggestion that this must relate to the special status or representative functions of the main gates and façade of the residence.

Large parts of the tower, including the floors showed traces of a white plaster in the buildings earliest phase, e.g. the level 7 phase which is considered pre-Assyrian. On some later walls also traces of white plaster appeared, but the white plastered floors do not return in later 'Assyrian' phases (**3**). It may suggest a function difference between the earliest and later phases of the tower.

On various places, white plaster is clearly related to 'heavy duty' use of the area, such as the cooking area in level 5 where both walls and floors were plastered white (**8**). White plaster was used in the construction of the bathroom floor in I07, and in the bathroom of M08. In the first it was the only waterproofing material, while in the second it was applied over a layer of bitumen. A small share of all ovens and bins were lined with a white plaster on the inside, suggesting purposeful functional use of white plasters in the construction of certain fixed features.

V.4.8 Bitumen

In the *Dunnu* bitumen is primarily found in the bathrooms. These are areas of intensified water-contact and places where some degree of hygiene was required (Figure 64, Figure 65). It was used as mortar between the fired bricks of the floor and plinth, and as a coat of bitumen plaster to cover the entire surface. The precise composition, e.g. additives such as sand or vegetal matter, is unknown. Interestingly, not in all bathrooms it was applied the same way. In the bathroom in M08 it was applied over a coat of gypsum/lime plaster. The bathrooms in the residence only use bitumen, and no white plaster is recorded. However, not *all* bathrooms were constructed using bitumen. For the bathroom in I07 only a very hard white (lime?) plaster was used. Why for some bathrooms bitumen was used while for others it was not, is unclear. It could have been a matter of availability, and/or related to the status of the people using the bathroom.

Figure 64. Early level 6/5. Occurrence of bitumen in the Dunnu.

Figure 65. Example of the use of bitumen as mortar between the baked tiles of the bathroom in square M08.

Large deposits of bitumen are found near Hit on the middle Euphrates, but also near Qalat Shergat (Assur) and Kirkuk. This means the Assyrians had good access to resources, but the concentration of this resource often meant that it had to be transported over long distances. The nearest natural deposit to Tell Sabi Abyad is Samsat (Roman Samosata) in present day Turkey, about 120 km north on the upper Euphrates (Connan, 1999).

Without chemical analysis it is impossible to determine the source for the bitumen in the *Dunnu* was, but the choice is narrowed down to two plausible scenarios. It was either traded with the closest source, e.g. Samsat, which was probably outside Assyrian territorial influence, or it was brought all the way from the homeland near Assur. Considering the small amounts used, it appears to have been a relatively scarce resource. If we assume that the purpose-built private bathrooms were not used by everyone, the targeted use of bitumen here suggests it was a rather valuable material in this context.

V.4.9 Stone

The use of stone in the mud brick architecture of the ancient Western Asia is limited, especially on the planes and river valleys. This also regards the Assyrian *Dunnu* of Tell Sabi Abyad. Stone played an insignificant role in construction, even though great quantities of limestone are available close by.

Stone is used to a very limited degree in floors, sometimes embedded in a white floor plaster. In a few cases it seems to have been applied as foundation layer below loam floors. Its function may have been to reinforce and stabilize the floor in intensive use areas. In loam floors, a layer of pebbles could also have served to improve drainage or create a less slippery surface under wet conditions. There are very few other architectural elements made of stone. The sockets for door posts can be made of stone. Evidence has only been found for bottom pivot stones. In traditional construction in the Western Asia, upper door post sockets can be made of a large oblong stone, embedded deep in the wall on one side, and pierced on the other side to catch the door post. Since not a single such object has been found, it is likely that the upper ends of doorposts moved in wooden sockets, or forked branches. Large stones are occasionally used as steps or thresholds. No hewn stones were found.

V.4.10 Baked brick or tiles

Baked brick or tile floors are found in the courtyards and bathrooms of the *Dunnu*, corresponding to the common application of this material in this period and region. The square tiles are smaller than the mud bricks, on average around 33*33 cm. In one case in the north-eastern corner of the great courtyard, the use of over-fired tiles was reported, which suggests that this otherwise relatively elaborate floor did not have to conform to the highest standards. The over-firing of such tiles are a common feature and is related to the manufacturing process. As noted in the general discussion of building materials in this chapter, such tiles were probably fired in a scove kiln, which produces many over-fired and under-fired bricks.

The tiles were most likely produced locally. However, no direct evidence for this process in the form of wasters, unbaked specimens, or storage near a kiln has been found. The scove kiln leaves hardly any structural traces, as it is completely dismantled to get the bricks out. The evidence on site suggests that the large updraught kilns found here seem to have been used for pottery production. They could nevertheless in theory have been used for tile baking at an earlier stage, although this seems unlikely because of their limited capacity.

It is likely that most tiles were produced at one point in time, when the large courtyard and the residence were built. Together these form about 80% of the total fired tile surface area in use at this point in time. It is possible that later incidences of baked brick, such as the floor of a bathroom in L11 contained re-used tiles. Re-use must have occurred, since only part of the tiles of the large courtyard have been found in-situ. That the original floor covered a larger surface, is clear from the occasional brick or imprint of brick found on the edge of an otherwise brick-less area. A pile of broken bricks was found on the side of the courtyard, and throughout the *Dunnu* other small piles have been found, as well as some tile surfaces. It is very likely that these piles and later surfaces all contain tiles from the older dismantled floors, primarily the large courtyard.

The baked tile pavements are an interesting floor type. In the *Dunnu* such pavements are restricted to bathrooms and two large spaces. This matches very well with what we know in general about the range of application of such pavements in the Middle and Late Bronze Age. Examples are Old Babylonian Ur (Woolley, Mallowan and Mitchell, 1976), the Middle Bronze Age residence at Bakr Awa (Miglus *et al.*, 2013), and Middle Assyrian houses in Nuzi (Starr, 1939, p. 44). Within the Mitanni/Hittite sphere of influence the same picture arises at sites such as Tell Fakhar (Khalesi, 1977), the palace at Tell Taban (Numoto, 2008), the Mitanni palace at Tell Brak (Oates, Oates and McDonald, 1998), and the palaces of Tell Atchana (Woolley, 1955) and Zincirli (Luschan, 1893). In all cases tile, pavements are found in private courtyards in houses, in large (semi)public courtyards in front of the main building in monumental architecture, and universally in bathrooms. Tile pavements are more rarely also found in a food production area, 'kitchens', such as in the palace of Tell Brak or in the middle bronze age residence at Bakr Awa (Miglus *et al.*, 2013). In Ur, it is interesting to note that in private houses tile pavements were occasionally found in the 'principal room'. Hence, although it is not restricted to exterior spaces, such pavements are strongly connected to public and representative spaces, that were often unroofed courts and courtyards.

V.5 Construction methods and techniques in the *Dunnu*

V.5.1 Dimensioning

The base unit for dimensioning buildings most likely was the *kuš* or cubit, or about 50 cm (V.3.1). The precise length of a *kuš* differs across regions and time periods. Variations in base unit length between different buildings could therefore be interesting as they give new information about the different building fases and the origin of their respective builders. Theoretically, the unit length used by the builders in the past can be reconstructed by laying out a grid with 50 by 50 cm squares over a site plan, then scaling it until a whole number of squares fit the excavated spaces. In practice it is hard to acquire reliable results when this method is applied on the *Dunnu* due to the strong post-depositional deformations of wall structures. In addition, there is no consistent documentation of the position of the wall bases, which would be a more reliable measure as opposed to the top of the wall that is usually drawn on the plans. The result is that reliable grid sizes are hard to establish. Notwithstanding these caveats, a grid size of 47.34 cm gives a reasonable fit for various wall-to-wall distances in the residence and tower, and various other buildings integrated in the fortification wall.

Figure 66. Two slightly different grid sizes projected over part of the residence.

V.5.2 Foundations and wall bases

Foundation methods in the *Dunnu* reflect the basic practices seen in traditional mud brick architecture (Figure 50). It is important to emphasize that generally, no use was made of trench foundations, one exception aside. Although trench foundations are occasionally referred to in the day reports of the excavation, the evidence is scanty and suggests that these were not applied consistently by the builders of the *Dunnu*. The features referred to in the reports are generally local cuts, possibly to level a slope or bump. The main concern of the ancient builder was to create level construction surfaces to ensure wall stability. The absence of trench foundations may be related to the large dimensions of walls in general, which increases their stability. The effect of this practice is that floors and walls are often founded on nearly the same level. Divergence between wall base and floor base level does however occur because of various more shallow techniques to level ground and micro terracing, to enable construction on the sloping surface of the tell. Levelling ground can also be attained by dumping deposits on a surface. In the case of the large rooms of the residence, it has been observed that this occurred after the construction of a wall. Beyond adding to our understanding of construction, these practices are also important to consider in reconstructing building phases, as they complicate stratigraphic relations. For instance, different walls, or even parts of walls of the same building may not have matching foundation levels. Stepped foundations are common, and this state of matter should not be wrongly interpreted as phased construction.

No other special treatments of the bottom of walls was found. No stone plinths or damp courses are used, apart from tile plinths in bathrooms. Thus one may assume that the effects of capillary water or rain was not a great concern to the builders of the *Dunnu*. More recent traditional construction practices in the area also do not apply stone wall bases.

In the following some archaeological evidence regarding foundations is discussed in more detail.

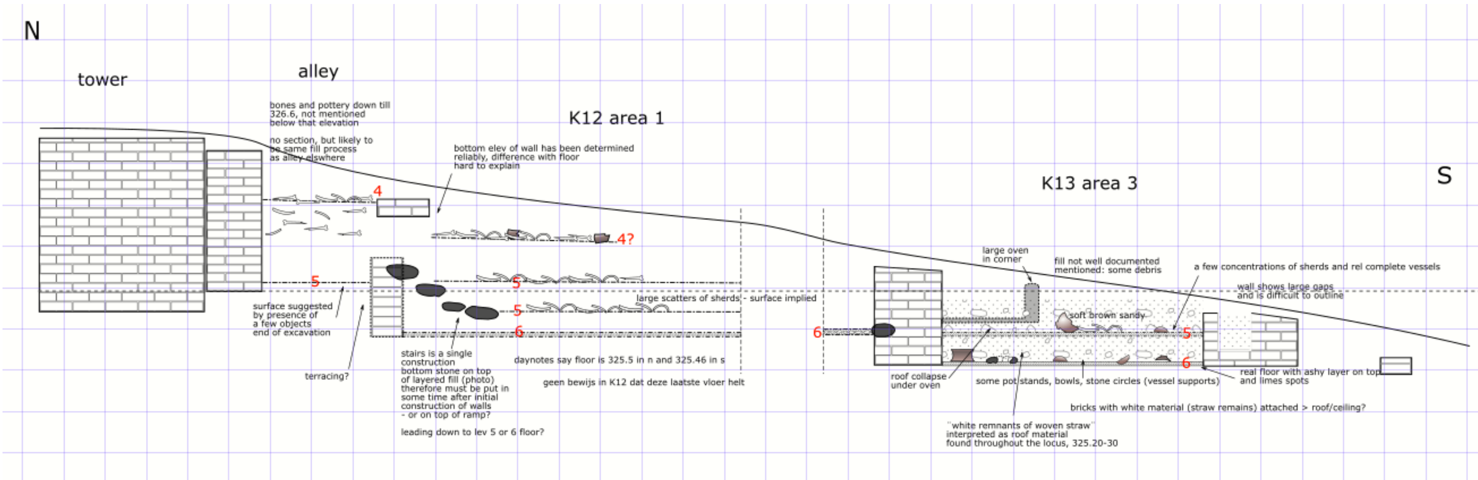


Figure 67. Deposit sequence graph of area south of tower showing the terraced nature of the architecture.

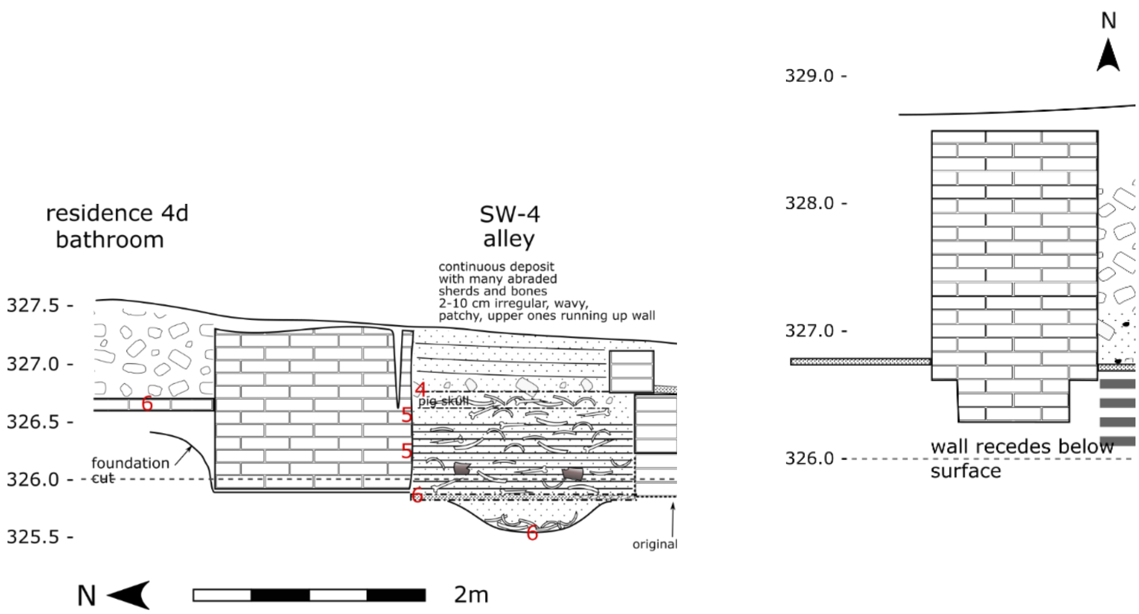


Figure 68. Left: southern exterior wall of the residence, showing the foundation cut, and the stratigraphic relation with the deposits in the alley along the back side of the building. Right: the receding foundation of the long eastern north-south wall of room 2.

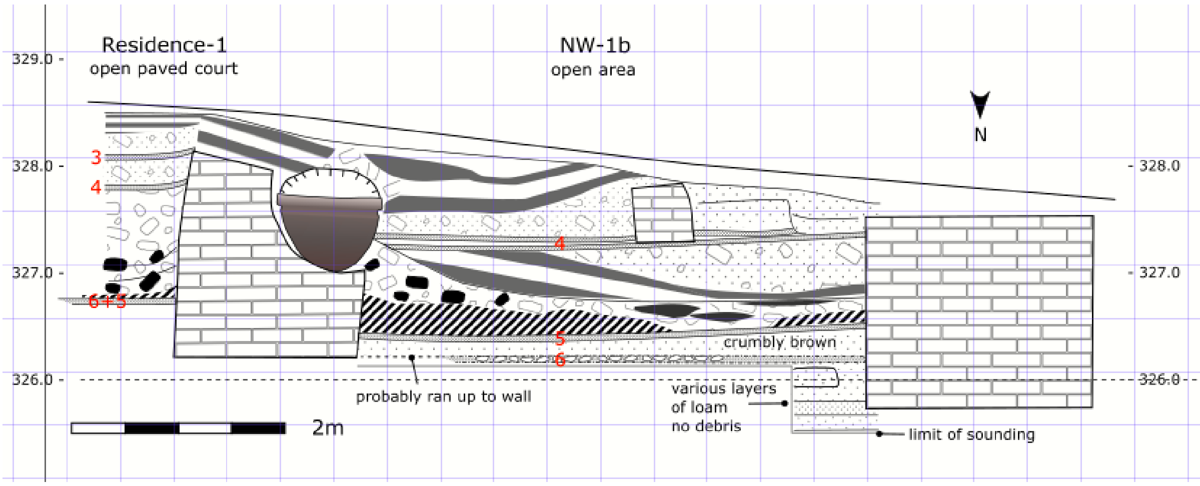


Figure 69. Deposit sequence graph of area between western wall of residence and western fortification wall.

Terracing is an effective manner of locally levelling ground for construction on a sloped surface such as a tell. It is evidenced on a number of places. It is most clear in the southern and south-eastern sides of the *Dunnu*, where the original tell surface was steepest (Figure 68). Terracing is also implied by the construction of long walls, such as the fortification wall, and the walls of larger buildings such as the residence and the tower, whose wall bases are stepped. In the southern *Dunnu* we find three terraces: one for the fortification wall and associated heavy walled buildings, one for the lighter walled architecture, and one for the southern walls of the two large central buildings. The southern walls of the residence and the tower seem to have acted as retaining walls at the same time as giving support to the roof of these buildings (Figure 68, Figure 67). It seems that in these cases, terracing causes a difference in foundation heights between the heavy walled structures attached to the fortification wall, and the lighter architecture that was built against it. The elevation difference ranges from 15 to 50 cm between the foundation of the heavy walled architecture and the floors of the light-walled architecture. It quite plausible that earth was brought in to create level floors, causing the stratigraphic difference. In this area, there is some evidence for a phase preceding the light architecture, hence the terrace is partly built up by previous occupation layers that have caused the rise in elevation relative to the heavy walled architecture.

Another case of terraced construction is found in the area east of the tower. The same pattern occurs where three terraces are implied by the construction heights of the tower, the light walled architecture, and the fortification wall and connected buildings. However, in a second construction phase, the area was modified completely. The terraces were removed by filling up the lower parts, those located directly alongside the interior of the fortification wall, with great quantities of debris. It is possible that this was done out of convenience, as it was an easy way to dispose of the demolition debris that was created by thorough renovations.

Last, we have evidence of terracing in the construction of the residence and western fortification wall (Figure 69). In a trial trench crossing this space a thick layer of loam was found to be deposited against the fortification wall. Again, it is plausible that this was a backfill layer, deposited after construction of the fortification wall and the residence in order to level the sloping ground between the two buildings (Figure 71). This interpretation suggests that the residence and the western fortification wall were probably part of a single building project.

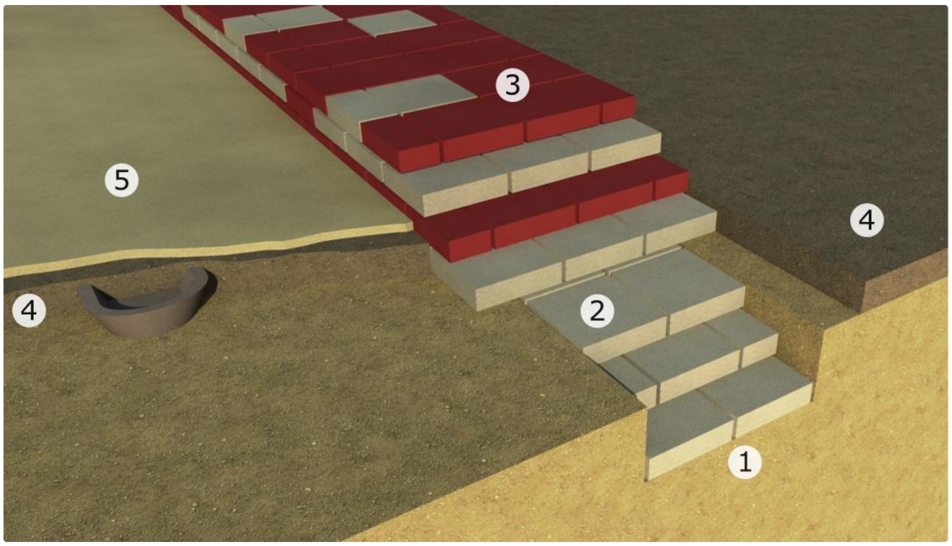


Figure 70. Interpretation of excavation data for interior load bearing north-south walls of residence. Showing the receding foundation, and dumping of soil as levelling layer.

As said, there is not much evidence for foundation trenches, apart from in one building, the residence. The residence forms a special case in the foundation methods used in the *Dunnu*, underlining the special status of this building. As mentioned above, its exterior walls were constructed on small terraces especially made for them, carved out in the slope. A trench foundation method appears to have been used for its two long load bearing interior walls, the only walls for which we have good evidence of a trench foundation, cutting into previous LBA exterior use surfaces (Figure 70). As opposed to common foundation types for brick masonry walls, the wall constructed in this trench is in fact *less* wide than its superstructure. This suggests that the main function of the trench wall was not to distribute the downward forces of the building more evenly to the subsoil. There are two possible other locations where such foundations have been found in the *Dunnu*: in the tower, and below the fortification wall in room in the north-eastern corner of the *Dunnu*. Since the archaeological excavation rarely extended underneath the walls, it might have been a more common foundation technique for heavy architecture. In the tower, the receding foundation was taken in the reports as the evidence of an older construction phase of the wall rather than a foundation type. The evidence for the oldest building phase in this part of the tower – as opposed to the northern part – is however too scanty for definite conclusions. Because of the partial excavation, we can also still not entirely exclude the possibility that the foundation wall in this trench was of a previous building.

Another typical feature of the foundation of the residence are the raised floors (Figure 70). After construction of the main walls, a levelling layer was deposited inside the building. Due to the size of the building, it covered a significant portion of the irregular surface of the tell, requiring the addition of this layer. Although many buildings show such a raised floor built on top of a backfill or demolition deposit, this always concerns a secondary construction phase. In the case of the residence on the other hand, the levelling layer was part of its original construction.

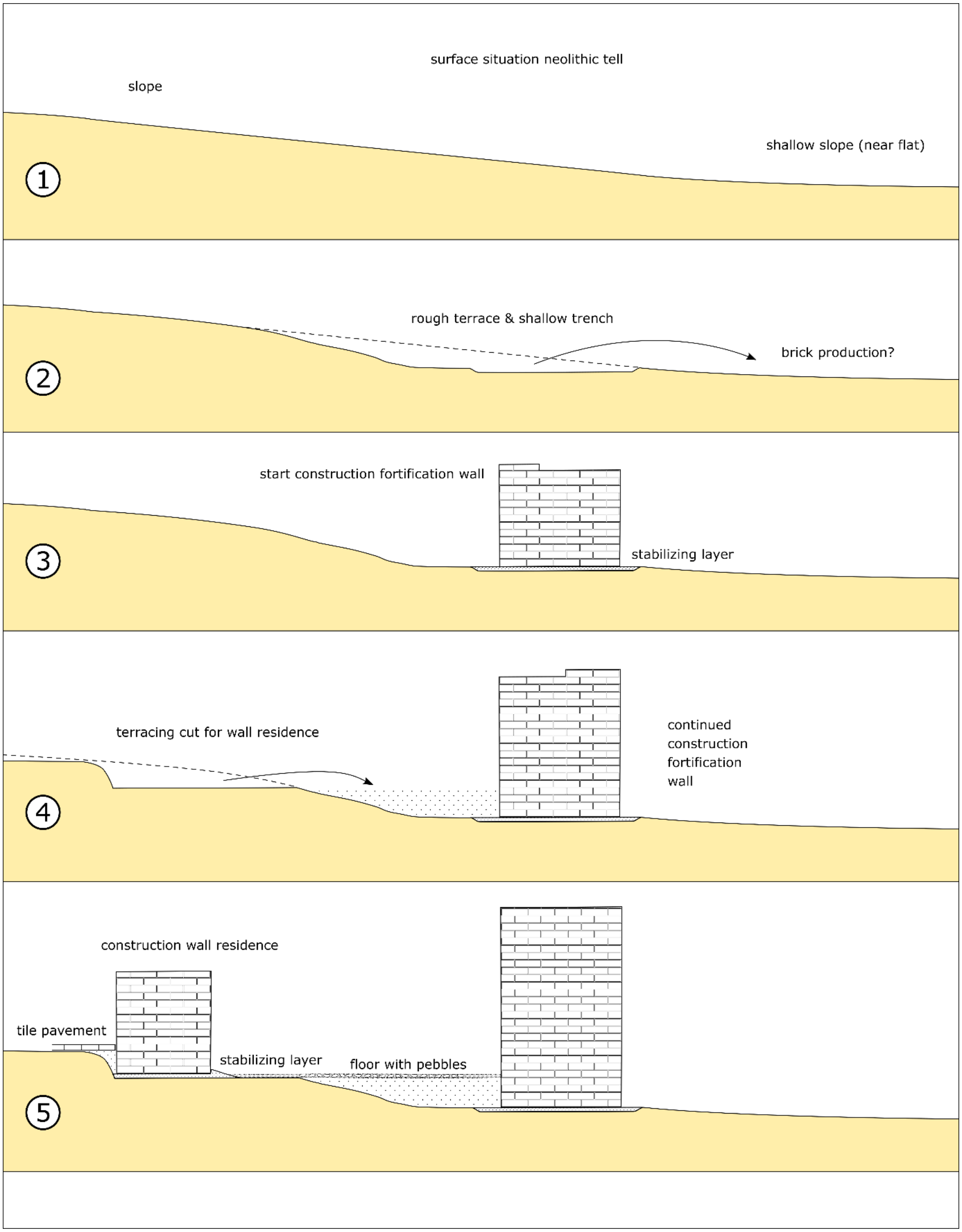


Figure 71. Proposal for the order of construction of the western fortification wall and residence.

A common foundation practice in ancient construction was to prepare the construction surface with deposits of ash enriched soils, which is aimed at soil consolidation (Wright, 1985, p. 382; Miller Rosen, 1986, p.

75). This may have been observed in a section across the northern fortification wall in L08/M08 (Figure 89). Also visible on this section is that the fortification wall (Q2 on the figure) seems to cut another layer (4 on the figure), which may indicate that soil was removed prior to construction. This was followed by a stabilizing layer of ash, and then a wall. But it is just as likely that the layer indicated with 4 was not cut by the wall, but deposited against it to level the construction surface for walls K/Q3. The ambiguous interpretation of this section results in opposite hypotheses regarding order of construction events, and have a major impact on our understanding of settlement development.

Finally, the practice to use mud bricks to create construction terraces or platforms may also have been used locally at the *Dunnu*, but the situation is quite unclear. In square L08 two superimposed mud brick ‘floors’ were found underneath the building just discussed (space NE-2b). They do not seem to be part of an interior floor, but seem to have been used as an outside surface. The structure is also quite fragmentary, and it is possible that these were used in a levelling layer that in part filled an older (fortification?) structure of which the remains were found underneath the eastern wall of building NE-2.

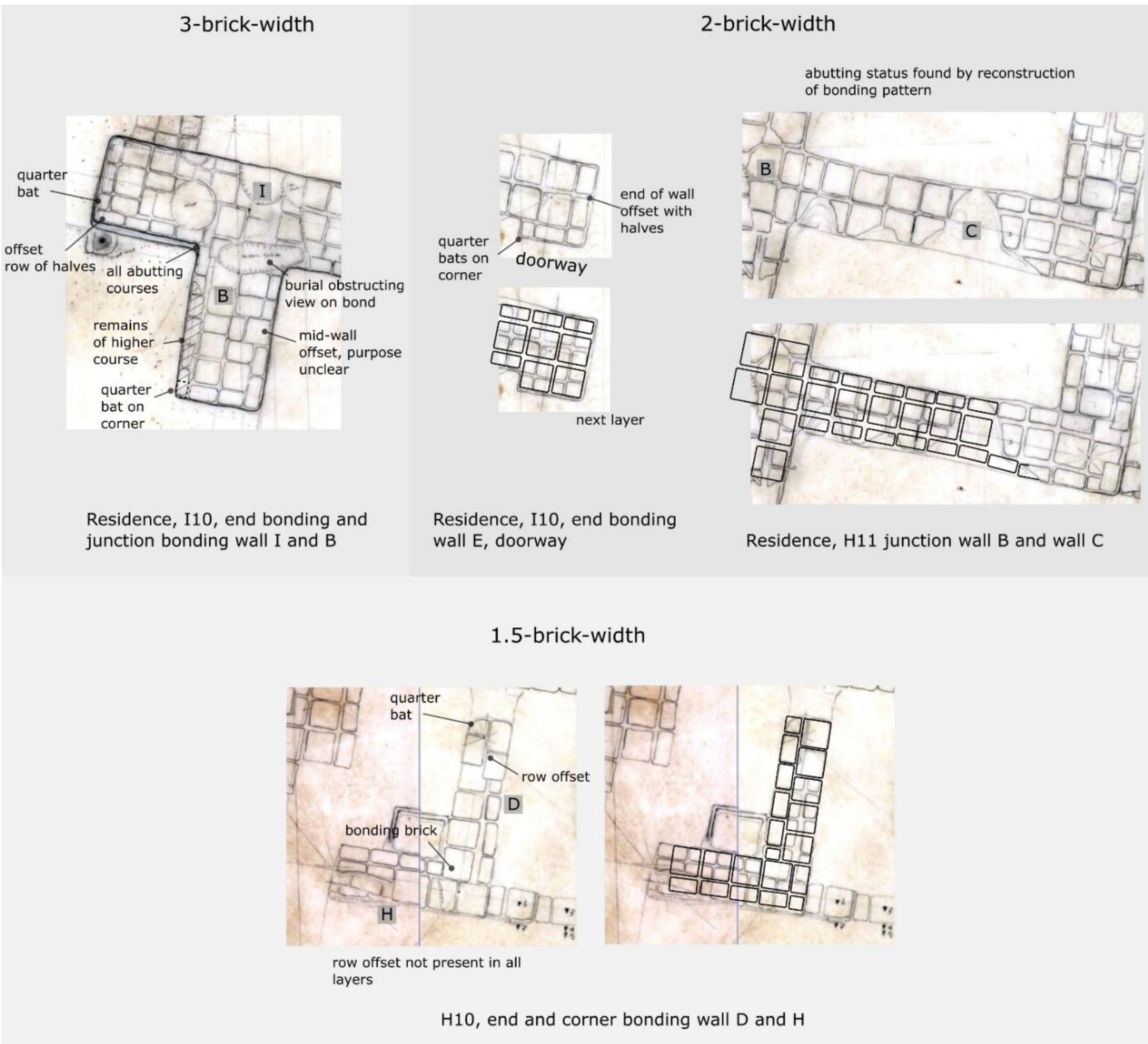
V.5.3 Wall construction

Wall construction in the *Dunnu* may be characterized as straightforward and highly functional. The walls of the *Dunnu* are made of large quadrangular mud bricks of a type that had already been a standard size for a long time: they are used in Akkadian architecture of the late 3rd millennium and seem to have become a regional standard around this time or a little later (Sauvage, 1998, p. 157). These are large and heavy units of construction, measuring about 40 cm x 40 cm x 10 cm and weighing about 22.5 kg each, a size and weight that can only be handled by one person if using two hands. Measured examples taken from the day notes show a range from 34^2 to 42^2 cm, suggesting no standard sized brick moulds were used. However, we should take into account the inaccuracy involved in measuring archaeological bricks, variable shrinking rates, and post-depositional factors.

Figure 72. Plan of the Dunnu *with all mud bricks drawn.*

V.5.3.1 Brick bonding patterns

Bricks are laid universally in running bonds. As noted earlier in this chapter, square brick masonry has no headers and stretchers. As a consequence of this, and of the variable wall-width there is quite some variation in bonding patterns, revealing the craft and training of the builders. To create the offset required for bonding, halves and quarter bats are used at the edge and end of walls. Walls are between 0.5 and 8 bricks in width. For each width, a different bond pattern is required, and applied with skill at the *Dunnu*. For instance, whole brick width walls (1, 2, 3 etc.), every other course, two rows of halves must be used to create an offset. With walls of a size that already includes a half (1.5, 2.5), every course has one row of halves, but the location of the row switches to ensure the vertical bond. Occasionally, quarter bricks are found to be used at the end of a row of halves, or to fill up a hole in a corner bond. The wider the wall, the larger the range of possible solutions for brick bonding, and interestingly some variation in practice may be observed here. For instance, in some larger walls, rows of halves are sometimes found in the core of the wall, while in others, rows of halves are only used on the exterior face of walls. Unfortunately, as the bonding patterns of walls have not been documented systematically layer by layer, it is impossible to make more detailed observations or draw further conclusions.



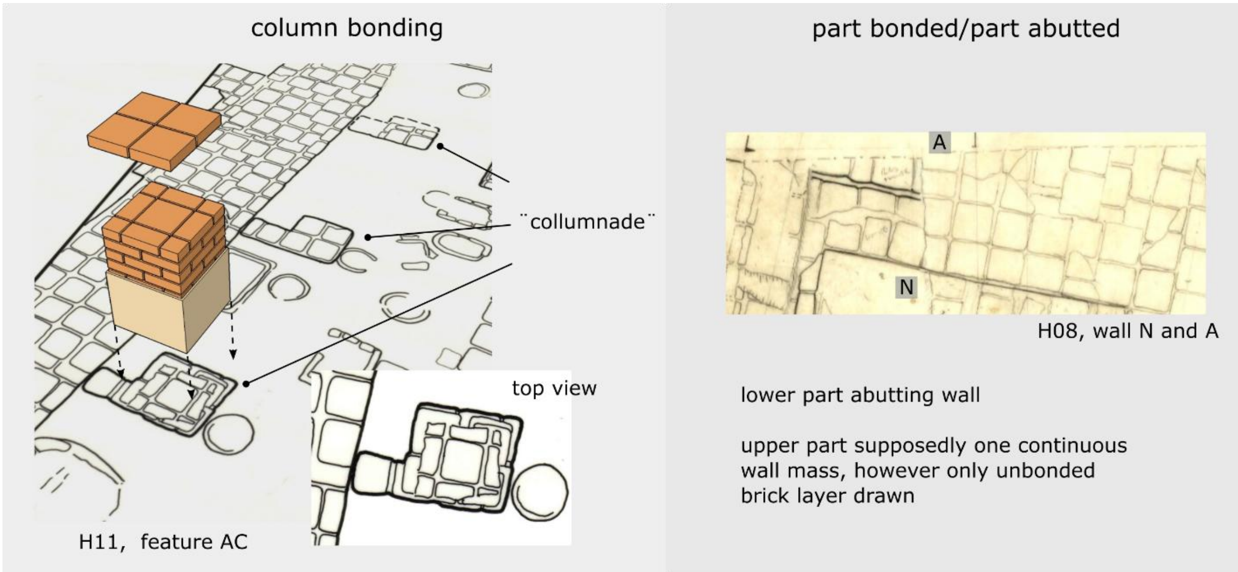


Figure 73. Brick bonding patterns documented in the Dunnu

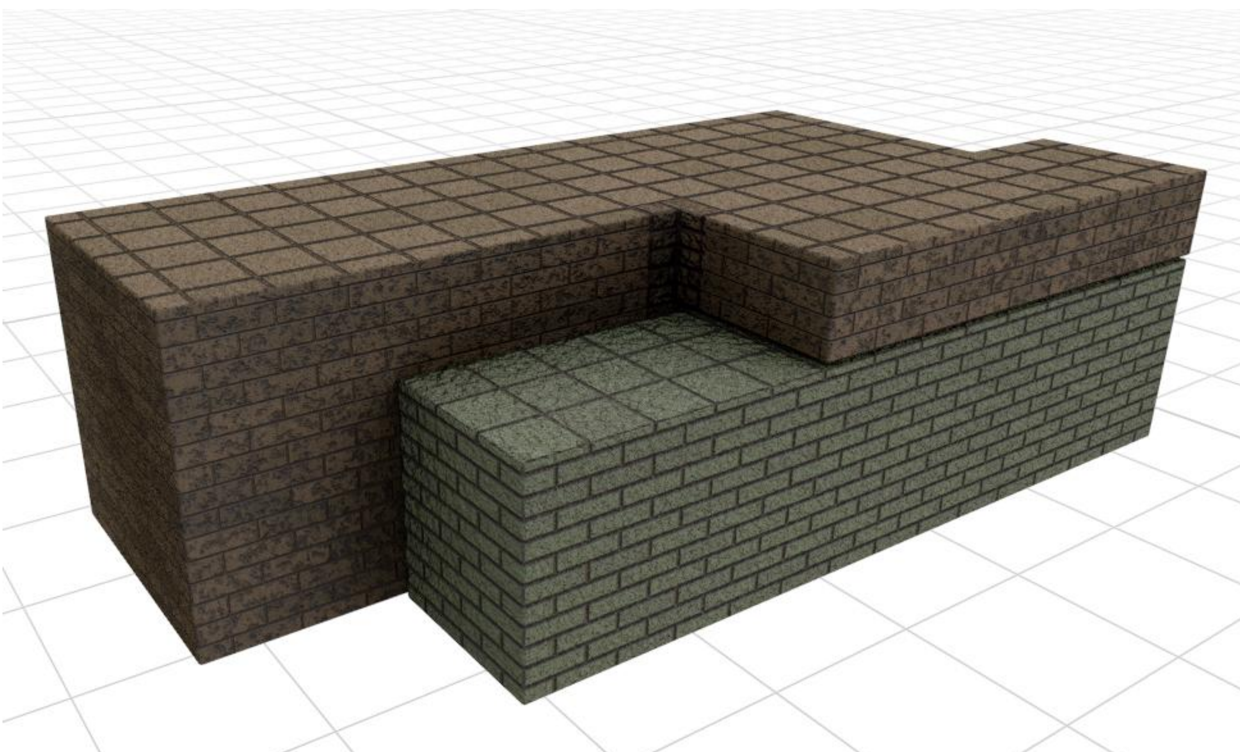


Figure 74. Example of a wall abutted in the lower section, while bonded higher up.

V.5.3.2 Brick variability within walls

As discussed above in the section on building materials (V.4.2 and V.4.3), mud bricks used in walls are not all the same. A large variability in terms of mud brick sizes has been noted (Figure 58). A large building like the tower applies mud bricks of a larger range in sizes than the residence, which is interesting and may be related to the different construction histories and functions of these buildings. Another source of variability is mud brick material, or loam source. It appears that different sections of wall of the tower were constructed using bricks made of slightly different loams. In one cross-section of the fortification wall, various layers of bricks with different material characteristics have been noted (Figure 75). The cause of this variability is uncertain: they could be either indicative of differences in construction phases but may also relate to building logistics. In the latter case, different batches of bricks from different sources have been applied in the building. Especially large structures such as the fortifications or the tower can be expected to have been built with a range of bricks sourced from different loams, and/or from brick production teams with different regional backgrounds. The difficulty in determining the cause of these observed patterns in masonry variability is an important source of uncertainty with regard to the reconstruction of building phases.

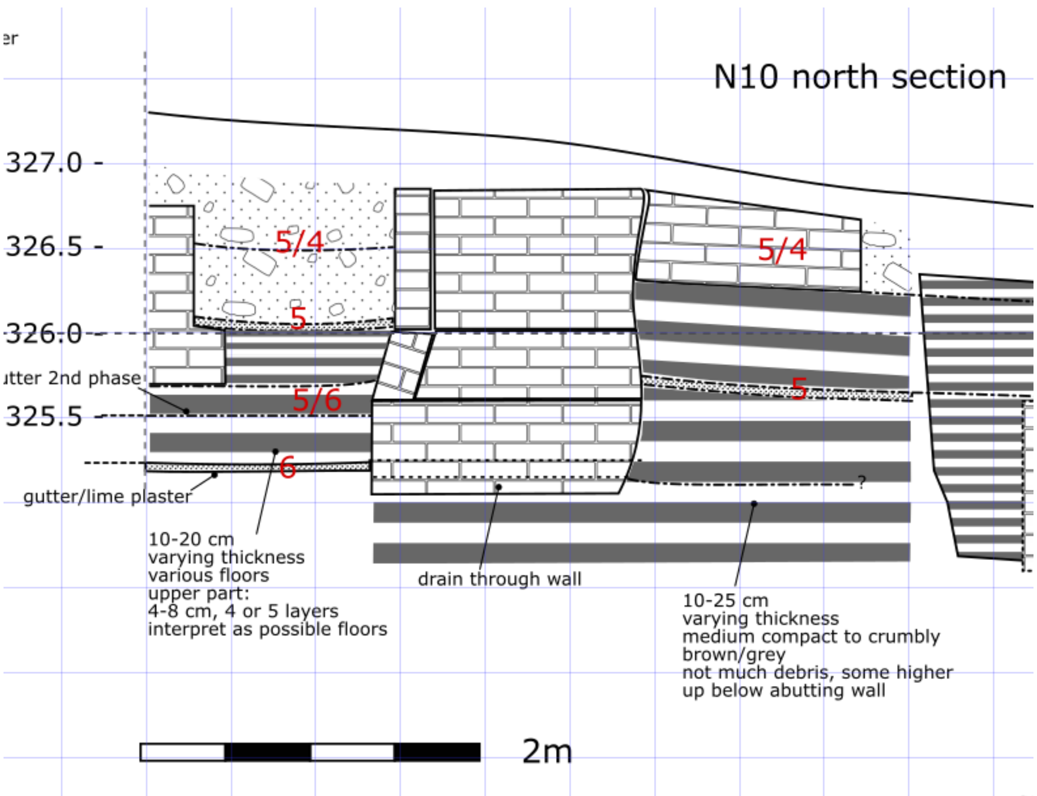


Figure 75. Deposit pattern graph of area around eastern fortification wall, square N10.

In another case, variations in brick material reflect deliberate choices in the patterned application of building material. The intermittent courses of red and brown bricks, as seen in the residence (Figure 59) and walls of the large courtyard (Figure 84) is clearly a constructional decision made by the builders. Although it is not completely clear what the function of this feature is, the pattern appears to be limited to the area of the *Dunnu* that was most strongly involved in the communication of political and social status. However, as the bricks themselves were not visible, and the pattern was too irregularly executed to have any decorative function, it was most likely related to a structural consideration. Possibly "wall quality", or the fact that these walls were to be plastered with red coloured loam plasters and renders played a role. The latter, somewhat speculative, hypothesis is suggested by the fact that only the lower, red plastered, part of the courtyard walls also had intermittent courses of red and brown bricks (Figure 84). But it could be that the red bricks provided better bonding surface for plasters. However, an alternative explanation for this material distinction is that the upper part of the wall belongs to a renovation phase during which this part of the *Dunnu* was partially demolished and build up again. But this also is not an unproblematic hypothesis (see V.6 Modification and repair).

V.5.3.3 Vertically narrowing walls

Builders may apply the principle of vertical width reduction in order to optimise space and structural functioning of a building. In such cases, the width of a wall decreases either gradually or incrementally with the height of the wall. This enhances wall stability, lessens wall weight, reduces the amount of building materials and increases space size on upper floors. The decrease of width often initiates at the second-floor level, and therefore rarely preserve archaeologically. Although the technique is often seen used in large structures such as fortifications and buildings with over two floors, it is uncertain whether this technique has been applied in the *Dunnu*, as wall height preservation is never sufficient.

At one location only could decreasing wall widths be identified. In space NE-3b, both the northern and southern wall have stepped interior faces (Figure 23, Figure 76). The northern wall, the interior face of the old fortification wall, is set back only once, while the southern wall has two shorter steps. The excavation documentation refers to these as 'wall phases', implying a near complete demolition and rebuilding of these walls. Although possible, it is stratigraphically and practically unlikely. An old, blocked doorway cuts both "steps" and since this blocking appears stratigraphically earlier than these supposed building phases[49], it would imply that a blocked doorway was rebuild during these renovation phases. There is in other words no justification to rebuild an unused doorway, implying these steps should be considered integral part of the original wall construction. An alternative option is that the wall was intentionally reduced in width without demolition and rebuilding, but simply by excavating it vertically to set it back some decimetres. The fact that these width reductions align with the floor levels in this room, may imply a correlation with such different kind of 'building' phases. Trying to find the logic behind such choices, it is possible that the northern wall of this space, which also is the old fortification wall, could be reduced in width as its defensive

[49] Assuming the rebuilding phases are associated with the higher floor levels.

function had been lost. This reduction of wall width, allowed for some increase of floor surface of the room inside. Whether the minor reductions in width seen in the southern wall can have the same reasoning applied to them is however questionable. The possibility that we are dealing with exposed and damaged wall surfaces, difficult to recognize in excavation may also play a role in the creation of this pattern.

Summarising, the evidence for a building method in which wall width reduces with the increasing height of the wall, is limited.

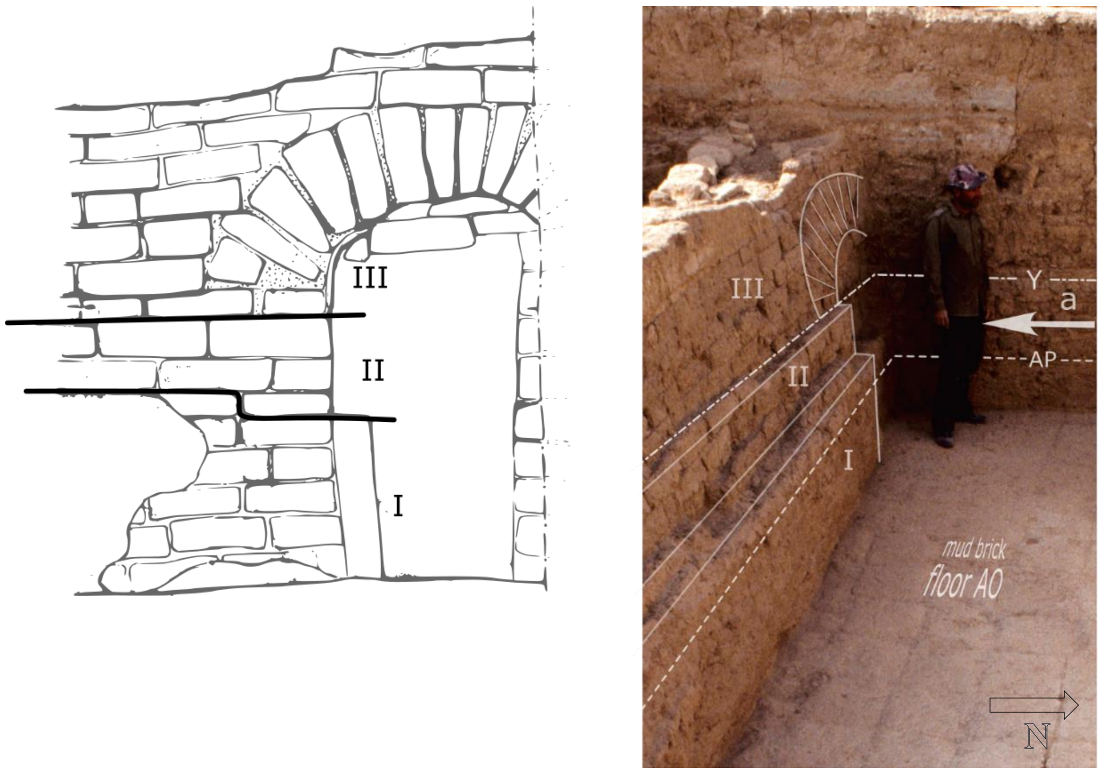


Figure 76. Doorway AJ and wall I, in space NE-3b in M09 with layers of offsetting brickwork.

V.5.3.4 Corners and T-junctions

At the meeting of two load bearing walls in a corner, a corner bond is needed. In a few cases with larger buildings, interior walls are also bonded to the exterior walls at T-junctions. Bonding at corners and T-junctions is often applied only every other brick layer. This makes using the plan drawings for establishing the presence of a bond unreliable, since generally only the visible course is documented. Although wall relationships are required to be filled in on the feature forms, this has not always been done. There are also possible cases where unique bonding patterns are overlooked by excavators unfamiliar with the potential variability of mud brick building techniques. An example is the way the long interior walls of the residence are bonded to the exterior walls (Figure 78, Figure 79). These are load bearing walls, and one would thus expect solid T-bonding with the northern and southern exterior walls. However, bonding is attained using just one brick every course. This brick may switch locations within the course, or stay in the same place (Figure 79). The use of a single brick as bonding brick makes it difficult to recognize bonding when looked at the wall interface from the side, which gives the wrong impression that the wall is abutted (Figure 78).

Figure 77. Wall relationships found in the Dunnu

Figure 78. Abutted or bonded? All documentation of the connection of these walls suggests they were abutted. The top was disturbed by a grave, and the other side was not investigated with the same rigour. The mirroring set of walls across the central room however suggest that bonding was done by just one brick on one side of the wall (Figure 79).

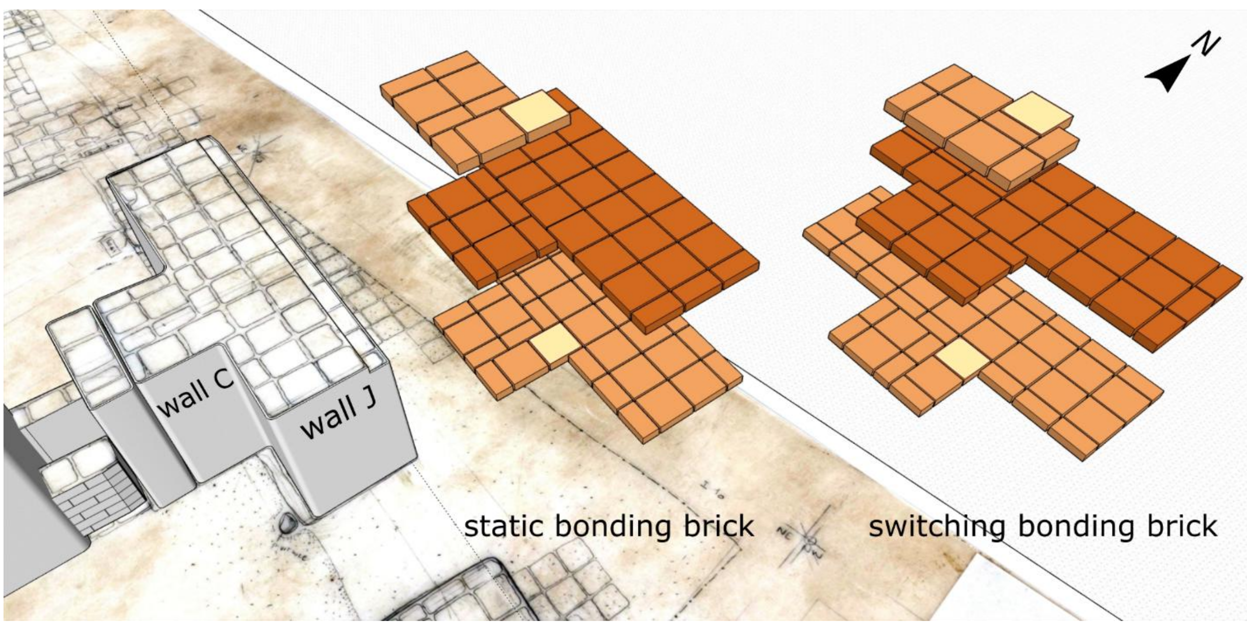


Figure 79. Hypothetical reconstruction of the T-junction bonding of walls C and J of the residence, suggesting two alternative patterns. In the first hypothesis a static bonding brick is used, e.g. the bonding brick returns on the same location every other course. In the alternative hypothesis, a switching bonding brick is applied, which switches between two locations. In the above examples the bonding brick returns every other course, while it is equally possible that each course had a bonding brick.

Not all T-junctions are bonded. Although such "abutments" are in the archaeological field documentation generally interpreted as reflection of a chronological difference between two walls. However, the real reason for walls not to be bonded is probably structural: these walls did not need to be structurally reinforced. This may often indeed be the case with walls that have been put in later to quickly partition a space for instance. However, the internal partition walls of the residence, build at the same time as its exterior walls, are also not bonded to the main structure. Their sole function was the subdivision of and probably played no role in carrying the roof structure. There are other walls in the *Dunnu* however, that appear to be unbonded T-junctions, while some of them appear to have carried a roof after all. In all cases this involves lighter architecture. There are some abutting T-junctions of walls constructed in the open space west of the residence (NW-1a), in between the heavy fortification walls and the residence. The row of lighter structures in the south, constructed against a heavier building that was integrated with the fortifications, also appear to be abutted T-junctions (Figure 80). It is interesting, as this must be viewed as a structural weakness, especially for the covered structures. The structural bonds have unfortunately not been explicitly confirmed in the wall documentation forms, but can only be derived from the plan drawings, which is an unreliable source. However, even if an abutment is certain, it is theoretically possible that these walls were abutted at their lower courses, while bonded higher up at a level that has not been preserved.

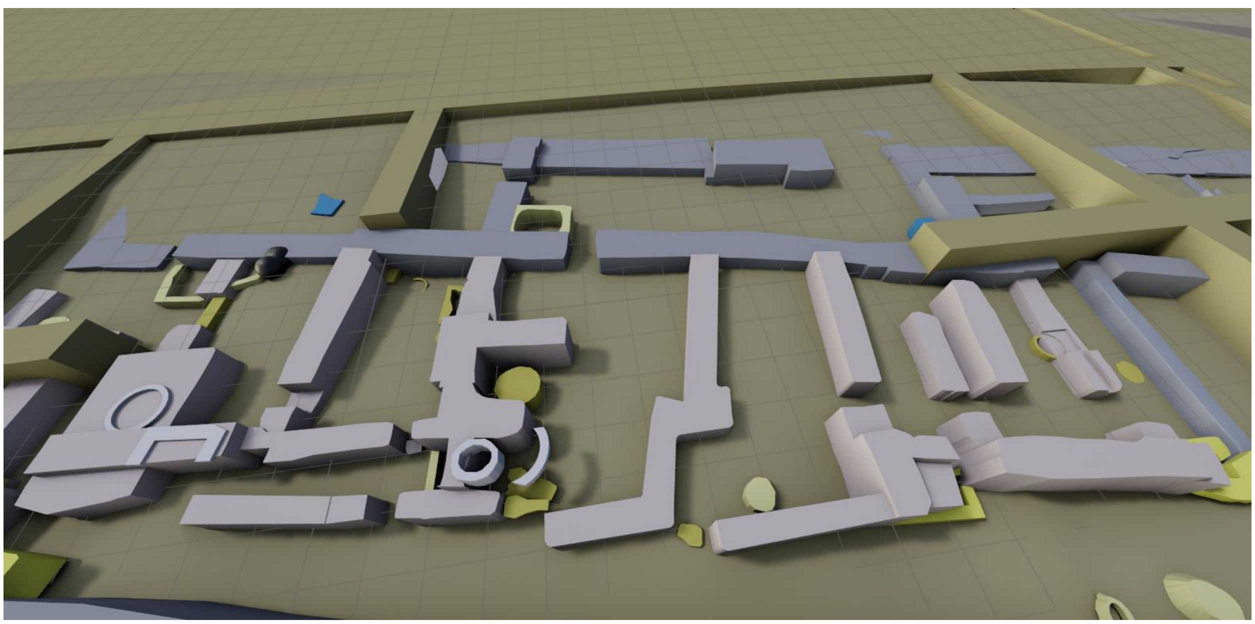


Figure 80. Series of T-junctions that are probably abutting in the southern Dunnu.

V.5.3.5 (Roof) load bearing walls and non-load bearing walls

Load bearing walls are walls that carry the weight of the structure including roof loads and upper floors. Often, the exterior walls of a structure are its load bearing walls, while the interior partition walls are not. The main load that the mud brick buildings of Tell Sabi Abyad had to carry is heavy roof deck made out of timber and loam. As we are dealing with flat terrace roofs, most these forces are directed downwards, rather than laterally as is the case with pitched roof and vaulted constructions. Nonetheless, locally, other vectors act on the top of the walls as a result of bending the roof beams, classified as edge pressure. The differences in structural function are often reflected by differences in wall width. In buildings in the *Dunnu*, roof bearing exterior walls are constructed wider than interior partition walls, or non-roof bearing walls such as the short sides of buildings or rooms. This shows that the builders of the *Dunnu* were well aware of these, and used this knowledge to optimally economise the use of building materials. To secure the construction, load bearing walls are always fixed by means of corner bonding to other load bearing or non-load bearing exterior walls. Interior walls not bonded to the main structure may be classified as non-load bearing partition walls, although technically their presence may also be used as intermediate support of roof beams. In the example of the residence, the main roof structure was probably carried by the long walls. The interior long walls are therefore both wide, and bonded to the exterior walls of the building. The interior partition walls on the other hand, used to create separate rooms, were not all bonded to the main structure, which implies they did not play an important structural role in carrying the roof.

V.5.3.6 Abutment

There are two general types of wall abutment: parallel and perpendicular. Parallel abutting walls are constructed along the length of an existing wall. Perpendicular abutting walls are T-junctions, and have been discussed above at V.5.3.3. Parallel abutments generally indicate a structural separation between two buildings, constructed in sequence. Some other parallel abutments may have served to reinforce an existing building. With regards to the former, there are several of them documented in the *Dunnu* (Figure 81). Examples are the two long and narrow structures identified as staircases (spaces SE-6 and NE-5), which possess long walls entirely abutted to the exterior of the fortification wall. Others are the residence's eastern exterior long wall, and the long walls of the building appended to the north (NE-2). The constructional pattern these walls share is that they are thinner than the other exterior walls of the same structure. This indicates that the builders took the presence heavy architecture into account and adjusted the width of the abutting walls of new buildings accordingly. Although these walls had to carry the same vertical load as their sibling walls in the same structure, the additional support they received ensured they did not require the same width needed for wall stability as freestanding walls. This building practice reflects the rational and economising choices of the builder.

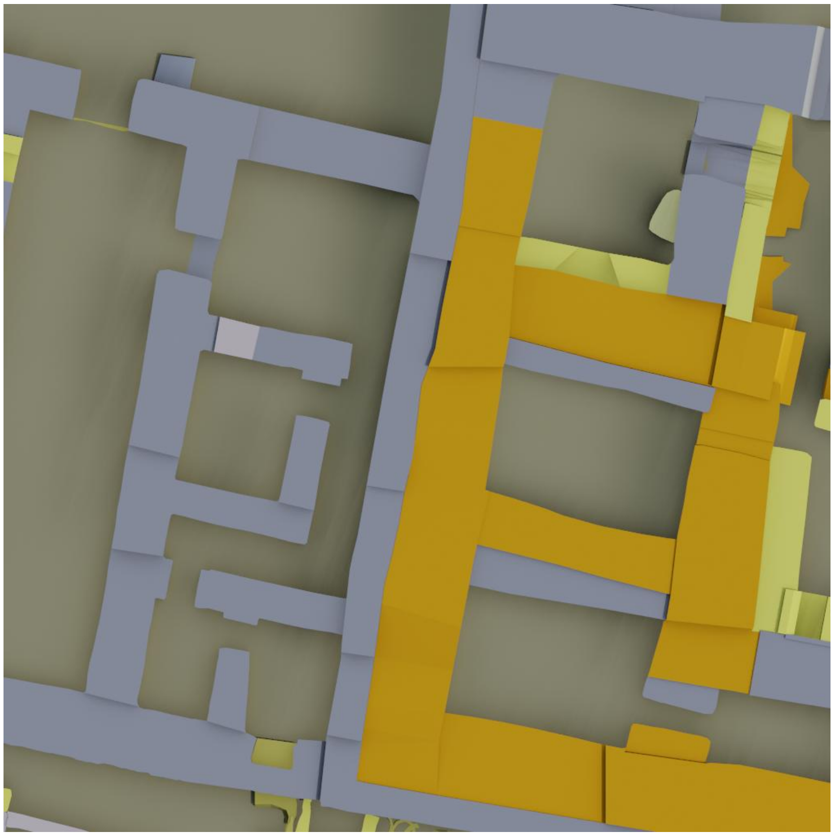


Figure 81. Examples of parallel abutments in the Dunnu. In the middle the long parallel abutment that structurally separates the two central buildings. On the right some parallel abutments on interior spaces in the tower. Orange = level 7, blue and yellow = levels 6/5.

Other parallel abutments may have served to reinforce an existing wall or building. These are mostly found in and around the tower. Other locations are at several segments of fortification wall, and in the elongated space behind the postern gate (SE-2d). In case of the tower, the entire building is uniformly reinforced both on the interior and exterior, which seems to indicate a large structural modification, such as the addition of a floor on top. Examples from ethnoarchitectural case studies support this interpretation (see Figure 19 and VI.5.2). In the excavation documentation and various publications, it has been suggested that these modifications to the tower reflect a renovation in response to the dilapidated state of the building. However, with walls already this thick and heavy, the question is what kind of structural support such a thin encasement would offer. A renovation of a dilapidated building would have more likely looked like wall surface reconstruction with floor and roof replacement, and possibly localised structural support by means of buttressing, rather than a structural reinforcement in all sections of the building, interior and exterior. If the building would have showed signs of sagging or leaning, buttressing it with strategically placed buttresses are the preferred solution. In the case of space SE-2d, and room 5 of the tower, the construction of an abutment may even indicate the roofing of a previously unroofed space. If true, these are good examples of archaeological traces on ground level that tell something about the building on higher levels.

V.5.3.7 Buttresses

Both buttresses and abutments are forms of structural wall reinforcement that may be part of original construction or added later during works aiming at repair or building modification. Buttresses are structural reinforcements perpendicular to the wall. They may be part of the original construction to support long and slender walls, or constructed later as a preservation measure to prop up tilting or bulging walls. In the *Dunnu* such structures are rare, only found as part of the structural reinforcement of the main gates, and next to the front gate of the tower (Figure 82). It is uncertain whether this latter buttress indicates a late fix to a structural issue, or was part of a structural reinforcement plan related to the addition of height to this building. In the excavation documentation, features are frequently named buttress, but these are misnomers. Features classified as buttress in the archaeological documentation are in reality short walls, and part of door jambs.

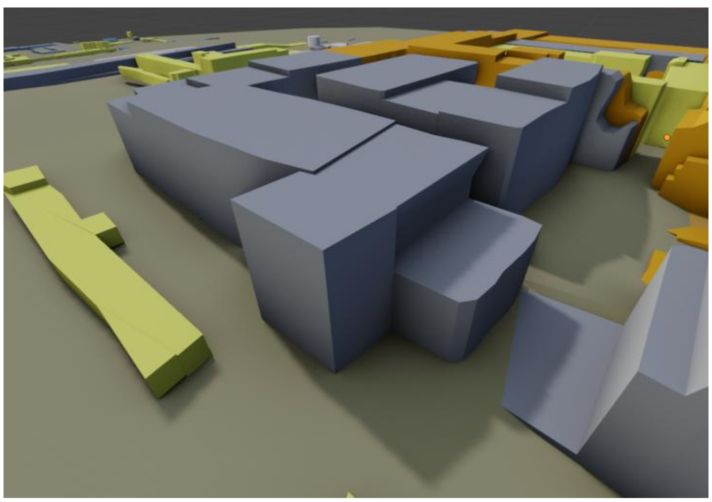


Figure 82. Buttress at the front gate of the tower.

V.5.3.8 Layered or complex construction

In some cases of wall construction in the *Dunnu*, a type of constructional layering has been documented (Figure 85-Figure 88). These are characterised by transitions of brick material or bonding type within the same wall, or blocks of multiple, separate walls joined in construction. These wall complexes are remarkable as they appear to have been constructed as separate abutments near the base, but are integrated as bonded structures higher up. This raises questions regarding their manner of construction, their function, and the temporal relations of these walls.

Figure 83. Areas with layered or complex wall construction discussed in the text.

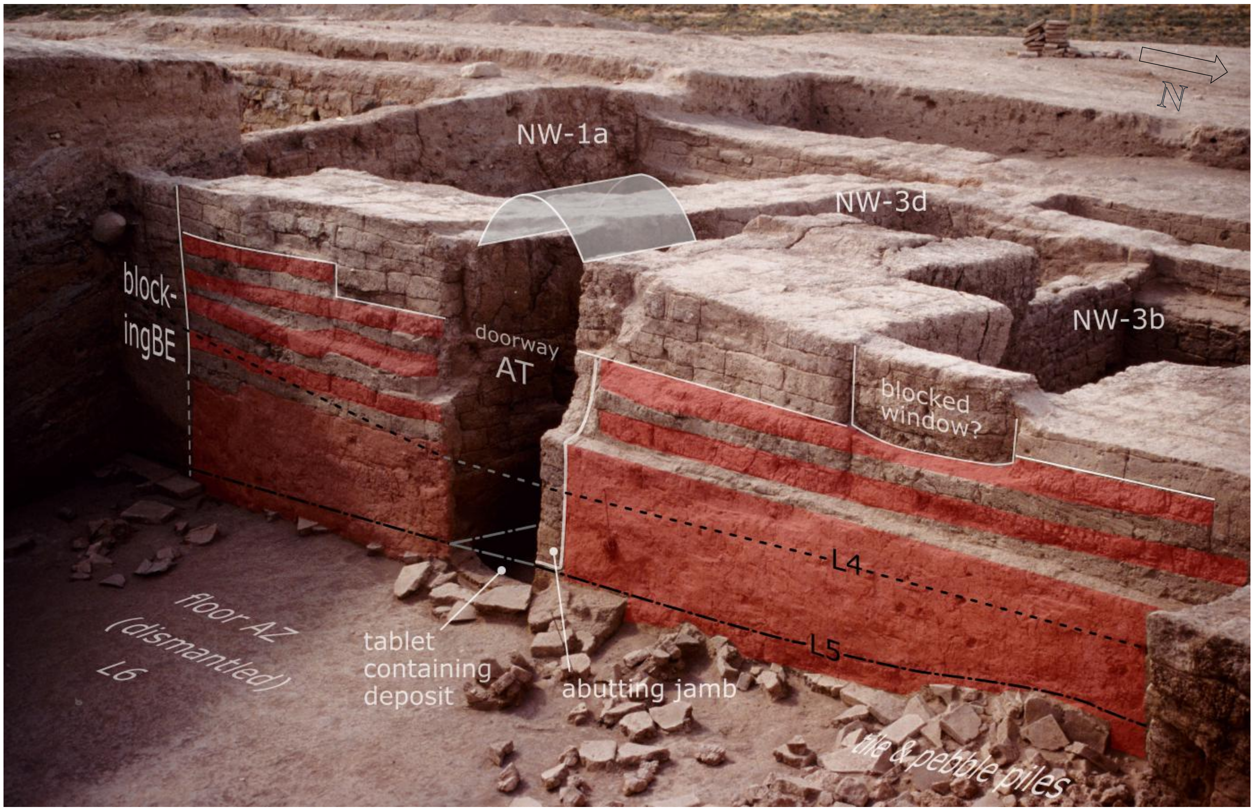


Figure 84. Western wall of large courtyard, NW space 2a, viewing southwest. White lines indicate distinct sections of brickwork. Lines and colouring based on field sketches and day note descriptions of square I08. The red plaster was pigmented, the red bricks are made of reddish soil.

The cases of layered construction complexes are part of or near to the fortifications, which suggests a relation with fortification building practices. The cases will be discussed here in more detail. The first case is found in the north-western corner of the *Dunnu*. The corner appears to have a layered wall construction. This is noticeable on the western wall of the large courtyard, which is constructed with characteristic layers of red and brown bricks in the lower part, but with uniform brown bricks above (Figure 84). But also elsewhere a layering in construction in noticeable, which is not distinguished on the basis of brick material, but on the basis of a difference between abutted and bonded construction (Figure 85-Figure 87). This also includes the massive block of brickwork north of spaces NW-3a and NW-3b, which is unusual both in form and weight. In general, the entire corner is constructed in a way that near the base of walls, these are separate, abutted constructions, but higher up, the entire structure is joined by wall bonding. The obvious interpretation as to the cause of this pattern of horizontal and vertical complexity is phasing, but some observations may give some cause for doubt. In the case that phasing caused the layered wall construction, the consequence is that at some point in time, the walls in this area were taken down to just about 1 to 1.5 meter above founding level, and rebuilt afterwards, integrating previously abutted walls. Considering the size and height of these walls, being part of the fortifications, this was a considerable effort for which the justification is so far unclear. Theoretically, modifications to the spatial structure are a valid reason for demolition and rebuilding, but nothing was changed to the spatial structure of the cluster of rooms NW-3. Nor were any modifications made to the support structure, which could potentially imply changes to the higher building levels. Of course, the construction of the large block of wall north of NW-3 could have somehow structurally justified the demolition of bordering architecture. However, this block is not well understood in terms of stratigraphic belonging[50] and architectural function, which makes any hypothesis based on it problematic. There is another explanation possible for the observed layered pattern, which relates to the logistics of construction and building planning. Construction of the fortification wall may have started a little earlier than the internal structures of NW-3. Only after construction at the internal structures had caught up with the level of the fortifications, the wall bonds were created and continued to be bricked up as joined structures. Starting construction with the fortifications, then adding internal structures while the fortifications are still under construction, finds its parallel in the sequencing of construction works at Garšana (Heimpel, 2009).

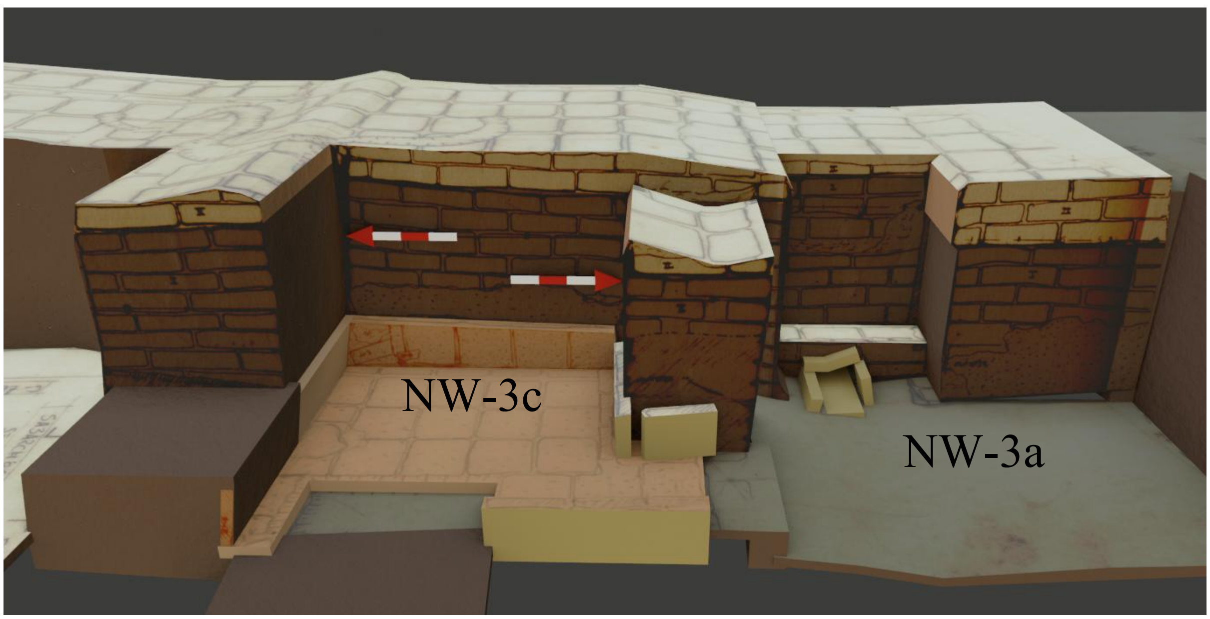


Figure 85. Walls of spaces NW-3c and NW-3a. Lower part abutting against, higher part bonded to fortification wall. Arrows indicating abutting joint lines.

[50] From the archaeological documentation it appears joined with the western fortification wall, but in the plan phase drawings produced by the project was built over an older phase of the fortification wall.

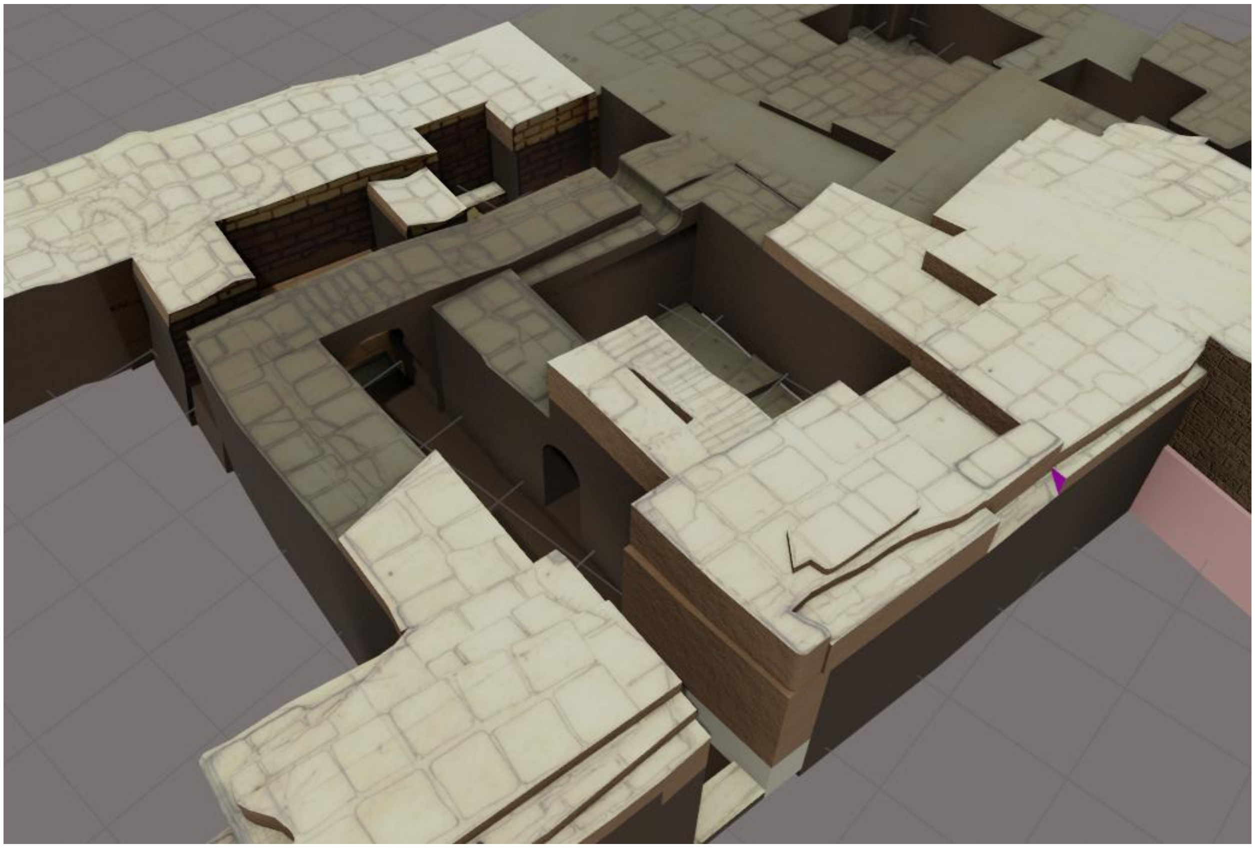


Figure 86. Layered differences in masonry material and structural characteristics, indicative of either a renovation phase, or logistics of construction. North-western corner, building NW-3.

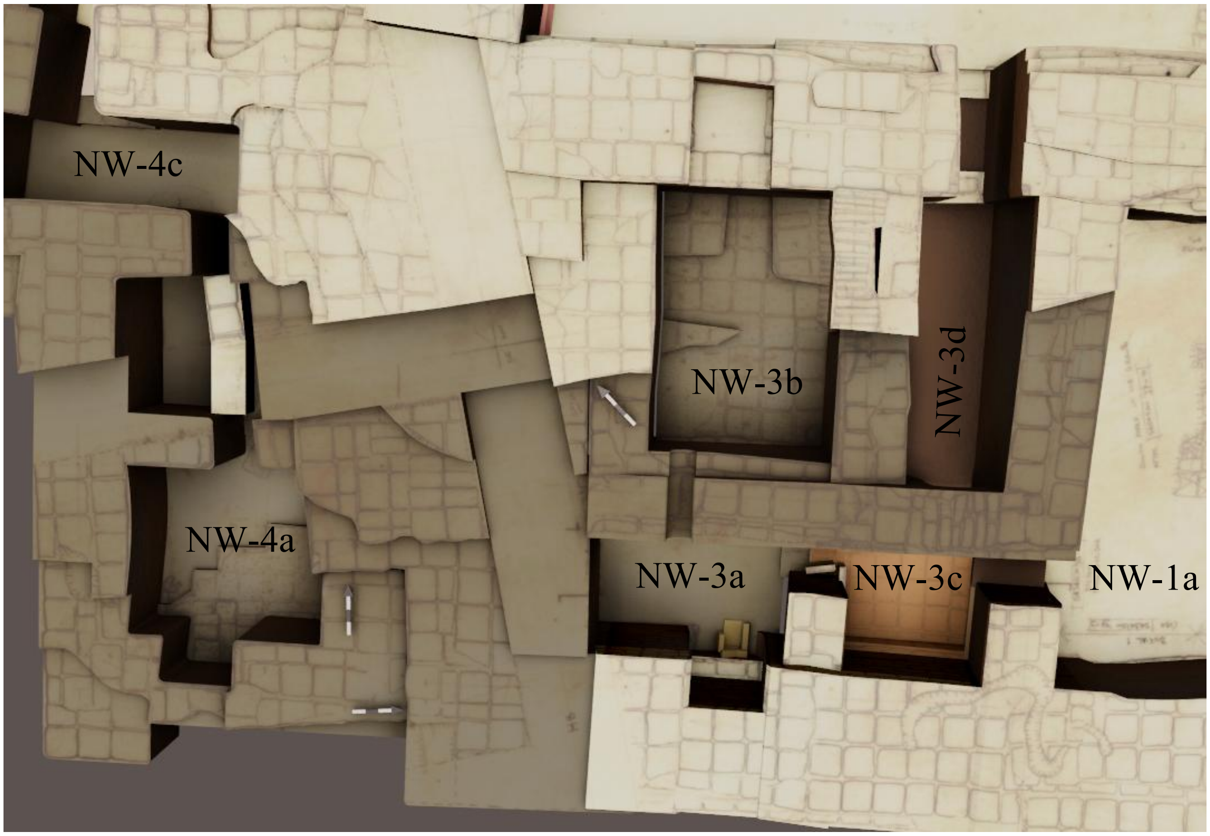


Figure 87. 3D plan of north-western corner of Dunnu, characterised by a massive masonry block. Below a certain level, walls are abutting, while in higher segments, they are bonded. This corresponds to the height of the renovation of the western wall of the main courtyard (Figure 84). Arrows point at abutting seam lines.

Another case of complex and layered wall construction is found in the central northern part of the *Dunnu*, where the new northern fortification wall is built against a double-roomed building (NE-2a/2b) (Figure 88-Figure 89). The two walls are abutting, but the top layer that was preserved for just one or two brick layers, clearly shows that higher up, the walls are joined into one. The cross-section through these walls, indicates that these walls are indeed of a different construction phase (Figure 89). Therefore, the bonding must have been created at a later stage. The section does in fact indicate the fortification wall was constructed before the two-roomed building (possible surface levels indicated on Figure 89). As seen on the section, there was an earlier wall underneath that building (roman numeral I), that is contemporary with other fragments of older thick walls and possibly mud brick surfaces found in the direct vicinity. These remains may have been part of the original fortification system, a hypothesis discussed in more detail later.

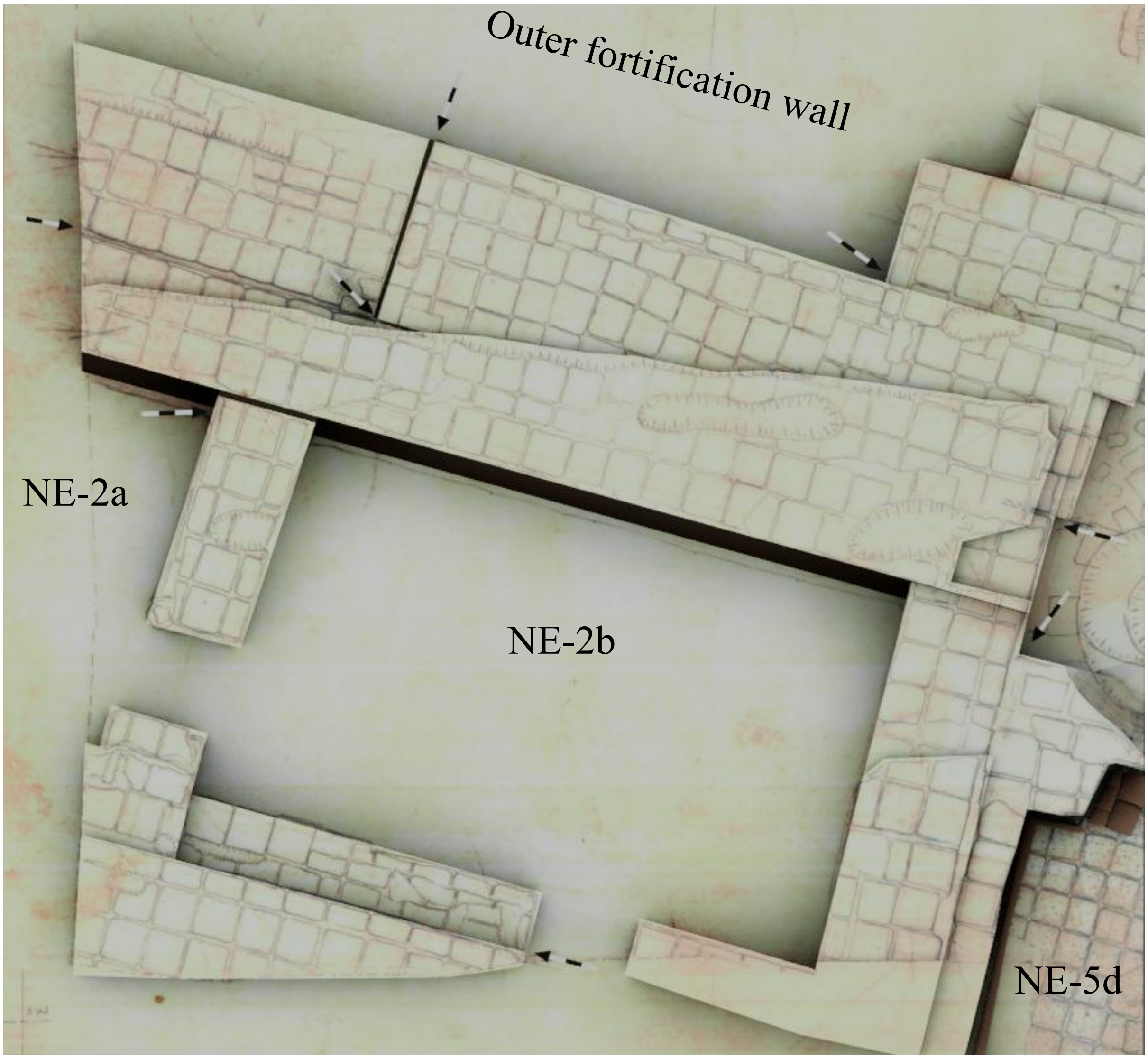


Figure 88. Plan of building NE-2 and northern fortification wall. The arrows point at confirmed abutments. The upper courses of the building and the fortification wall are bonded, while the lower courses are abutting. There is no evidence that this was also the case with the building's south wall. See also Figure 89.

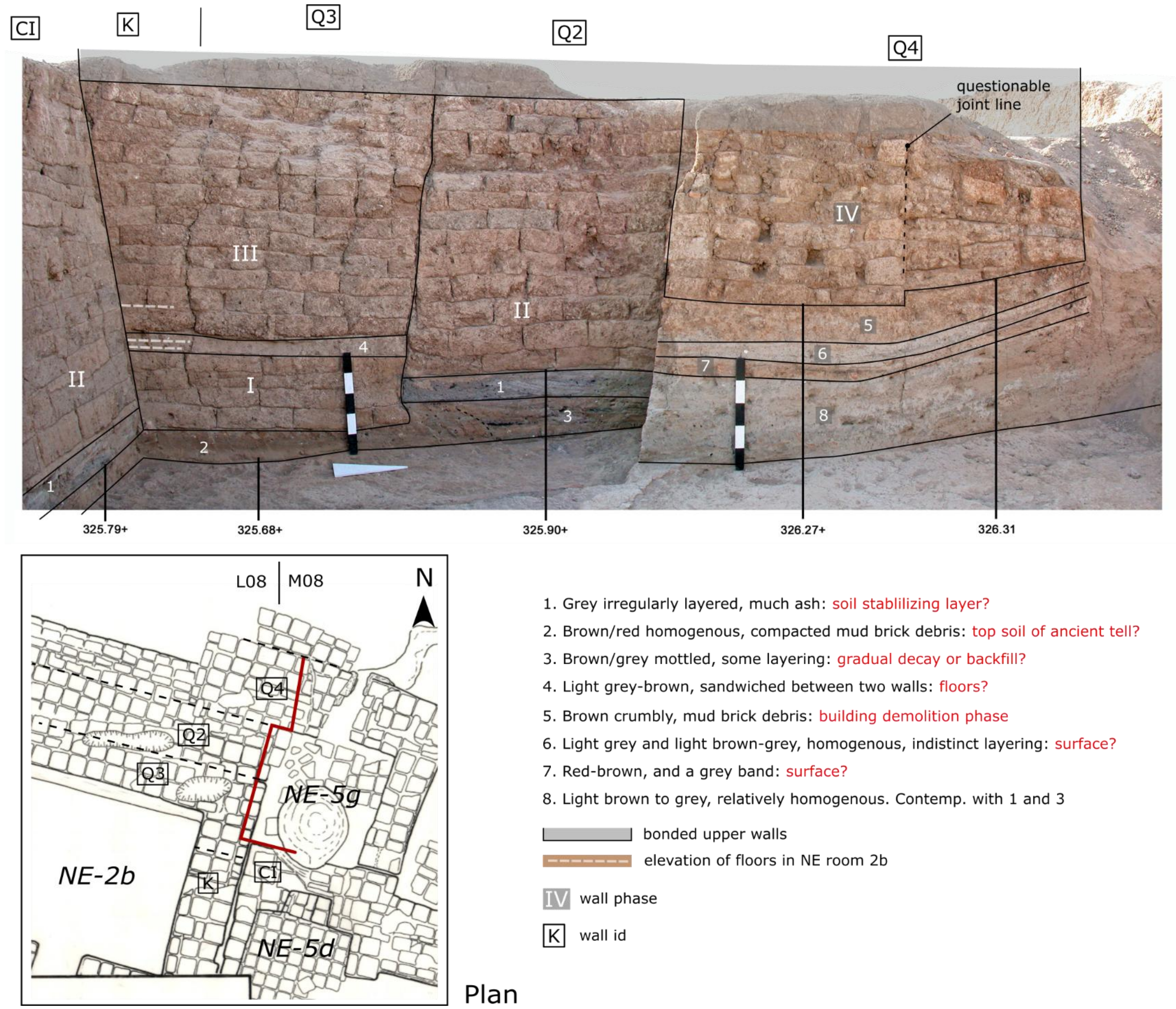


Figure 89. Cross-section of a sequence of walls that are separate walls at the bottom, but appear to be joined into a bonded structure in the upper courses. See also Figure 88.

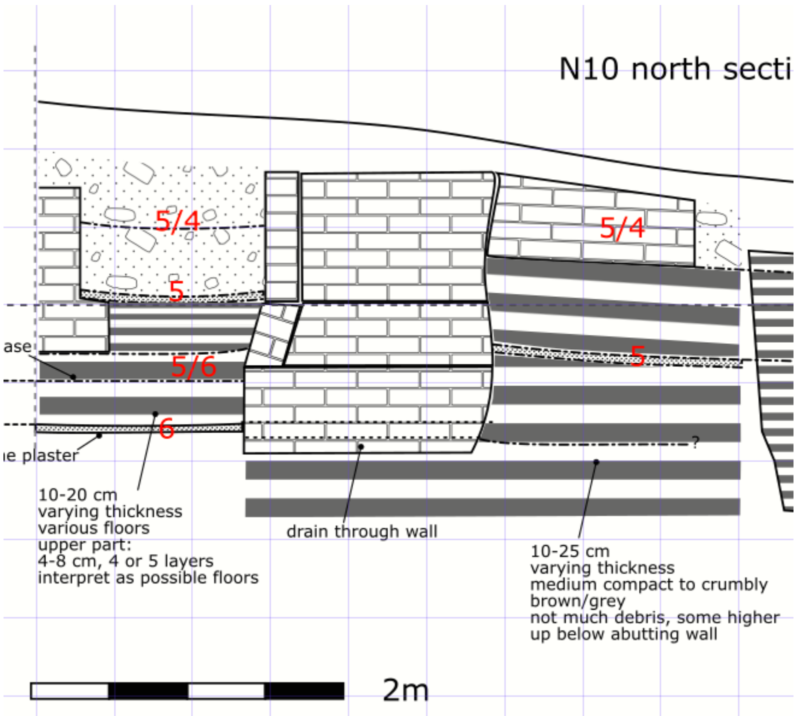


Figure 90. Deposit sequence graph of section through eastern fortification wall in N10. Black lines demarcate layers or columns of mud bricks with similar compactness.

Additional cases of complex layering and transitions in brickwork are found in the eastern fortification wall in M12 and N10. In a section of the fortification seen in square N10 (Figure 90) there are multiple horizontal and vertical layers of brickwork distinguished based on colour, consistency, and bonding. Again, the question may be posed whether this indicates rebuilding phases, or simply different batches of bricks used in the construction of the fortification wall. The latter seems the more obvious, but it cannot be proven with certainty. In a section of fortification wall in M12 (Figure 91) these are just two brick layers of different consistency and colour, but an apparent cutoff levelling of the lower bricklayer does seem to indicate a rebuilding. Interestingly, the space using this wall also has a rebuilding phase in the wall on its opposite side (Figure 92-Figure 93). The space itself contained a significant amount of mud brick rubble, top surface levelled, implying that indeed at this case, it appears that a larger renovation had taken place. During this renovation, the fortification wall may have been demolished and rebuild. As a new elongated space on the exterior of the fortification wall was also constructed, which has here been plausible identified as a stairway. The demolition and rebuilding also appears to be related to increased access restriction of the area. The spatial structure and access pattern of the architecture was modified significantly (VI.12), justifying the thoroughness of the demolition and rebuilding activities.

Figure 91. Two noticeably different brick layers in the eastern fortification wall on top of each other. Based on the excavation notes and photos it is unclear whether bin AE abuts both wall layers, or just the lower one. There is no evidence for a floor associated with the level of the joint line, although one has been postulated by the excavators.

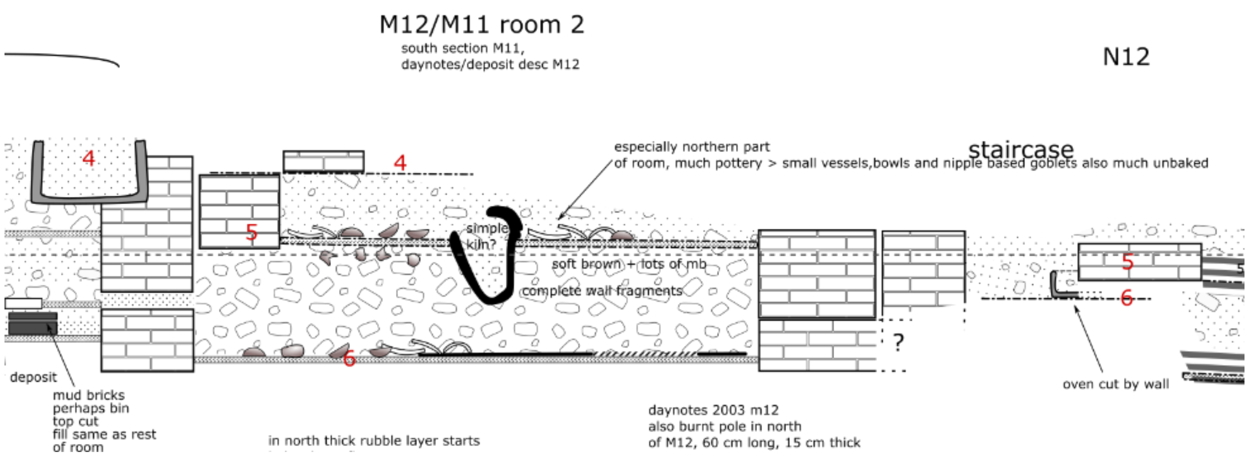


Figure 92. Deposit pattern diagram of buildings in L12 and M12, in the SE sector. The construction phases are separated by rubble deposits. On the right the layered construction of the fortification wall, illustrated on Figure 91. On the left the apparently mirroring pattern on the other side of the space, also shown on Figure 93.

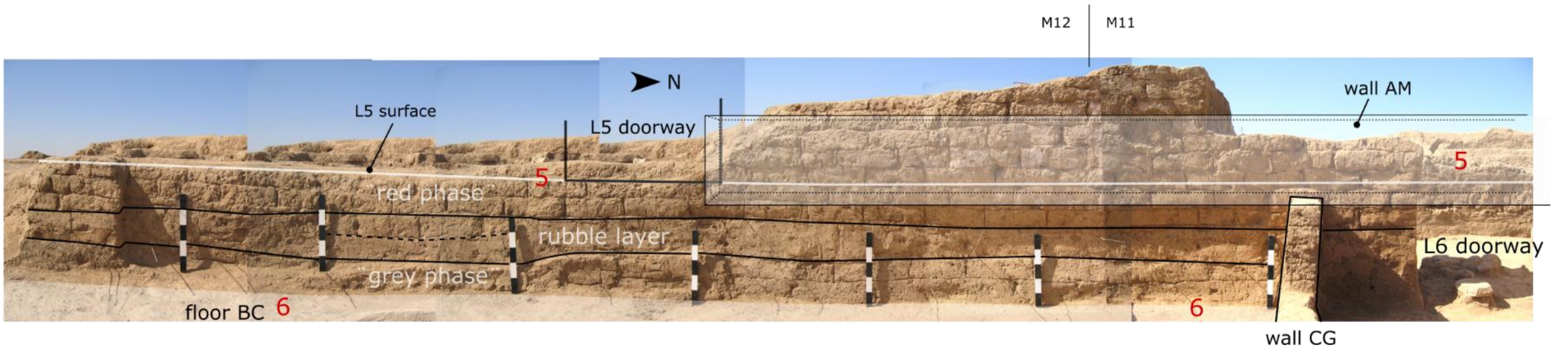


Figure 93. Wall B/C in M12/M11, showing the same dual-phase construction separated by a rubble layer.

V.5.3.9 Wall finishing

Most walls were finished with a layer of loam render (interior faces) or plaster (exterior faces). The exact compositions and way of application has not been investigated in detail during excavation. Some additional details are available, but a systematic analysis is not possible. A lot of walls in the western part of the *Dunnu*, including the fortification wall near the main gates and the front walls of the residence were plastered with a calciferous material (Figure 62). Since no chemical analysis was performed, it cannot be established whether it was lime or gypsum based, although lime has been assumed by the excavators. The main court was finished with a plaster mixed with a red pigment. In this area, an underlayer with grooves was used, probably to improve attachment of the final outer layer. An underlayer with a dotted pattern probably created by inserting a stick in the wet plaster was found in a single room in the residence. The size and depth of these holes make them less useful for plaster adhesion (they would take up a significant amount of material), so it seems that something else was fixed to the wall here. The hypothesis that their use was decorative seems unlikely since no apparent effort was made to create a coherent pattern with the holes.

Figure 94. Grooved loam plaster, most likely a base layer for the application of a fine red pigmented plaster.

V.5.4 Vaults & arches

The excavated remains of the Assyrian *Dunnu* bears evidence of six arched doorways, one window-like opening, the remains of a vaulted corridor and one vaulted staircase. The difference between 'arch' and 'vault' is arbitrary here since these constructions above doorways are in fact all short vaults. None of the arched doorways is constructed as a single arch and the method of construction does not differ from the longer vaults.

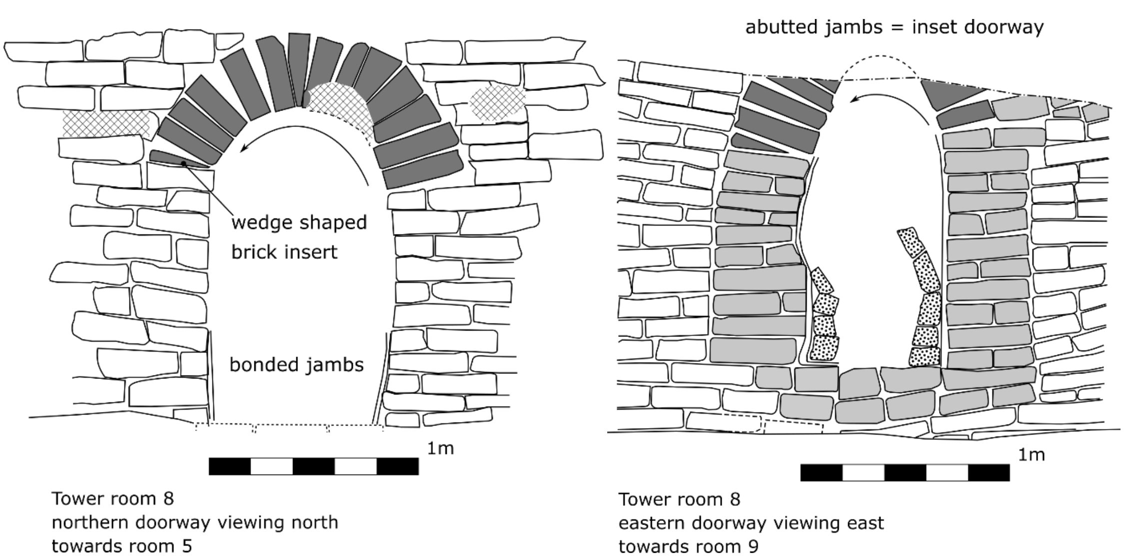


Figure 95. Two vaulted doorways in the tower. The one on the left with bonded jambs is part of the original wall construction, while the one on the right with the abutting jambs is probably a later modification.

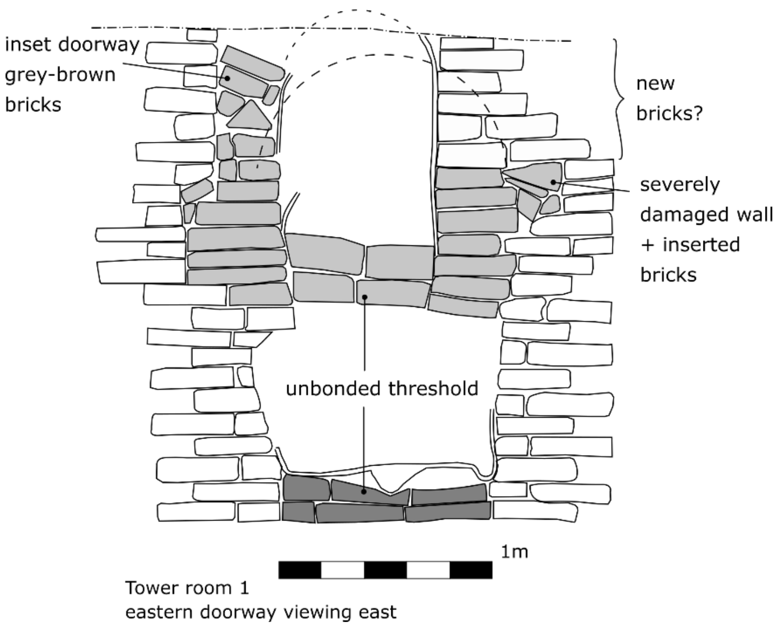


Figure 96. Younger smaller doorway set in older larger doorway.

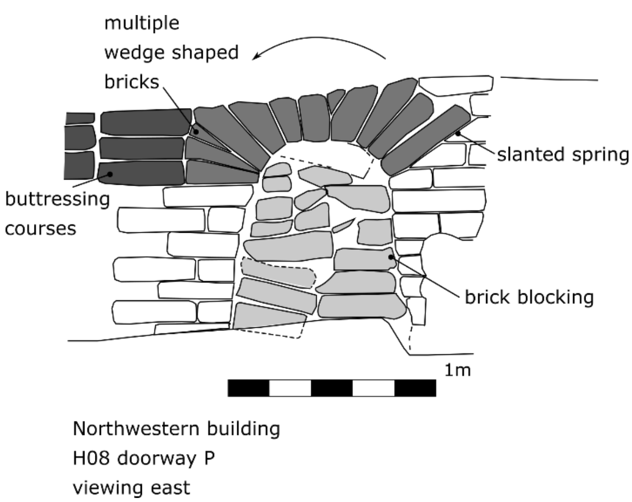


Figure 97. Vaulted doorway in building NW-3, showing a more elaborate construction practice as regards to the use of multiple wedge-shaped bricks, and a slanted spring base on one side.

All vaults are small radial vaults with the bricks laid in a running bond. The bonding pattern depends on the length of the vault, and it appears that bricks especially produced for vaulting have been used. Bricks with a length of 1/1, ½ or 1/3 of the base unit have been observed. The 1/3 base unit is not seen in regular wall construction. Typical of most of these vaults is the use of a single wedge-shaped brick on one side on the spring of the vault. It is unclear what this means in terms of construction: if these wedge-shaped bricks were inserted from the exterior to fill up a gap, the vaults were constructed before the wall that covered them. It also seems to indicate a directionality in the construction as only one side of the arch contains wedge shaped bricks. Perhaps the vaults were constructed starting from one side, and ending on the other, rather than starting on both sides and meeting in the middle. This is only possible if there is enough support during construction, such as a rubble fill that was removed later. Indeed, from a construction historical point of view, this is the most likely (Van Beek, 1987).

The vault of the doorway of building NW-3 diverges significantly from the others in construction manner (Figure 97). There is no special structural need for using this different method, so it seems that here we see the hand of a builder that learnt the trade from a different tradition. The possible chronological differentiation between this building and the tower, which would also imply a different builder being responsible, underscores this observation.

Figure 98. Remains of vault of corridor space NW-3d, "Tammitte's office". On the left the part that covered the doorway, which was lower thus better preserved. It applies wholes and 1/3-size bricks. The row of mud bricks placed on their side in the room directly to the north, may also indicate the pitched brick vaulting technique was used.

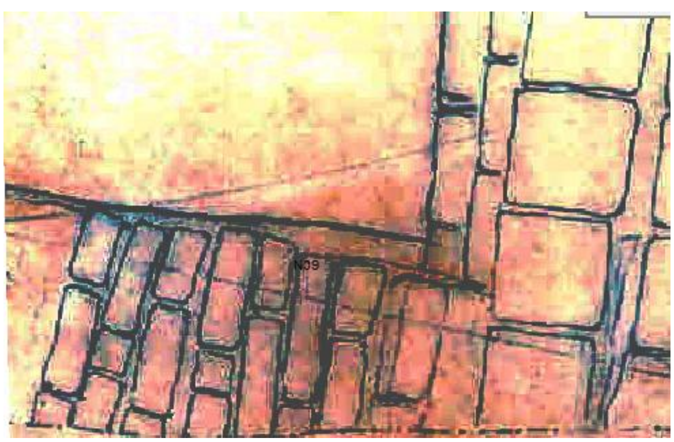


Figure 99. Vault above doorway of space NE-7. A running bond using, whole, 1/3-size and 2/3-size bricks.

Two vaults are found used for larger structures. One was found in the staircase in the north-western corner of the tower (Figure 100). This staircase is characterised by a massive central spill wall, which prime function was to resist and transfer the cumulative weight of the vaulted steps. Various parallels can be found for such staircases (see below). The vault itself was probably a stepped construction, not much unlike that the great temple at Tell al Rimah. Only a small part of the vault was recovered and documented. With the running bond applied, it would be interesting to know how they solved the problem of connecting the individual segments of the vault.

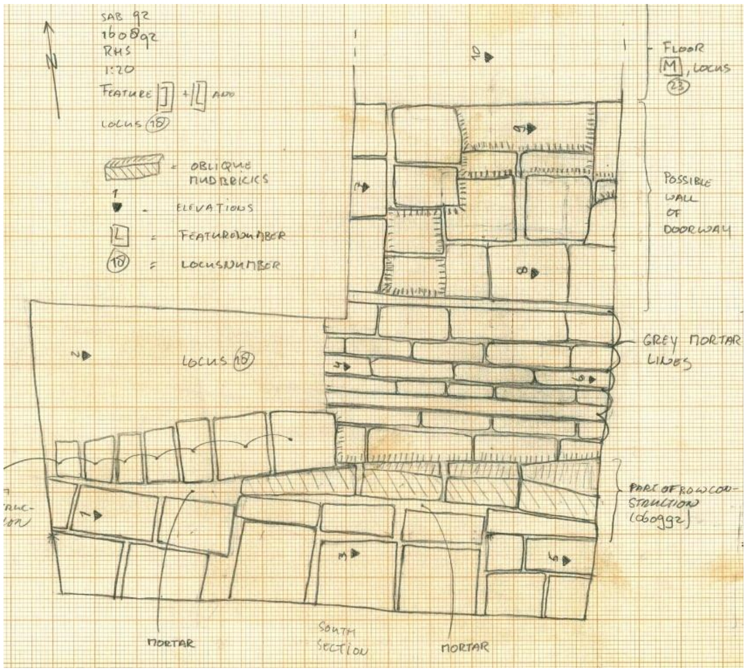


Figure 100. Sketch of the top view of the vault of the staircase in the tower, space tower 3.

A last place where a vault has been found is covering a corridor in square H08, in the building called ‘the office’. Again, its manner of construction was not documented in detail, but plan drawings and sections clearly show a bonded vault. The crack pattern of the walls along the length of this corridor also indicate an inwards shift of the wall caused by the removal of the vault.

The use of a vaulted construction in the staircase, as well as in the corridor suggests that vaults were likely present in more places where narrow spaces had to be spanned.

V.5.5 Floors

Most floors are of the rammed earth type, or simply trampled by regular usage, while fewer are whitewashed or plastered. For the occurrence of white floors see the discussion of the use of white plasters under V.4.7. Loam floors are often described in the excavation documentation as covered with many ‘lime spots’, suggesting perhaps a loam/lime mix or a disappeared wash. But such spots are also part of the general loam matrix found throughout the settlement, so it is hard to say what such spots represent.

Figure 101. Floor/surface material types.

Few floors are made of fired brick tiles. Such floors are found in the courtyards and bathrooms of the *Dunnu* (also see V.4.10). Some surfaces in the *Dunnu* are covered with sherds and/or pebbles, which seems to be intentional, and associates in one case with the presence of water channels leading to it suggesting these could function to improve drainage.

Floors have unfortunately not been recorded in sufficient detail to be able to describe their precise construction. In some spaces many thin layers on top of each other have been observed, and interpreted as series of floors. However, the genesis of some of such deposits may be of (natural) sedimentary origin, formed in an open area. In others, their formation is less clear from the recorded material and context (see IV.3.1).

V.5.6 Doorways

Doorways in general terms are simply gaps in the wall starting at floor level, and with a certain limited height. The variation in doorway construction is seen in the bonding pattern on the sides, the door jambs, and the way the superstructure is supported. Of the door itself usually nothing remains, although many door sockets have been recovered indicating the use of rigid panels connected to a pole that was fixed in a top and bottom socket. In terms of superstructure, there were originally probably two main types of doorways, those with flat timber lintels, and those with vaulted or arched lintels. Clearly, of very few doorways the top parts have been preserved, so it is impossible to say something about absolute or relative numbers of occurrence. And only brick vaulted doorways preserve due to their material a superior structural strength. However, it is likely that vaulted doorways and passages are preferred for most of the heavier architecture with walls two mud bricks wide and wider (e.g. approx. 80cm).

The standard doorway is completely integrated in the wall, meaning that its jambs form no separate construction (Figure 95, left). Of the 8 complete or near complete examples, all have an arched lintel (see V.5.4). Nonetheless, it is likely that many doorways, especially in lighter architecture, had a timber based lintel construction.

Of the timber door construction itself nothing is preserved. It is likely that no doorframes were used. Most doorways would have used the pole-and-socket contraption to swivel to door. In this construction method, a doorframe is not required to attach the hinges.

V.5.6.1 Lintel construction

The only evidence we have for lintel construction are the preserved vaults or arches. We know from various archaeological examples that vaults or arches were not only used for smaller doorways, but also for tall ones and for city gates (see V.3.9). The top of the doorways leading out of room 2 of the tower for instance were not preserved, but their estimated height would be similar to the high and slender vaulted doorways documented in Tell al Rimah. These were 2 to 2.40 m in height. More such examples can be found. The northern Syrian vernacular building tradition documented in the 20th century, shows a preference for the horizontal wooden lintel even though wood is limitedly available (Pütt, 2005, figs. 297–298). It is quite likely that flat wooden lintels were also applied in the *Dunnu* in the lighter structures. The gateways were most likely arched as well, since all preserved examples of ancient Western Asian gates, and most iconographic evidence indicates the same. Nevertheless, one can find examples of gates in traditional construction that possess large wooden lintels (Hallet and Samizay, 1980; King, 1998). The two gates found at the *Dunnu* are flanked by large protruding jambs. This is a common feature of gates, and also these often support an arch. This construction practice monumentalizes the gate while keeping the actual entrance passage itself relatively small and controllable (see VI.11.7).

V.5.6.2 Doorways with abutted jambs

A few doorways have separately constructed jambs (for instance Figure 95, right). In the excavation reports such doors are assumed later constructions. To construct these, first a larger hole than the actual doorway opening must have been cut, and then the jambs that carry the arch are constructed inside the hole. Unexplained in this interpretation is that how the load of the of the upper wall is diverted to prevent collapse while the doorway was under construction. Also, in the illustrated example, the placement of the wedge-shaped brick used to close the arch on the left side must have been inserted while the abutting wall was not yet at this height. This would suggest either a larger part of the wall was demolished than indicated on the drawings, or that the abutted jamb method was part of the original construction. Which hypothesis is correct, significantly influences the reconstruction of the architectural development of this building in this case.

There are several doorways with an abutting jamb on just one side. This feature has a clear spatial patterning, as it is solely found in the architecture surrounding the main court and the residence. Examples are the doorway from the main courtyard to building NW-3 (Figure 84) and from the central hall of the residence into room 3a (Figure 123). The function of this feature is not entirely certain. In the excavation documentation this feature is often referred to as a 'narrowing' of a doorway, implying it was always added in a secondary phase of a doorway. Indeed, its abutment to standing architecture, and in one case its clear stratigraphic placement in a new soil 'layer' would suggest its part of architectural phasing on not of original design. However, we should not rule out the possibility that its function was more structural in nature, related to the renovation of the upper structure of doorway. However, it is currently hard to imagine what constructional procedures would exactly be helped with a single new jamb. The fact that these door features seem to be limited to the area of the large court and residence, may in the end suggest a relation with the functional shift of this area in the latest phases of the *Dunnu*. This was a shift away from the representational and administrative functions to manufacture and subsistence related activities.

In two cases, a single pillar of bricks is found abutted to on one side of the doorway rather than a full jamb (Figure 102). This feature is only found in the residence, at the main access gate into its court, and at a doorway leading from the court to the main room of the western apartment block. The former has an abutting jamb, of the kind discussed above, on its eastern side, and a brick pillar on the north-western corner. Right behind the brick pillar we find the pivot hole for a door post, suggesting the brick pillar may be a reinforcement of the gate's rotating system.

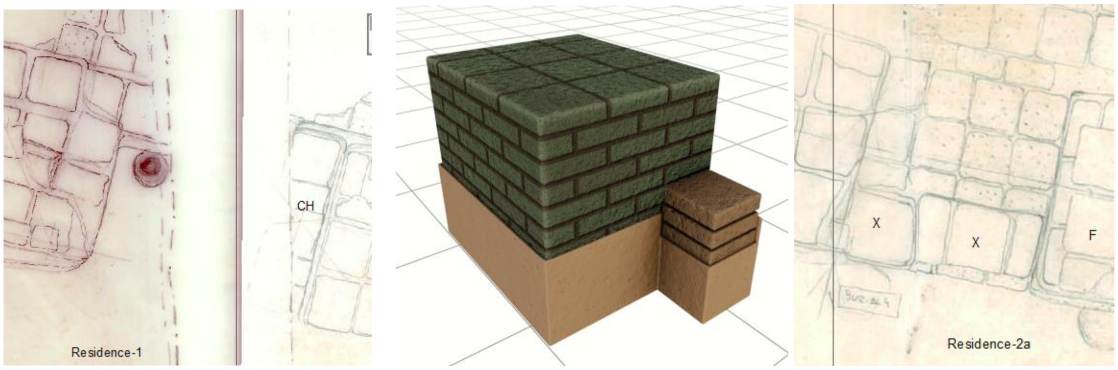


Figure 102. Doorways in the residence with constructions inside them. Left and centre: passage from main court to inner court, Right: from the inner court to room 2a. It has a brick pillar, integrated with the plaster of the main wall, and a separate small wall blocking. The latter does not seem to have blocked the full height of the passage.

V.5.6.3 Thresholds

In many cases the passage has no observable threshold, and the floor simply continues into the next room. Occasionally doorways are found to have a constructed threshold. Some doorway passages are completely enveloped by a wall, with a threshold being formed by the lower courses of the wall. Such a construction has been found at two small doorways in room 2a of the residence, and possibly at some doorways in the tower, and one in the north-eastern corner of the *Dunnu*. It seems that the explanation for such a construction is that the walls have been dug in, with the floor level above the base levels of the walls, hence the doorway needed to be constructed slightly higher up. The suggestion that such doorways have been cut through later, as sometimes suggested by the excavators, does not seem to hold.[51] Other doorways have separately constructed thresholds made of mud brick, and occasionally of fired brick tiles. These are clearly put in after the construction of the wall. In such cases, the purpose of the threshold might be to form a firm lower ledge to be able to close of a space properly with a door. In two cases, at the older main gate, and the gate into the central room of the residence, the threshold is a ledge cut into the loam or plaster floor. These clearly functioned to stop a door. Additionally, the purpose of the build in brick thresholds can be to keep out dust and dirt from the outside. Hence, the presence of a threshold might be related to a certain special use of a room that either required it to be able to close it off properly or the keep it clean or both.

There are also a few thresholds or steps made of unworked fieldstones, it seems that in these cases, found in the southern *Dunnu*, function to bridge a difference in elevation.

---

[51] Regarding the small western doorway in room 2a of the residence, the excavators have assumed that this is a later doorway, cut into the wall. I have found no evidence for this statement. In fact, all the drawings and descriptions and the fact that a northern doorway mirrors the construction method, suggest the opposite: that this exit was part of the original design of the building.

V.5.6.4 Door post sockets

The door post sockets that were found, suggest that doors were present at many passages in the *Dunnu*. No upper sockets were found, so we must assume these were made of planks with a hole, or forked branches. Lower door sockets come in three types:

1. Simple holes in the ground, may be plastered and reinforced with pot sherds.
2. Lime stone or discarded grinding slab or mortar with a circular depression
3. Pits with at the bottom a pivot stone (made like no 2), and reinforced with cobbles, rocks and fired brick.

Type 1 sockets are found least often, which may also be attributed to the fact that they preserve less well and are hard to find. They are basically post holes, and indiscernible from regular post holes if not found near a corner of a doorway. Most sockets found in the *Dunnu* belong to type 2. They are usually placed on top of the floor, which means that these doors are relatively lightly constructed. Perhaps important to note is that these are easily dislodged, thus not so safe. Their main function thus must have been to divide space, and allow people privacy. In this light, type 3 would be the door socket for heavier and more secure doors. These are found subsurface, and when they are reported in excavation, it is likely that the surface they belonged to is already dug away. This has caused some confusion in the reports regarding the surface the door socket associates with. The only heavily constructed door sockets are found at the new main gate, the residence (both front gate, as entrance to main hall), the old tower entrance, the entrance to room 1 of the tower, and the entrance to the long building in L09 (space NE-3a).

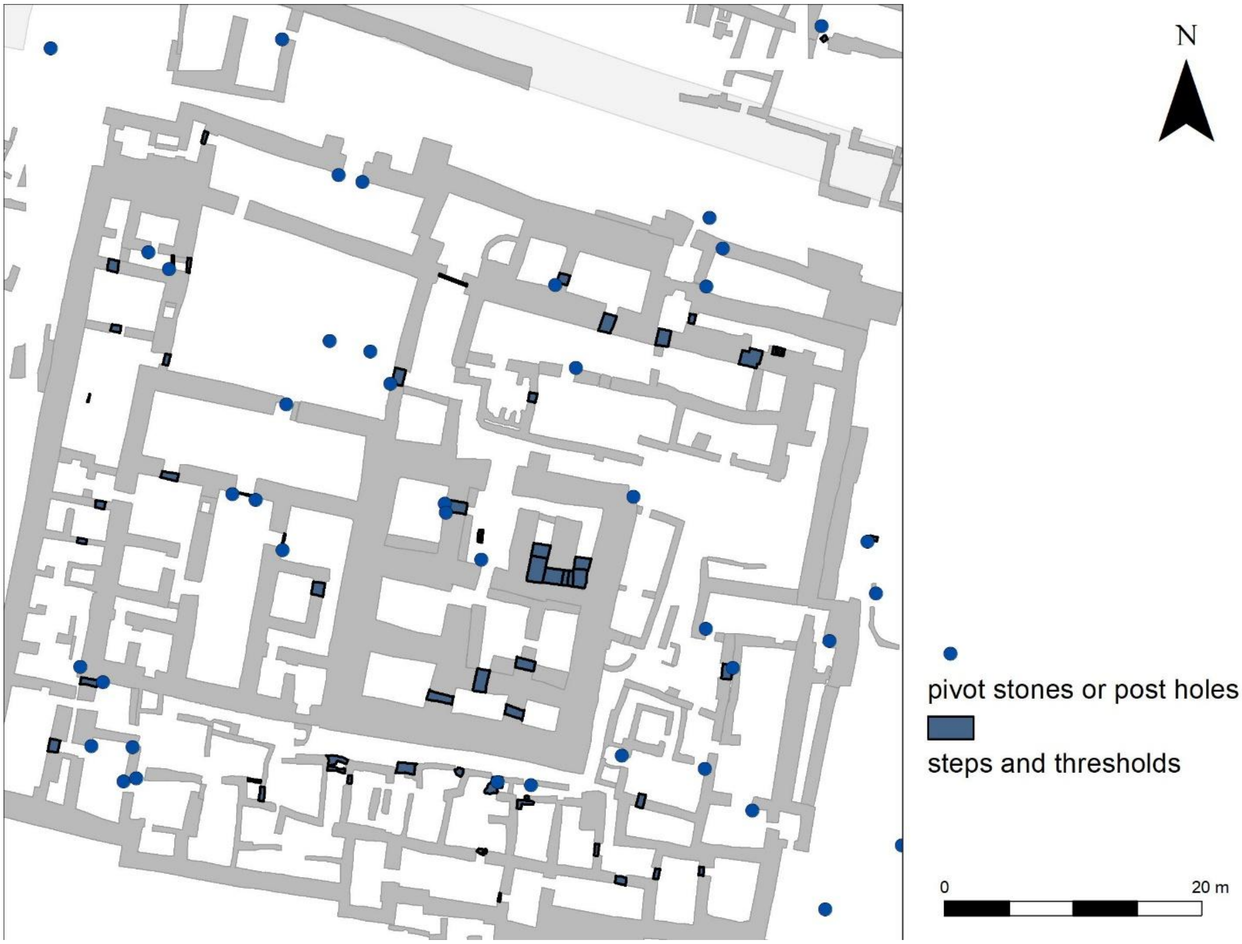


Figure 103. Location of pivot stones, post holes and thresholds/steps, level 6/5.

V.5.6.5 Doorway width

The width of doorways is indicative of their use. In the *Dunnu* doorways vary considerably in width, from 40 cm to 1.63 m (Figure 104). The calculated average of over 116 measured doorways is 79.5 cm. About 42% of doorways fall in the 70 to 86 cm range. With all the inaccuracies involved with measuring mud brick doorways, we may suggest the standard doorway width dimension was 80 cm, or perhaps more accurately: exactly two mud bricks. Those falling outside this range may thus have a special purpose: to allow passage of larger than human sized objects. This may be animals, or people with large loads possibly on carts.

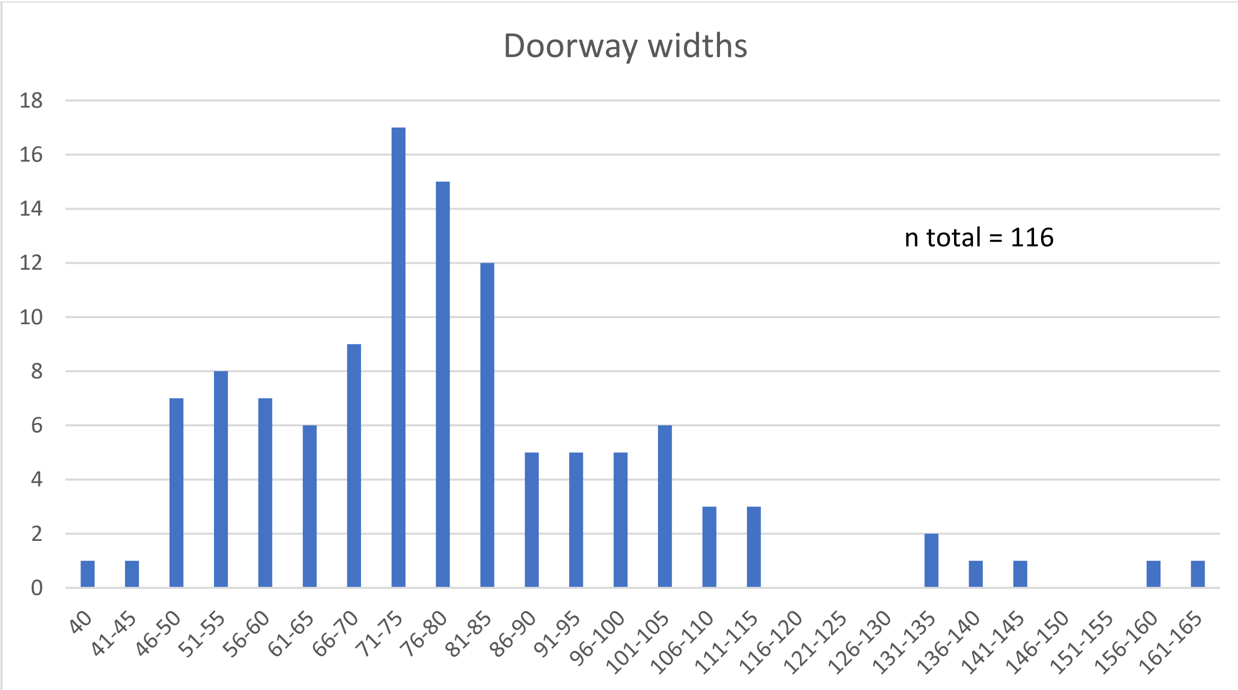


Figure 104. Chart of doorway widths in the Dunnu. Only doorways which width can be determined have been included.

V.5.7 Staircases

There is evidence for staircases in the archaeology of the *Dunnu*. Before turning to the archaeological evidence, traditional staircase construction methods are discussed to identify the possible variety of staircases that may have been originally present in the *Dunnu*, but did not preserve.

V.5.7.1 Staircase types and construction methods

In terms of architectural form and construction material traditional staircase construction varies considerably. With regards to form, staircases can be straight, L-shaped, U-shaped or 360 degree revolving. Stairwells, rooms specially created for staircases, may be constructed while in other instances, no dedicated rooms are created for them, and stairs are built against the interior or exterior walls of buildings. Significantly for archaeology, staircase construction material and method influence their chance of preservation. Staircases may be largely timber constructions, largely mud brick constructions, or a combination of materials (Figure 106-Figure 108). Structurally, any staircase consists of two parts: the supporting structure, and the steps. Supporting structures can be timber based, solid masonry, or vaulted. Combinations are possible too. A very common staircase type found both archaeologically and in recent traditional construction is a block of mud brick masonry supporting straight timbers, bridging the gap to the next floor (Figure 109-Figure 111). The mud brick steps are put on top of these timbers. Slightly more advanced are staircases which employ a vaulted mud brick construction to bridge this gap and support the steps. In such cases, the archaeological signature is also different as there will be a second supporting point or pillar at the far end of the staircase receiving the other end of the vault or arch. Completely vaulted constructions are also possible, with a raising vault constructed across a narrow space to support the steps (Figure 109, middle). In this case, heavy supporting walls on both sides are required to anchor the raising vault. Even if the vaulted structure has collapsed, these supporting walls may still identified archaeologically. These vaulted or timber-based construction methods consequently create an empty space underneath the staircase, which may subsequently be used in various ways, hence playing a supporting role in the functioning of a building. Due to its greater chances of preservation, stairs built of massive masonry are most commonly found in archaeological contexts (Figure 109, top). Often such staircases are part of infrastructural works in a settlement, or just part of the base structure of a larger staircase. However, even if steps cannot be identified many staircases may be recognized just by their surrounding structure, the stairwell. In these cases, the steps have long gone, decayed, and collapsed, but the walls supporting them preserve (Figure 107). Such spaces may be identified based on their shape and access structure. Staircases are generally found in narrow, elongated spaces with a single access point. In the case of revolving stairs, these spaces may be arranged in a square or rectangular shape.

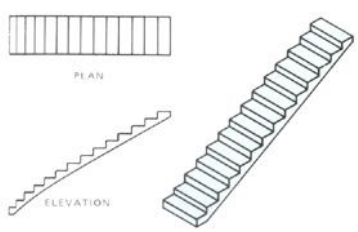
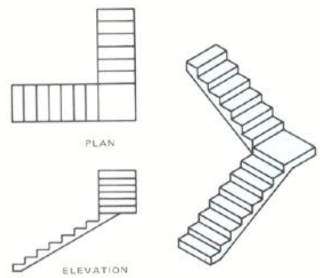
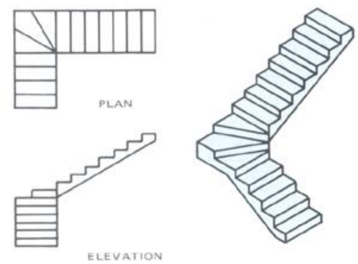
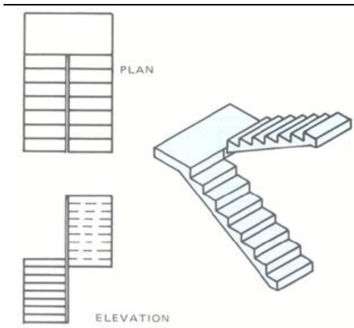
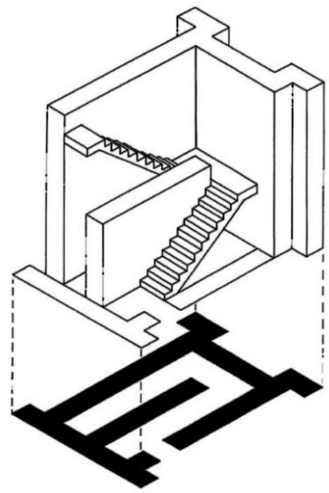
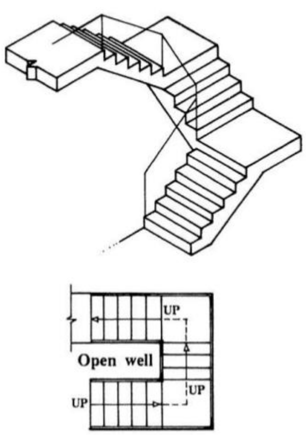
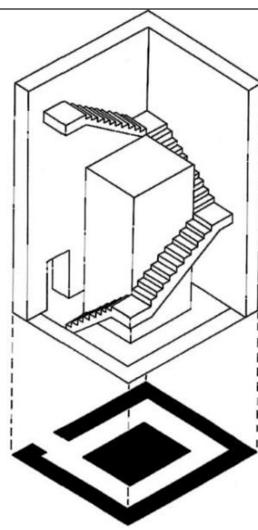
		
Straight running stair	2a. L-shape stair with half-way landing	2b. L-shape stair with winders
		
3a. U-shaped or dog legged stair	3b. U-shaped with spine-wall (after Margueron, 1999b).	
		
4a. Open well with two quarter space landings	4b. Revolving stair with square spine-wall (after Margueron, 1999b).	

Figure 105. Staircase morphological types.

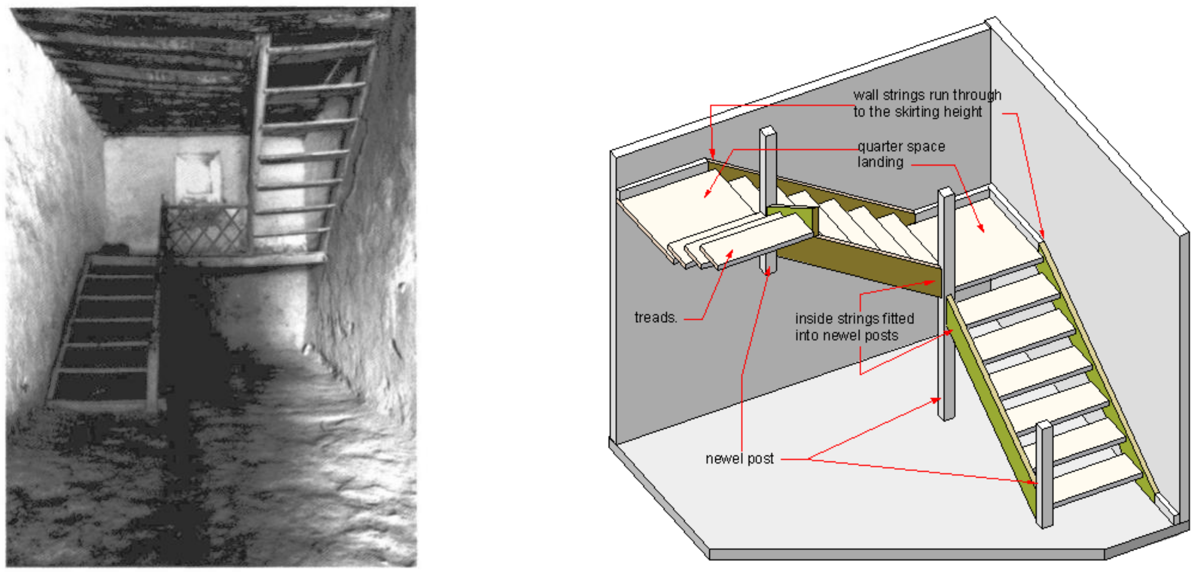


Figure 106. Timber stairs. Left: stairs in a house in Cafer Hüyük, Turkey. These U-shaped stairs are supported by a landing made of large beams embedded in the wall (after Aurenche *et al.*, 1997, fig. 4.13)*. Right: a common type of wooden stair construction. It uses so called newels, or vertical posts, to suspend the entire structure (drawing by Bill Bradley).*

Figure 107. Ruined staircase in Morocco. The mud bricks of the steps have weathered to an unrecognizable degree. The wooden base construction still holds and protects the empty space under the stairs, but when it gives way the stairway would only be recognizable by the walls of the stairwell (photo by author).

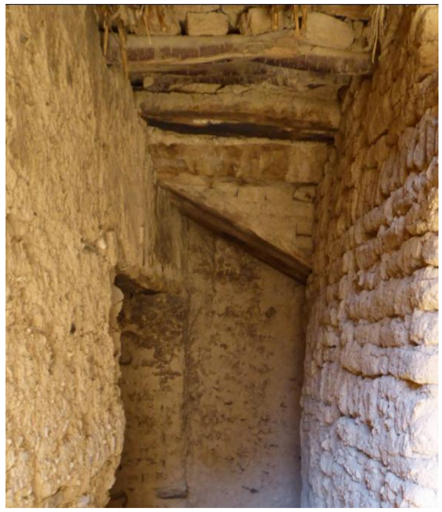
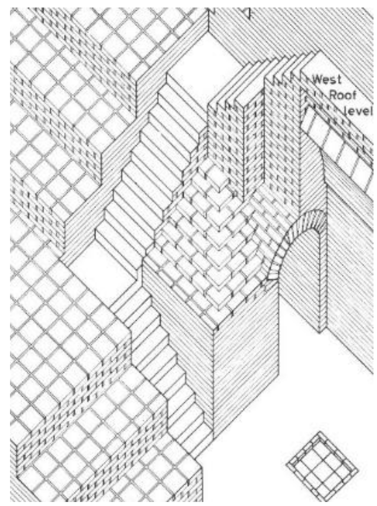


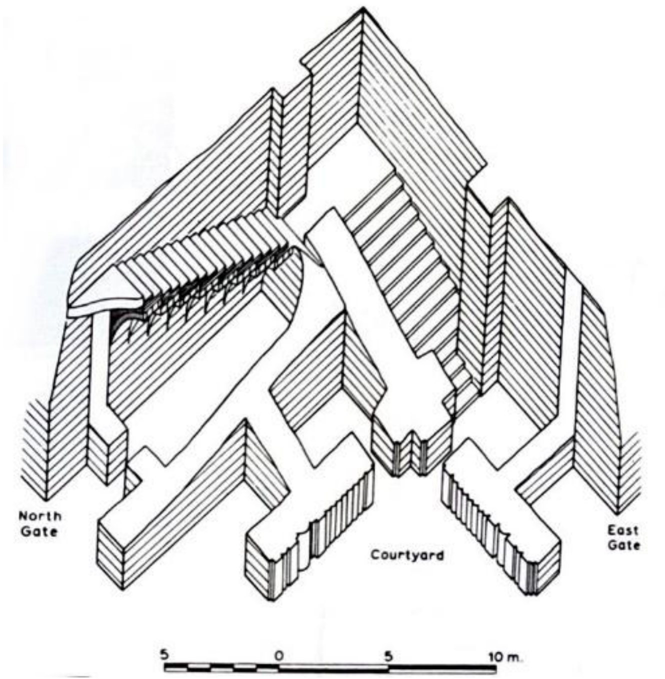
Figure 108. An example of a stair with mud brick spine wall in a ruinous house in Morocco. Like in Figure 49, the mud brick steps are put on a palm trunk base. The mud bricks have now degenerated to a precarious loam slide which the author climbed up to roof (photos by author).

Mud brick stairs plastered with loam plaster in the Red House of Tall Šēḫ Ḥamad

Baked brick stairs in old Babylonian Ur, unplastered. Each step is three bricks high

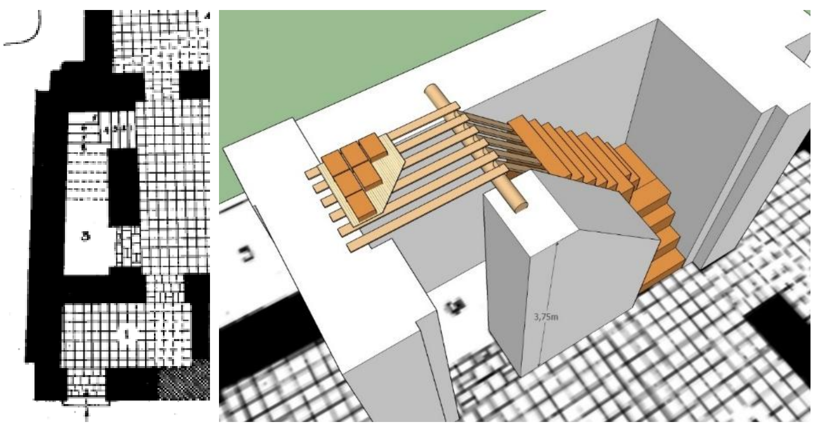


Reconstructed stairs in the Mittani palace of Tell Brak, running over vaulted corridor.

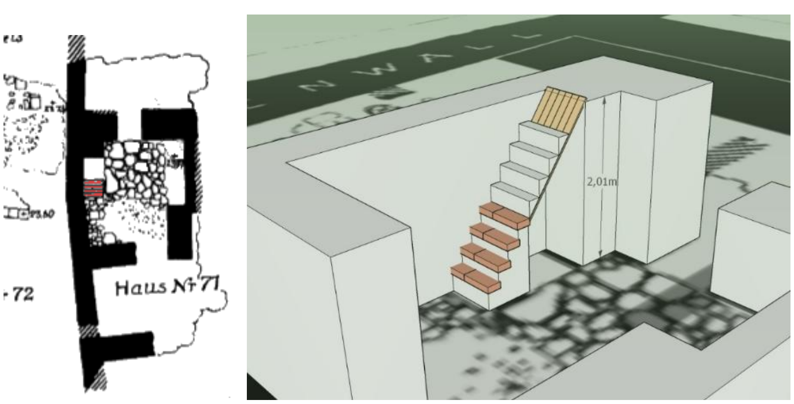


Staircase of the "Great temple" at Tell al Rimah (1800 BC). Arches are constructed on incremental elevations to form the base for the steps of the staircase. Note that the first flight is not vaulted but consists of a solid block of masonry (Oates 1990, fig.5).

Small stairs in a house in Nippur. The single half arch is a remarkably slender construction (after McCown, 1967, Plate 48B).



Staircase of the house at No. 2 quiet street in Ur. Left: plan drawing by Woolley. Right: reconstruction based on one of Woolley's suggestions. The reconstruction would lead to floor on 3.75 m. above ground level.



Evidence for stairs in house 71 in Assur (after Preusser, 1954, Pl. 25). Right: reconstruction, which leads up to an elevation of 2 m.

Figure 109. Examples of archaeological staircases.

Figure 110. A stair with a solid base and retaining wall of masonry and a timber superstructure under construction in Morocco. It was constructed in just over one day by a master builder and (unexperienced) assistant (photos by author).

Figure 111. A variation on stair construction from Egypt. Here, just two beams form the support of the stairs, while a strong layer of reed stem mats support the mud brick steps (after Correas-Amador, 2011, p. 16).

V.5.7.2 Staircases in the Dunnu

There are good indications for the presence of a number of stairs or staircases in the *Dunnu*, even if only in one case steps have been recovered. There are two types of large staircases: the heavy revolving staircase of the tower, and two long straight staircase that were used to access the fortification wall. Although of the latter type no steps have been preserved, the shape and location of these spaces leave no better alternative explanations. There are also indications for smaller staircases used to get to the roof or second floor of other buildings.

Already introduced in the discussion of vaulting, a heavy revolving staircase has been found in the north-eastern corner of the large central building (room 3). The staircase has two construction phases, one belonging to the original building, the other to the renovated and expanded building. In the later phase, it is rectangular in plan, and has a massive spill wall which anchored a vaulted construction that supported the steps. Parts of this vault has been recovered in excavation. The steps did not start directly after the entrance passage at the stairwell, which was located in the north-western corner. Instead, steps only start in the south-eastern corner, which means that one had to pass through a cornered corridor before the ascend started. This curious situation probably stemmed from the earlier phase, during which the staircase was smaller. We must therefore assume that they kept parts of the earlier phase of the staircase, and created an extension that mainly affected the higher levels. Although the extent and form of the original staircase is quite uncertain, it must have been smaller. If the step height and length remained the same between the phases, the later, larger staircase would have allowed for a much higher rise, and therefore implies that storey height was increased.

The width of the passage and the steps is 1.20 m-1.25 m, which implies that two people could easily pass each other, indicating it could be used as a two-way stairway.

Figure 112. The heavy revolving staircase of the central building. Left: the remains of the steps. Right: the vaulted construction that supported the steps (photo's by the Sabi Abyad excavation project).

The steps of this staircase were built on a vaulted structure. Unfortunately, the precise manner of construction is not disclosed by the excavation notes, as the original documentation drawings suggest this feature was not understood correctly. Besides the poorly documented remains of the vault, the heavy spill wall necessarily implies the use of vaulting. It seems however likely that we are dealing with a rising vault, possibly similar to those found at the great temple of Tell Al Rimah (Figure 109). In this case, each pair of steps had one supporting arch in this case. Alternatively, a diagonally rising vault may have been used, although no archaeological examples dating to the Bronze Age exist that suggest that staircase vaults were constructed in this way.

The length and height of the steps is not entirely certain. The excavation notes give variable step length of 35 cm to nearly two meters. Some of these steps show a 40 cm rise. Both the variable length and the substantial rise (beyond comfortable use) indicate that some steps may not have survived or were accidently missed during excavation. Steps such as these are however hard to recover, as their surface will almost certainly have suffered severely from erosion, like the top of any wall. In VI.5.7 it is inferred that more likely, the staircase had steps with a 40 cm tread and 20 cm riser. This results in a very comfortable incline, which may be explained by the possible use of this staircase as cargo lift. In section VI.5.7 the details of the reconstruction of this staircase and the related storey heights are discussed.

On two locations (buildings NE-5 and SE-6) in the *Dunnu* we find long and narrow spaces attached to the exterior of the earliest fortification wall. These spaces lead to dead ends and would be impractical for storage as a main function. No other good use for them can be thought of than to consider them as remains of staircases, even if no steps have been found. The original steps would have decayed and collapsed, or in one case intentionally removed during a renovation. This could mean that it originally housed a timber support structure for the steps. But even if the steps had a vaulted mud brick support, this may have collapsed or simply decayed earlier than the surrounding walls, which have a greater volume and therefore take longer to erode away. There are other structural similarities between the two cases that indicate that we are dealing with similar structures. First, both have a length of almost 10 meters, which suggests that stairs built within them would rise to a similar height. This is expected, as they would both lead up to the top of the wall. They are also of similar width, with measurement varying between 80 cm to 105 cm, which approximates the width of doorways. The most characteristic feature of each is that they were constructed by adding a narrow 1.5 brick width wall to an already existing wall, in both cases the exterior face of the fortification wall. This is another indication, the spaces were used as stairwells, as this abutting wall would not have been necessary were these spaces just intended to be long corridors. However, such a wall would make the construction of steps much easier and more reliable. Where this wall is preserved high enough, at the north-eastern staircase, no clear indication can be found that steps were attached. If the steps were originally vaulted, the spring of the vaults should be visible embedded in the wall.[52] As this is not the case, it seems that the alternative hypothesis, a timber-based support for the steps, gains additional ground.

Looking closer at the plan of the *Dunnu*, more possible candidates for staircases appear. On a few locations we find narrow spaces attached to a building, and open on one short side. It is very hard to think of a functional use for these other than as stairs. The light single brick walls indicate that if they supported steps,

---

[52] This is not entirely certain as no good photographic documentation or elevation drawings of this wall exists.

these steps had a timber base construction rather than a vaulted construction. Note that the particular type of stair construction found in the *Dunnu* (if interpreted correctly) is not represented by the ethnographic examples of traditional construction. In more recent traditional building, we often see the type with a massive brick base, and slanted timbers on top of which the steps were constructed (see pervious chapter).

Figure 113. Possible location of staircase in building SW-6.

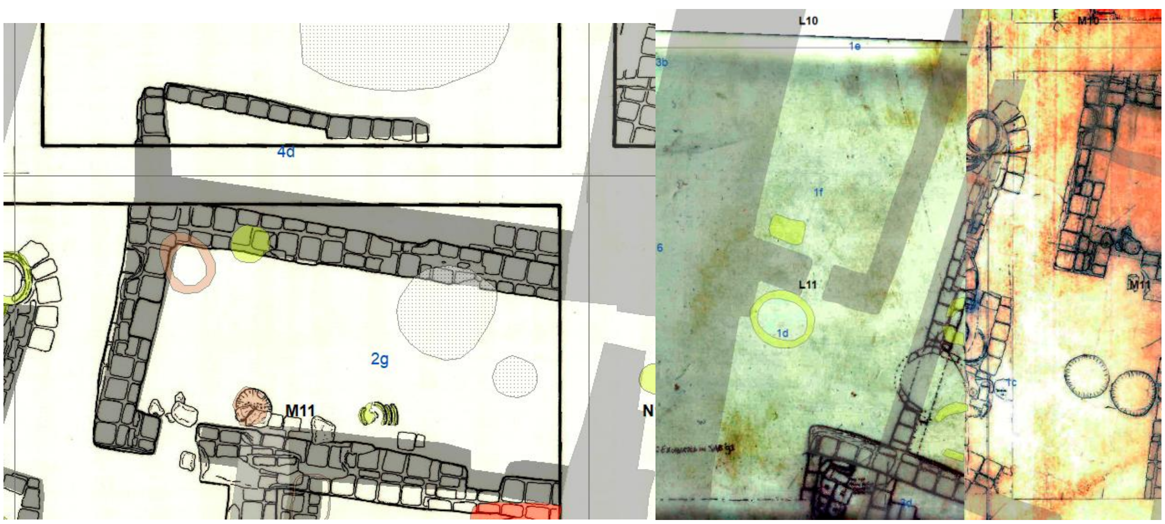


Figure 114. Two potential locations for staircases, judging from the elongated nature of the space. Left: north side of building SE-2. Right: In between building SE-1 and a separate stretch of wall without further apparent function.

One of the two more likely cases is found attached to the north of building SW-6 (Figure 113). Another is found attached to the north of building SE-2 (Figure 114: left). Just to the west of the former, we find another potential candidate for a staircase against the eastern side of building SE-1. This case is however less certain. A narrow, elongated space is found here between the building and a single wall that seems otherwise to have no clear function. However, it does seem that if here was a staircase, it would belong to the earlier phase of the *Dunnu*, since in later phases it was derelict and partly demolished.[53] Moreover, in the later phase, the presence of a staircase on this location would also block circulation. There are further architectural features that may indicate the presence of staircases in the eastern and norther extramural sectors. As the level of preservation is bad in these areas, these hypothetical staircases are less certain. But there are currently no good alternatives for the reconstruction of elongated narrow dead ending structures to the side of buildings.

A last case that should be discussed is found in the south-western corner of the *Dunnu* (Figure 115). The architectural situation is hard to understand here, but the observed irregularities require an explanation. Here, the parallel walls of space SW-2a and SW-2c are constructed with some spacing between them. The walls are of unequal thickness, and show irregular features, which may be caused by very limited preservation and post depositional movement. One hypothesis is that they might be remains of an earlier fortification wall that ran over this line prior to the construction of the residence, which required expansion of the fortification wall. Another interpretation, and perhaps not necessarily excluding the previous, is that we see the remains of a staircase. Perhaps this staircase ran in two directions from room SW-2b: one to the south towards the fortification wall, and one to the north towards the residence. However, for this stair to reach the top of the wall, more space is needed. Instead of two stairs running in different directions, it is possible that it represents one long stair with an access at the south-western corner of the residence. The length of this potential staircase, 9.2 m, would be near in length to the other staircases that reached up to the fortification wall, therefore possibly reflecting a pattern. The structural type, with a massive block of brick at the lower end of the stair, and a lighter, floating steps construction based on timber higher up, has been discussed earlier as common approach to stair construction (Figure 109-Figure 110).

[53] Its original base was however preserved by demolition debris and sediment deposits.

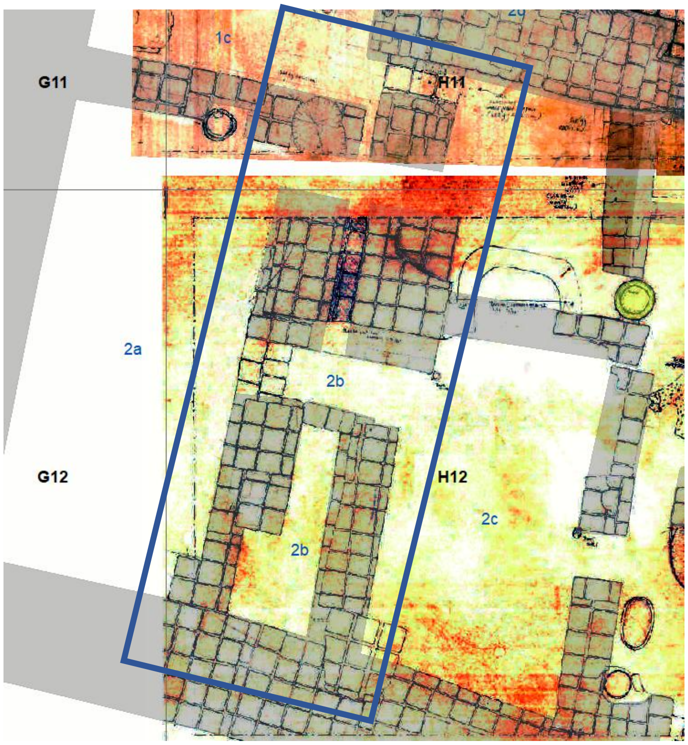


Figure 115. Unusual structural features (framed) possibly indicating the presence of staircases in the south-western corner of the Dunnu.

V.5.8 Roofs & intermediate floors

Although pieces of burnt timber are frequently found in the *Dunnu* (see also Figure 135), there is no direct evidence for large quantities of heavy timbers that one would expect if a roof collapses. Recognizable fragments of what seem to be poles of some sort are always relatively small: the few measured pieces are 20 to 60 cm in length and 5 to 8 cm in diameter. It seems a fair assumption that most of the pieces were part of the roof or ceiling as this it is in the roofs where the largest volume of wood is present. As discussed above (see V.4.5), some of the carbonized wood has been sampled and analysed, which shows that the major wood species are poplar, ash or willow.

One remarkable fire-preserved deposit may be roof collapse. It is found for example, in room 6b in the south-western sector (see Figure 34). The room fill contained large quantities of orange burnt loam, charred grain, and burnt bricks, almost immediately after the surface was scraped off at the start of excavating this area. Moreover, excavators reported repeatedly and independently of each other large slabs of burnt loam, in one case described as a slab of loam with a finely layered structure. Pottery in room SW 6b was found in relatively complete state, standing in situ, but with crushed tops. The most likely interpretation for this situation is that the fire baked large parts of the roof deck, which then came down, crushing the pottery inside the room. Like elsewhere no preserved remains of roof beams are found in this context. It is remarkable that the characteristic imprints of poles or reed were found nowhere in these slabs of burnt loam.[54]

V.6 Modification and repair

An important question is how the *Dunnu* changed over time as result of building modification. Like other construction practices, modification is part of the builder's repertoire of techniques and follow certain conventions as well as pragmatic decision making. Modifications to architecture often include entire or partial demolition, and therefore leaves a trace in the stratigraphic record surrounding the architecture. Deposits such as these were discussed in the previous chapter. A classification of different types of possible modification is given under IV.2.3. Here we will discuss the evidence for modification as seen in the preserved architecture of the *Dunnu.*

V.6.1 Evidence for modifications

Evidence for modifications is both found in the wall structure itself, and the deposits found inside buildings. Concerning the walls, there are two types of evidence: the structural relation between walls, i.e. bonded or abutted, and material transitions within walls, i.e. a change of brick type, or a different grout. The evidence found in between the walls mainly concern fills that include demolition debris or other types of intentional filling in order to raise the level of a building or roof. Large scale modifications requiring partial or entire demolition of a building will naturally be more visible in the archaeological evidence than repair related to regular maintenance.

[54] It is possible that this was overlooked by the excavators, as the slabs were just found and described in sections. Additionally, it is possible that their fragile state would not have allowed easy observation of the bottom part where one expects the imprints of poles or reed.

Evidence type	Options	Caveats
Structural relations between walls	Bonded	May equally be indicative of phasing, as of type of construction method.
	Abutted	
Deposits between walls	Mud brick wall debris	Cause of deposit may be hard to establish: natural causes or human, partial or complete building replacement.
	Levelling layer	
Wall material characteristics	Brick colour	Differences may instead be indicative of certain constructional choices or coincidences.
	Brick size	
	Bonding type	
Stratigraphic relations	In the same layer/on the same surface	Constructions on the same surface are not always contemporaneous. Layer differences may be caused by different foundation practices (levelling).
	In a different layer	

Table 6. Types of evidence used to determine building modification.

All the evidence is ambiguous to some degree, as observed situations or patterns might have different possible causes besides a modification activity. As a base rule of thumb in archaeology, bonded walls are often considered contemporaneous, while abutting walls would be constructed in chronological sequence. Abutments are logical when one considers the practice of constructing one building against the next, to expand the complex with a new structure. Walls belonging to the same structure, build at one point in time, are logically bonded to each other. However, the choice for walls to be bonded or abutted is more a decision based on structural requirements, than an accidental side effect of chronological building modifications. So, if structurally required, walls may be bonded even if they are chronologically separated. On the other hand, abutting walls may be opted for if there is no structural necessity to create a bond with other parts of the building. A good example of this are the interior partition walls of the residence, which were built abutted to the main load bearing walls.

Transitions in the material characteristics of brickwork, or in bonding occur frequently in the *Dunnu*, and may be indicative of modification activities. However, it is often unclear whether the transition reflects a change in building method or material that occurred during construction, or whether it reflects phased modifications. For instance, a change in brick material, primarily indicated by colour or consistency, may reflect a demolition and rebuilding phase of a wall. The very same pattern may be attributed to the use of different bricks from a different origin within the same construction. Especially with very large constructions, such as the fortification wall, this could have occurred easily, as large volumes of brick are required, and production batches can be depleted before the top of the wall is reached. Therefore, situations like documented in one section of the fortification wall as illustrated on Figure 90, may very well be the result of various production batches being used in the construction of this wall.

The clearest evidence for modification is usually found in cases where there is a clear stratigraphic separation between building phases. New walls are constructed on top of deposits that postdate the construction of a building. These deposits have been described in detail in the previous chapter.

V.6.2 Horizontal modifications: addition and partition

Addition involves constructing completely new buildings, or extensions to the exterior of already standing structures. Partition involves the creation of spatial separations in already standing structures. Examples of additions are the construction of the residence against the west wall of the earlier tower, and the new structures to the exterior of the fortification wall. That the residence is a later, added, structure, is clear from various indications. There is a clear stratigraphic relation between this building and the one it was built against, the tower. There were deposits of building and habitation accumulation outside the tower that occurred prior to the construction of the residence. The builders also took the former structure into account by applying a lower wall width on the side of the residence supported by the central building.

This also underscores the importance of stability over carrying capacity as main structural argument for the width of walls that builders applied. These are all examples of the long side of buildings being placed adjacent to already standing structures. An abutting long wall is still necessary as it needs to carry the roof beams. In cases where the short side of a building is appended to standing structures, no such wall is needed. This is demonstrated by the 1/1.5 brick wide wall structures that are added in the south to the heavier architecture integrated with the fortifications. The other type of new structures that may be added to standing structures are partition walls. These may be hard to stratigraphically differentiate in the case of interior spaces where hardly any deposition occurs. However, when observing cases in the *Dunnu*, this is quite a rare phenomenon. The few partitions that are added to the interior of large indoor or outdoor spaces, most likely postdate the main *Dunnu* phase, as they correspond to evidence of use that are inconsistent with the original functions of the architecture. Partitions are interesting pieces of evidence, as they indicate changes of function. The use of a space has evidently changed, which required the partitions to be put in place. There are also cases where partitions have been removed. The two only documented examples are found in two spaces in the tower (space 6 and 7). The survival of material evidence of these removed partitions is due to the use of demolition debris as levelling layers inside these rooms. Like the addition of partitions, their removal point to an important functional shift in the uses of this building.

V.6.3 Vertical modifications

Vertical expansion involves adding or removing height to a building. Archaeological detection of such modifications is hard since it usually occurred above preserved levels. Nonetheless, there are types of indirect evidence that may indicate such modifications. The first is the widening of walls. The addition of a floor would require reinforcement of walls on ground level. Such practices have been recorded in ethnoarchaeological studies of domestic architecture (Figure 19). Widening of walls has been observed on various locations in the *Dunnu*. In some cases, this may indicate the addition of height to a building, while in others it may be evidence of the roofing of a formerly open area. A difficulty with this type of evidence is however that widening may also be indicative of a reinforcing effort to counteract structural failure, rather than a change of building height. In none of the cases it is possible to completely exclude this possibility, but contextual evidence makes it possible to increase the likelihood of being evidence of a vertical modification.

The most interesting case is the tower (Figure 116). The widening of these walls on the interior as well as on the exterior is very hard to explain otherwise than to indicate an increase in building height. The architectural changes also accompany a change in mode of deposition in the central rooms (2 and 5), from gradual rise to a fixed floor level (Figure 139). These phenomena may have a shared cause: a roofing construction that was built over formerly open areas. The curtain wall added to its exterior and those added to the interior walls, are hard to explain otherwise than indicating the addition of building height. In favour of the height increase is also the enlargement of the staircase, which would in fact imply an increase in height for the individual floors, not necessarily the addition of new ones on top. The reinforcements of the tower have always been understood by the excavators as part of a renovation program to restore a decayed building. However, the placement of reinforcing walls seems more strategic, and aimed at reinforcing the entire structure to better withstand increased vertical loads. Also, the demolition of the northern exterior wall (while other walls are left untouched), its rebuilding on a new location, and the consequent increase of the size of the staircase has the appearance of a very specific constructional aim.

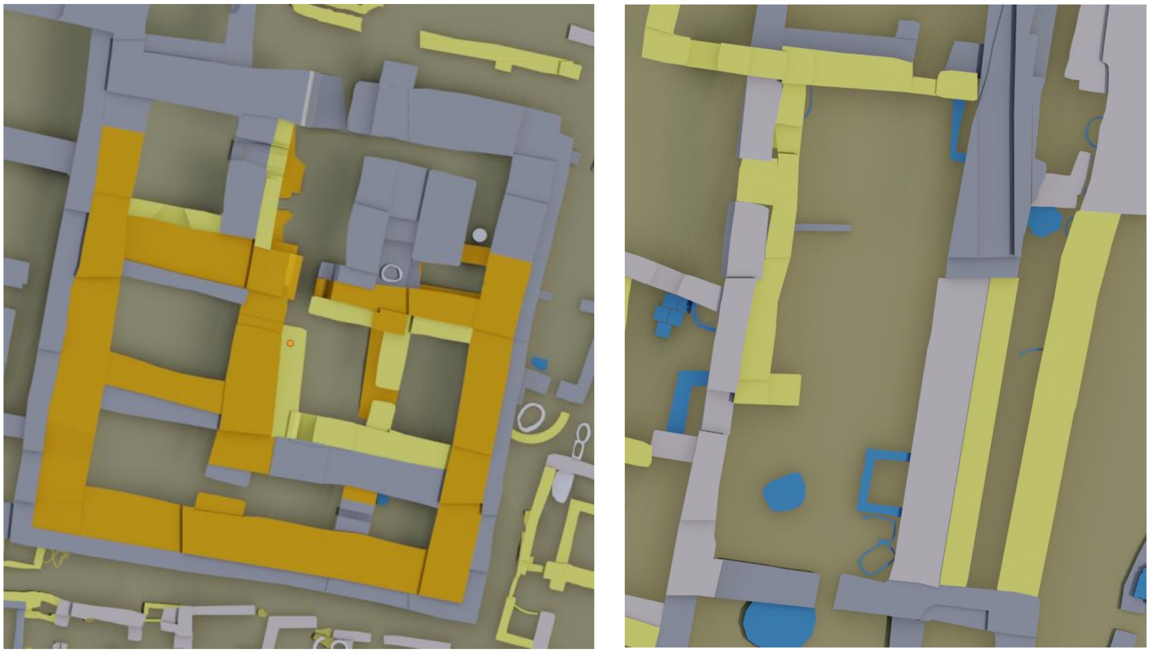


Figure 116. Widening of walls in the Dunnu related to structural modification on higher levels of the architecture. Left: the tower. Right: near the postern gate, buildings SE-3 and SE-6.

A wall width increase has also been attested on the western wall of space SE-3 (Figure 116, right). A new wall was constructed abutting an older wall, that itself was kept standing as well, effectively doubling the width of the wall. The main function of this wall was to create a separation between inner and outer *Dunnu* as it closed off the large open space behind the postern gate. The effect of the wall widening, is a decrease in space width, bringing it into roofing range. It therefore seems possible that the widening reflects the construction of a roof over a previously unroofed area. The proposed roof construction does not occur in isolation, as the addition of this wall correlates with a significant modification to the architecture in this general area.

Other cases of wall widening mainly concern the fortifications. On a few locations heavy abutments are constructed. Since these are targeting just small sections of the fortifications, these should not be considered as evidence for a general increase in fortification height. The walls do effectively increase the surface area on top of the wall, which may be related to the reason for their construction. On the other hand, structural reinforcement as a means of repair may very well be the cause.

Reduction of wall width has been observed in just one case, in space NE-3b (Figure 76). Here, walls are reduced in width, effectively increasing the surface area inside the space. It is interesting that the fortification wall is also involved in this reduction. At this moment in time, the fortification wall had lost its defensive function in this area. To justify the effort, there must have been a functional or structural architectural reason to do so. One possible interpretation is that the reduction of width may be indicative of a reduction of height of this wall as well.

V.6.4 Demolition and rebuilding

This type of modification concerns the (near) complete removal and replacement of buildings. Generally, with this practice, the stumps of previous walls are left covered underneath the debris produced by the demolition practices. This deposit is subsequently levelled and used for a new phase. There is evidence for demolition and rebuilding in the *Dunnu* in distinct areas (Figure 117). In these cases, older versions of buildings have been replaced by more recent ones, generally of a different type or form. These modifications are not part of common building repair and maintenance, but they imply a functional change of the architecture, and the *Dunnu* in general.

There is a difference between buildings that are completely raised and replaced by something else, or buildings that are partially demolished and modified. The tower is an example of the latter practice (Figure 117, no. 1). The northern exterior wall and attached interior parts are demolished, and rebuild on a different location, with the effect of expanding the building. As argued elsewhere, it is possible that this is related to the enlargement of the staircase, requiring the northern wall to be moved. Also, around the interior in rooms 5 and 6, demolition and rebuilding of some walls occurs. However, in the remainder of the building, the old walls are left standing, indicating continuity of the building in general.

In all other cases, complete buildings are demolished in order to make place for a new structure. In the area of the postern gate (Figure 117, no. 2), the access structure is reorganised with this modification, implying the demolition and rebuilding was motivated by a rethinking of the spatial functions of the *Dunnu* in this area. Another case is the expansion of the fortifications in the north-eastern corner (Figure 117, no. 3), which occurred at the expense of some extramural architecture of the old gate phase. The motivation for this expansion remains unclear. Since the rooms at ground floor are not very accessible, nor does the material evidence suggest any role of importance, it seems likely that the modification offered defensive advantages, and/or was related to the addition of new functions for which the upper floor was used. A similar case may have occurred in front of the new gate, which appears to have been demolished to make space for this new structure (Figure 117, no.5). Lastly, the large-scale demolition of all extramural architecture in the eastern *Dunnu* (Figure 117, no. 4) is of another nature, since it covered all the buildings of what seems to have been the pottery district. Although there are some indications of rebuilding, it seems that this took place to a limited degree. However, archaeological preservation due to surface erosion may have biased the picture here. Nonetheless, the architectural modifications again imply an important functional shift in the *Dunnu*.

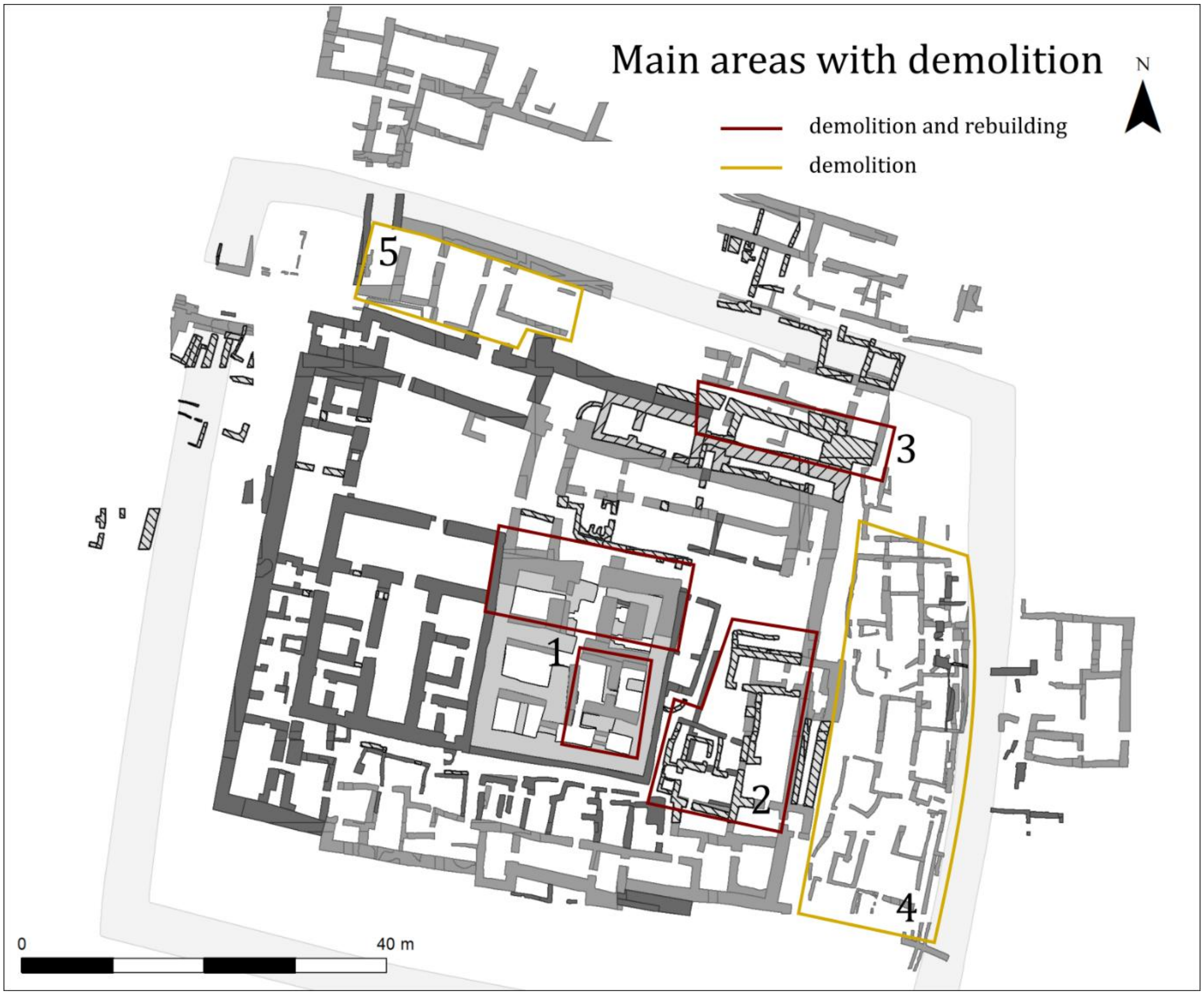


Figure 117. Primary areas of demolition and rebuilding.

The transitions in brickwork that can be observed in various structures in the *Dunnu* may be taken as additional evidence for demolition and rebuilding. However, as argued above, the meaning of this evidence is ambiguous. It is not clear whether such transitions indicate a true rebuilding phase, or simply reflect differences of used construction materials and methods within a single construction. Which one chooses has large repercussions on the reconstructions of the *Dunnu*. As most brick transitions have been observed in the fortification wall, this would suggest that the large parts of the enceinte would have been demolished and rebuild on the same location at least once.

V.6.5 Doorway modification: blocking and opening

Doorways form a separate class of evidence for architectural change. New doorways may be created by removing bricks from a wall to create a gap, or existing doorways may be blocked with bricks, rubble fill and plaster. Doorways may also be enlarged or reduced in size. The archaeological identification of doorway modification is not always easy, as certain building methods may create a wrong impression of modification. Again, we are limited by the amount of specific comparative information that can be found in the literature about traditional construction methods, to properly assess many situations in the *Dunnu*.

Figure 118. Plan showing various types of doorway modification.

The cutting of an opening for a new doorway in existing walls may be recognized in several ways. The first is that the end-bonding of the jambs may show unusual brick sizes, supposedly created by the cut at an odd location. Also, the cutting activity may have caused an irregular face of the door jamb. Both are problematic in terms of archaeological detection, as the sides of doorways are often damaged by erosion and building collapse. A second characteristic is the presence of a bonded threshold. In buildings of the *Dunnu*, generally, the bottom of doorways possesses no threshold, and are flush with the floor surface. The presence of a bonded threshold may therefore indicate the remains of a once uninterrupted wall. In such a case, the doorway may have been cut above foundation level due to the raising of floor levels. We can however not completely rely on this characteristic, as bonded thresholds may be part of the original construction and therefore do not always indicate such a doorway was cut later. A few examples can be drawn from the data of the *Dunnu,* for instance, various internal doorways in the residence clearly possess a bonded threshold which must have been part of the original construction. However, a small exterior doorway present on the north-western side of the residence has been interpreted in the excavation reports as a later, cut doorway, while there is no good evidence to exclude the possibility that it was part of the original construction of this building just as well. There are some interesting repercussions in terms of the spatial functioning of the *Dunnu,* and the hypothetical functional role of certain areas, as a result of how one views the construction of this doorway, that will be discussed later. On the other hand, unbonded thresholds, that were thus constructed after the creation of the doorway, may indicate the doorway was cut at a later point in time. However, it may also be indicative of an approach to construction that involved putting in the threshold last.

The presence of abutting door jambs are another indication of a doorway that was constructed later. In general, in doorways in the *Dunnu*, door jambs are structurally integrated with the main wall construction (Figure 95, left). In a few cases, jambs appear as separate constructions. This may indicate the doorways was a later construction. The separate jambs indicate a reduction of width of the doorway, while their structural function is the support of a new arched lintel. Therefore, it is possible that such newly constructed jambs had indicate the use of an arched lintel also in places where the lintel did not preserve. There are several of such cases found in the construction of the tower (Figure 95, right). The modification of these doorways on ground level implies a significant construction effort as the heavy superstructure would have needed to be supported during construction, while a short tunnel had to be made into the 2 meters thick walls. It remains a question how it was done. It is possible that the doorway was not cut at once, but step by step, followed by a segment of the vault, to minimise the chance of collapse. However, these vaults are not made of separate archivolts, but are entirely bonded brick structures. With this type of vaulting, it would be constructionally more logical if the vault was constructed lengthwise layer by layer, tilting each next brick layer somewhat more inwards. However, this approach would require a rubble fill and space on top for the builder to move and lay bricks. This would imply, that to build it, either the entire wall on top has to be demolished until the highest floor, or the gap had to be temporarily supported by heavy timbers in order to prevent wall collapse. The thoroughness of such modification would however fit in the general picture we get from the evidence of renovating this building.

In one case, a reduction in doorway size is indicated by the construction of a new doorway inside the gap of an old one (Figure 119). The construction of new jambs, abutted to the older wall is also clear from this example. It seems likely that the new doorway was constructed at the place of the vault of the old doorway, implying the latter had collapsed or was demolished. The new doorway is however associated with a very late use-phase of the *Dunnu* structures, which post-dates the primary phase of our interest.

The construction of low walls, reminiscent of benches, inside a doorway may be mistaken for the construction of new jambs in one case. The passage from the large gate room of the new gate towards the paved court, contains such low walls (Figure 120). Although it is possible that the upper side of these walls was destroyed, it seems more likely that they never were much higher. If they were constructed with the intention of creating new door jambs, chances are they would have been plastered to form one whole with the older existing courtyard wall, as is the case in other examples from the *Dunnu*. The absence of plaster and the fact their short ends are somewhat retracted from the face of the main wall, suggest these structures sat behind large doors. For other constructions inside doorways that have a different structural purpose than a door jamb, see V.5.6.

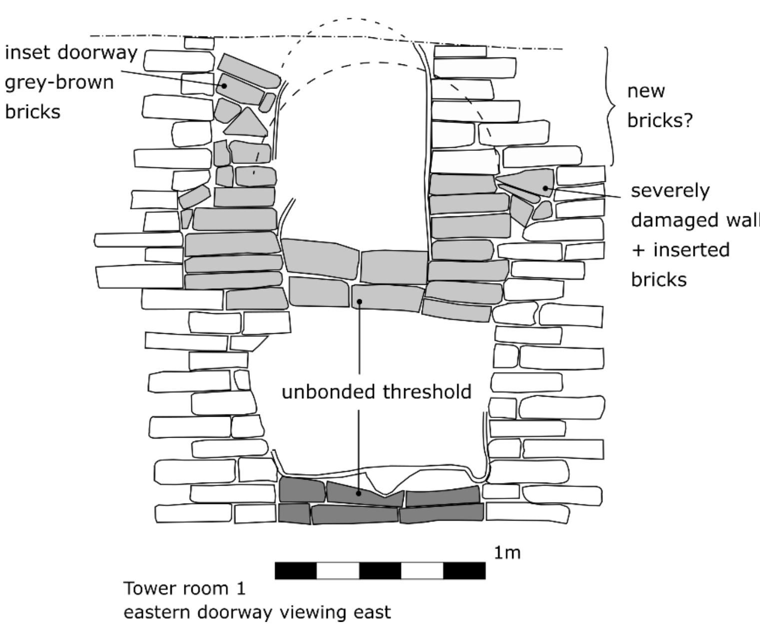


Figure 119. Doorway from room 1 to 2 in the tower. The best example of a doorway with two phases of which the second phase doorway is not bonded to the original walls. Both doorways, even the first doorway, have unbonded thresholds. The second doorway dates however to the secondary settlement phase during which the tower was partly in ruins.

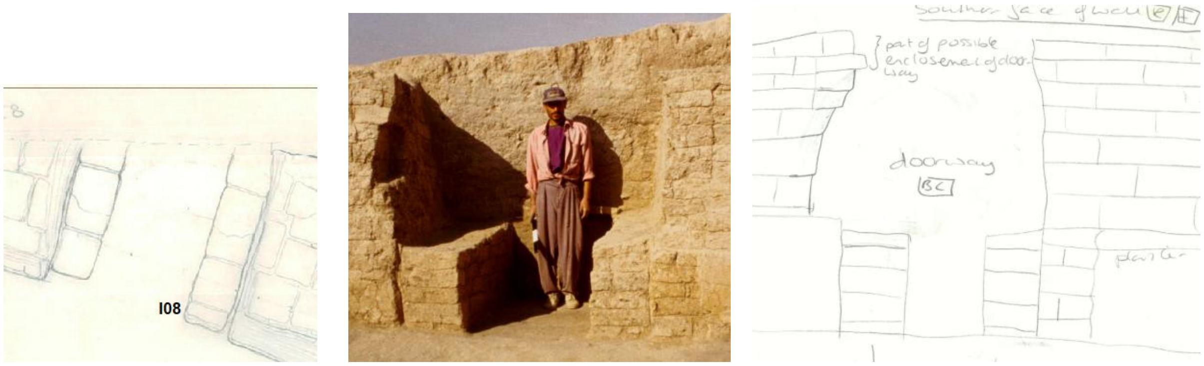


Figure 120. Gate to main court with benches.

Figure 121. Different threshold constructions in the Dunnu. 1: full width of wall, bonded with jambs. An example of a neatly constructed one in the residence. 2: Consisting of two baked tiles with some space between, probably a gutter for drainage of the main court. 3: Bricks on their sides applied on both ends of a doorway, which functioned as small retaining walls for a loam fill in the middle. 4: two bricks without special features.

Opposite to doorway creation, a number of doorways have been blocked. The construction of these blockings varies. The neatest blockings are those that fill the entire depth and height of the opening, and are covered with the same render as the wall itself. This is clearly done with the intention of continued use of a space in the same manner, requiring a neat finish on the walls. The best example is found in room 4a in the residence, where a doorway has been found in the southern wall. The reason for this blocking is unclear. Access between these two rooms is also possible around the corner, so it almost seems that a doorway here was a mistake in the original planning of this building. Then there are blockings that are less neatly constructed: single width walls of simple brick stacks, often not completely covering the entire height of a passage. Some of these features referred to as ‘blockings’ in the excavation documentation are so low, that they could easily be stepped over. However, it is possible that blockings, due to their feeble construction, may often not have preserved to their original height. In a few cases archaeological context clearly indicates a raising of floor level, which went hand in hand with the raising of a threshold inside a doorway.

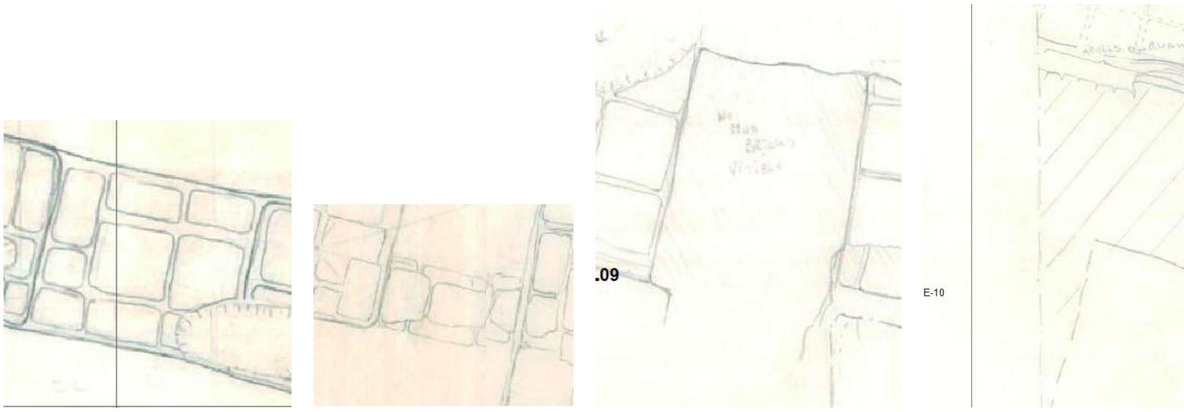


Figure 122. Doorway blocking in the Dunnu. 1: neatly constructed and integrated blocking in the residence. 2: hastily constructed blocking in the residence. 3 & 4: rubble fill with a later constructed wall blocking one side of the entrance.

Building NE-3 is another building that was significantly modified over time, which included doorway modification (Figure 122: 3 & 4). Different from other regular blockings constructed with brick, is that rubble blockings were constructed. Also different is that the blockings are clearly associated with the construction of new walls perpendicular to them. Doorway blocking here is thus motivated by functional repurposing of the building, or area in general.

In other cases, it seems that the blocking also served a new additional purpose besides blocking an entrance. Various interesting structures have thus been created inside doorways. In a few cases, some kind of windows appear to have been made by low walls inside doorways. Two of such structures were constructed in room 2a of the residence. The most curious blocking feature is one found in another doorway from and towards the main court (Figure 125). It appears to consist of four different structural parts, whose function has never really been clarified.[55] It is possible that it was a phased construction, with several different modifications applied to this doorway.

---

[55] Due to its stepped construction, it was identified by the excavators as possible stairs. But this seems quite unlikely since the three steps do not lead up to the original height of the wall, and there is no place for additional steps in this design that reach to a sufficient height. The steps are also of an unusual and inconvenient height.

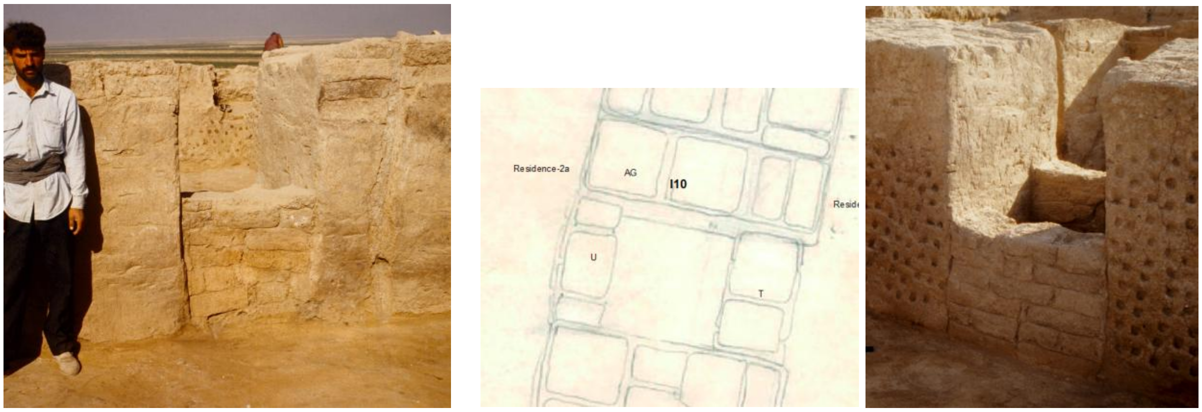


Figure 123. Construction inside a doorway in the residence. Jamb AG appears to have been constructed before walls U and T and is integrated with the main structure.

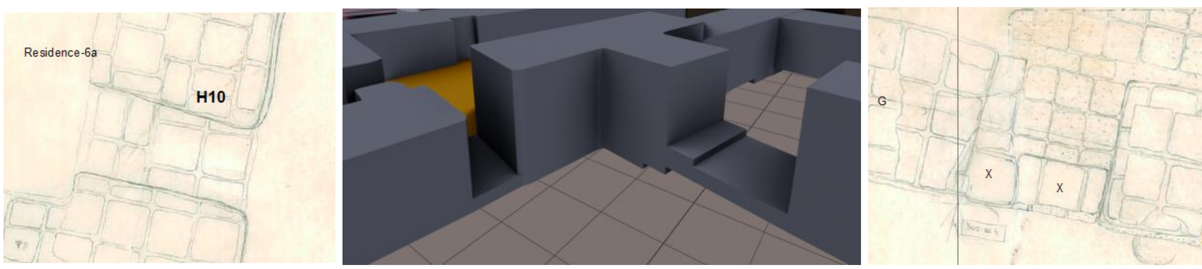


Figure 124. The western and northern doorway into one of the main rooms of the residence (2a). Both doorways have two courses of mud brick wall underneath the doorway.

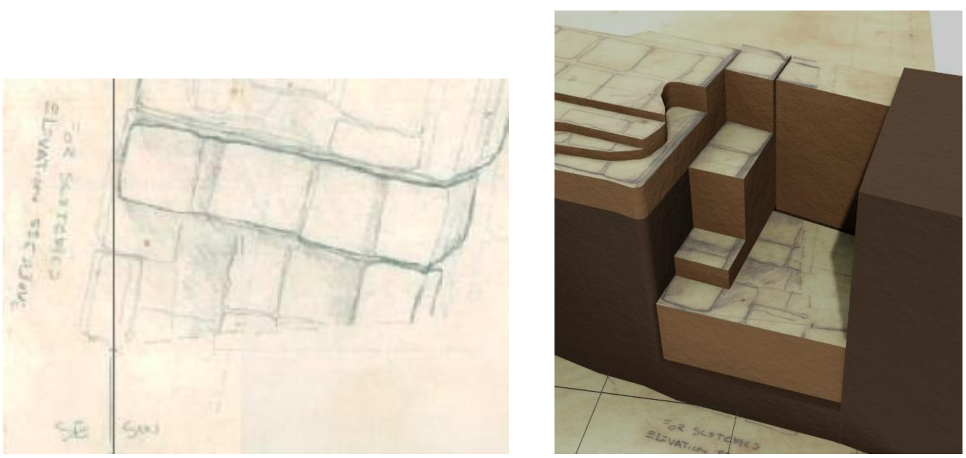


Figure 125. Feature AG in space NW-1.

In terms of phasing, stratigraphic evidence is often hard to assess, because no sedimentary stratigraphy was given the chance to develop prior to the placement of many blockings. Hence, they are placed on the original floors of the *Dunnu*, but there are indications that some of them post-date the main *Dunnu* phase. However, there is a marked difference between the north-western sector and eastern and southern sectors of the *Dunnu*. In the north-western sector and the residence, many doorway openings, blockings or structures inside doorways must be placed in a phase of transition after the end of the main *Dunnu*. Even though stratigraphic evidence is difficult to assess in several cases, the effect they have on the functioning of buildings such as the residence clearly indicates that they were not part of the original construction. Therefore, many of these openings and blockings most likely reflect a phase that the residence was no longer used as such. The openings and blockings of doorways in the tower, the north-western sector and south-eastern sector can generally be associated with wholesale renovations of buildings in these sectors, pointing at functional change prior to the final days of the *Dunnu*. The small blockings seen in the southern *Dunnu* on the other hand are part of continuous use and can in some cases be related to issues with drainage directions and sedimentation in the narrow alley at the back. This alley collected all water and erosive sediments from the two massive central buildings (see VI.7).

V.6.6 Repair

Common maintenance activities in mud brick architecture involve replastering walls and replacing roofs. As has been discussed, regular wall plaster repair is important for the long-term survival of mud brick architecture and commonly takes place annually or biannually. Interior and exterior maintenance is different in nature and frequency. Roofs similarly have to be replastered and compacted to maintain waterproofness. Replastering leaves relatively few archaeological traces, although layers of plaster should be visible on close inspection. Also, old plasters will end up at the bottom of the wall as a result of weathering and erosion and therefore leave recognizable traces. Unfortunately, neither type of evidence has been systematically documented, and it is therefore hard to say something about wall plaster maintenance practices in the *Dunnu*.

Roofs also require occasionally wholesale replacement. Although this practice has been recorded in ethno-archaeological studies, variations in frequency between climatic regions or cultural zones of construction practices are not well documented. Roof replacement, which involves demolition and replacement of roof beams, theoretically leaves a layer of debris inside a building. This layer may either be cleaned out or compacted into a new floor, which would result in a recognizable archaeological feature. Again, such building practices are not well documented, and it is therefore unknown what archaeological traces roof replacement really leaves. In the *Dunnu*, occasionally thin layers of rubble are found within a building. Although possible, this evidence does not allow us to link such deposits to roof replacement or any renovation in the upper sections of a building. It should however be considered as valid alternative to the interpretation that such rubble deposits are caused by abandonment and subsequent decay, a statement often found in the field documentation and some publications about the archaeology of the *Dunnu*.

Repair may also involve the structural reinforcement of buildings, using buttresses and abutments. Buttresses and abutments are not by definition indicative of repair related reinforcement, and as such their structural context has to be assessed very carefully. Again, abutments and buttresses are also used when a building modified and requires reinforcement, such as when another floor is added. In these cases, repair is not the aim, and such reinforcement cannot be used as evidence for the structural condition of a building at a point in time.

V.6.7 Brickwork transitions as evidence for modification

In paragraph V.5.3.8 the phenomenon of layered or complex wall construction was discussed. Although the explanation of these patterns is uncertain, one possibility is that it is indicative of wall renovations or architectural modification. An alternative one offered here is that during wall construction, at some point a transition was made to a different brick or a different bonding method, thus mainly reflecting the logistics of construction. In one case were a cross section of the fortification wall revealed multiple layers of bricks of different material characteristics near to each other, the latter seems like a plausible explanation. In the case of the south-eastern corner, a clear cut may be observed in the brickwork, corresponding to other evidence of an extensive remodelling of the *Dunnu* architecture in this zone. Therefore, the simple dual layering is probably indicative of one modification phase. In the north-western corner of the *Dunnu*, the evidence is less straightforward. Although on first sight is appears as a very likely a case of demolition and rebuilding that can also be correlated with debris and levelling deposits found inside the buildings. However, some of the evidence is confusing or inconsistent. For instance the preservation of certain partition walls in this rebuilding phase seems unnecessary, considering the new function of all of the spaces. The question is, why put the effort into rebuilding an entire building during a renovation phase, and not change its spatial layout more suited to new functions?

The answer has a significant impact on our model of settlement development. If these are interpreted as wall renovations, this implies that large segments of the fortification wall were taken down to 0.5 to 1.5 meters above ground level, and entirely rebuild. This would affect a large part of the northwestern corner, a segment at the centre point of the northern fortifications, and a large part of the eastern fortification wall (for details see: V.5.3.8). Although no such layered complexes were documented in the southern *Dunnu* this does not mean it does not occur here. However, wall preservation is simply not high enough in this area to be able to tell. Rebuilding 6-meter-high fortifications is a labour-intensive project, so there must have been good reason to undertake them. In this case, either the fortifications had structural defects, or there had been historical events that required a significant redesign in the functioning of the fortifications or the *Dunnu* as a whole.

V.7 Conclusion

The evidence discussed in this chapter shows that the *Dunnu* was constructed by people familiar with the building craft. Analysing architecture from the perspective of construction methods, it becomes clear that the builders of the *Dunnu* were well aware of structural performance of loam architecture and applied a certain degree of pragmatic efficiency in their work. In their practice, rational choices were made regarding construction methods and architectural function. Although this may seem an obvious conclusion, this is not a feature often highlighted when discussing ancient architecture because there is a tendency to emphasize the symbolic and cultural aspects of buildings. This is not to say that architecture could not have symbolical meanings, or that its form was not motivated by an abstract idea. However, this is to say that given this ideological context, architecture's physical part primarily reflects technical attempts to counter the problems of gravity, the weather and the limitations of the available building materials.

The pragmatic approach of the mud brick builder of the *Dunnu* and the observed repertoire of techniques also help us create a more comprehensive model of the complete buildings and their functions, which will be the focus of the next chapter.

VI. Architectural analysis

This chapter discusses the architecture of the *Dunnu* from the perspective of spatial structure, architectural forms and diachronic changes. By comparison and juxtaposition with information about artefact distribution, other features and available textual information, a hypothesis about the functions and functioning of the *Dunnu* is developed. The method used here involves the analysis and integration of iconographic sources, general information about building methods and architectural traditions, and direct archaeological evidence.

The aim of this chapter is not only to get an idea about the original physical appearance of the *Dunnu*, but to explore the consequences of building forms for construction, and use of the built environment. Through this exercise our attention is focussed on the constructional logic of the plan, which in turn helps us to better understand archaeological architectural features.

To clarify the nature of the excavated walls, and the logic embedded in them, a classification of the architectural remains has been made. Two different approaches to ground plan classification are used: constructional and spatial. The constructional classification has been made on the basis of the constructional relation and functions of walls. The spatial classification identifies groups of spatially related spaces based on their connections. Both are in essence alternative approaches to identify ‘buildings’, as isolated units.

In addition, a large part of this chapter deals with various functional aspects of the buildings, which are explored based on the extant archaeological remains. Is there evidence for conscious planning and design in roof elevations and the alternation of open and closed spaces? What is the relation between plan and elevation, and can we find solutions for thus far unexplained architectural features by using reconstructive reasoning? To what degree do the remains indicate a fortified structure, and how did it function? And what conclusions about the intentional structuring of space can we derive from access analysis?

VI.1 Theoretical considerations

VI.1.1 The relationship between building plan and upper construction

Since surviving architecture from archaeological contexts is often not much more than the base of the walls, much of its interpretation depends on an analysis of the site plan. Such an analysis requires the identification of each architectural feature, and second – in case of a reconstruction – assess its theoretical relation to the upper built structure (Margueron, 1999a). For instance, specific types of staircases have characteristic shapes, recognizable in the plan, which may be used to infer the presence of a second storey. Another example is to understand differences of wall width as an indication of differences in building height (Loud and Altman, 1938, p. 19). The theoretical assumption underlying this, is that there is some logical, structural relation between architectural base and upper structure. Between various scholars that wrote about interpretations of ancient architecture from archaeological sources, there is some disagreement as to what degree this is the case. For instance, some (Heinrich and Seidl, 1967, p. 5; Wright, 2000, p. 89) have argued that there is no sound structural reason for the massive dimensions of walls in ancient palatial and temple architecture, and that explanations should be found in the realm of symbolic meaning. Others (Loud and Altman, 1938, p. 38; Margueron, 1982, p. 503), on the other hand disagree, and consider it groundless or absurd to assume that builders of the past worked without rational principles as they had to deal with the same forces of gravity and limitations of resources and construction material as nowadays. Although this is a specific issue, it reflects an old theoretical divide in interpretations of architecture, namely that between symbolic and functional/structural explanations. This theoretical problem also impacts the basic interpretation of ground plans, and its subsequent reconstruction in 3D space.

The position taken here is that we must assume that architecture both reflects symbolic and practical thinking. The degree to which symbolic thought influences the form of architecture beyond what is practically required, probably varies according to specific circumstances. Monumental architecture may come to mind first as a class of architecture with highly ‘symbolic’ meanings, that may have been accentuated by its dimensions (Amos Rapoport, 1990). However, completely mundane and simple buildings such as common people’s houses had symbolic meanings too, and may have been shaped according to them. However, at the same time such structures adhere to the common constraints of gravity, material limits and economic resources. Therefore, in general, the opposition between the two seems false, and is perhaps only applicable to the specific issue of the thickness of walls. We will return to this issue below. For the interpretation of the *Dunnu,* it starts with the perhaps obvious assumption that the features seen on the plan are meant to support some structure that has now disappeared. It is further assumed, following Margueron (1999a), that these features are not redundant or useless, so we can assume a specific and reasonable structural function of these features. However, to be able to make a proper assessment possible, a base selection of possible structural functions must be made. In the absence of direct evidence, this selection must come from indirect evidence, similar architectural features that we know from better preserved ancient structures contemporary constructions. For a large part these are architectural parallels described in the “ethno-architectural” and “ethno-archaeological” studies and literature.

VI.1.2 Form and function

Another tool for the interpretation of archaeological architecture is suggested by Jean-Claude Margueron. He asserts that any architectural reconstruction should meet the basic human needs or functional requirements of a building. He suggest that these are good lighting, air-flow and circulation of people

(Margueron, 1999b, p. 192). This forces one to think about how buildings were constructed to support these functions, including the location for light shafts, air access and how to get in and out a room. Based on such criteria, Margueron (1982, 2005) inferred that the narrow dark corridors of Mesopotamian palaces are impractical and should therefore support a more spacious second floor with wooden or mud brick columns supporting a roof. In the same vein, many buildings may have areas with elevated roofs, to make place for windows and air vents. Without it, very large spaces locked in by other architecture, would be closed off from air supply and light. Margueron's model might be specifically applicable to large palatial structures. Nonetheless, this approach to the structural and functional interpretation of architecture must be lauded for its consistency and transparency, as opposed to many frontispiece archaeological reconstructions that do not disclose their underlying theories, assumptions and methodologies.

Underlying Marguerons approach is that a building had to support certain functions, and its form may have been attuned to do so. Margueron is smart to choose very general functions, as the relation between form and function is not deterministic. From documented use histories of buildings, it is evident that the same space may have had different specific functions, such as cooking, social meetings, or storage. This space may have hosted all these functions at the same time, or sequentially, i.e. the function changed after a certain number of years. The space itself may have hardly changed, but its use changed completely. Physical modifications to the architecture may also have taken place. However, most of this functional change would be reflected in its fixed or semi-fixed features (Amos Rapoport, 1990). The question therefore is, to what degree can we use function as seen in the semi-fixed features found in a room, as a principle to guide a reconstruction? The answer is, to a very limited degree. For instance, one may assume that a smoke and fire producing activity such as bread baking or cooking on open fire is most conveniently located in an open, well-ventilated area. In fact, there is much ethnographic evidence that supports this, as traditionally in the rural settlements in the Middle East and elsewhere, bread ovens are located outside in the courtyard. But there is also much ethnographic evidence that shows that bread baking in wood fuelled ovens took place in roofed spaces. These were often dedicated spaces, or small buildings specifically built for this purpose. Many fire-related activities take place inside, with smoke and blackening of walls and roofs as result. The degree to which people have 'ventilation' and 'clean air' as a priority in their architectural designs, is very context dependent.

Nonetheless, the intended function of a building may have shaped the design in very specific ways. Storage rooms for bulk storage of grains or liquids often have very specific designs. Other examples are large social gatherings, movement control, or security and defence. It is nevertheless possible that in later stages of the use of these structures, the original function may have been abandoned. For instance, the large mud brick castles built by Berber lords and chieftains in Morocco in the 19th and early 20th centuries were originally intended to house the leading family and form a secure storage place for the harvest of a tribal community. But as the traditional social structure changed and the influence of the tribal lords waned, these fortified farmsteads were in the 1960s often inhabited by several regular farming families (Nijst *et al.*, 1973).

Since form and function are in a non-deterministic relationship, while at the same time originally intended functions may influence decisions made in the construction of a building, one can only apply this type of thinking flexibly. For instance, from the analysis of the plan the idea may follow that a building may have been created to shape patterns of movement in a specific way. Some parts of the building are incomplete due to difference in preservation, but the plan may be completed in just one way that does not harm the hypothesis about controlling the pattern of movement. The functional hypothesis therefore shaped the reconstruction. On the other hand, one may go the opposite way and use the alternative reconstructions of the plan, based on other strains of evidence, to disprove the hypothesis. Choosing which direction the reasoning should follow, and with which type of evidence or hypothesis to start, may be very hard to substantiate. A pragmatic choice has therefore to be made. In this study reconstruction starts with structural analysis and reasoning, using principles of architecture and construction. A functional model is then used to validate or question the resulting reconstruction, and possibly modify it according to insights thus gained.

VI.1.3 “Ethno-architecture” as source of information

One method of archaeological inference is to amend gaps in knowledge with information coming from more complete but similar contexts or objects. Both the fields of ethno-archaeology and experimental archaeology have been introduced to offer the possibility for reconstruction based on such analogues or parallels. In the case of interpretation of archaeological architecture, one may refer to traditional building practices in more recent times. In this case, one has the option to stay geographically close to the archaeological site in question, or expand the horizon in search of good parallels. In this case, the decision was made to include information both of regional architecture practices in Northern Syria, of Mesopotamia more generally, and the wider traditions of mud brick and other loam construction techniques from North Africa to Central Asia. Therefore, the construction material itself was considered guiding, rather than geographic or cultural vicinity.

There are good reasons for this choice. First, the *Dunnu* as an architectural form, is not something that has survived into the present in Northern Syrian. Some other building traditions however did, such as the practice to construct domed houses (Pütt, 2005; Mecca and Dipasquale, 2009). We know this solely because these are represented in Neo-Assyrian palatial art. The dome, or the flattened dome (which includes a small timber roof construction) is considered the perfect adaptation to a dry climate and a region where trees are scarce. This may very well be the default choice of construction for sedentary people in this region. The rectangular houses seen more often also use traditional techniques, but may be a relatively late arrival. At least Pütt attributes some of the documented house types to Arabic or Kurdic migrations/traditions. Using these to inform the reconstruction of buildings in the *Dunnu* is therefore probably just as random as any mud brick building elsewhere.

Similar structures of fortified farmsteads that serve as the base of power for important families are found throughout Western and Central Asia and North Africa, in countries including Iran (Horne, 1991, pp. 49–51), Afghanistan (Hallet and Samizay, 1980), Morocco (Nijst *et al.*, 1973), and Saudi Arabia (King, 1995). These may serve as examples for the scale, architectural forms, building techniques and approaches to spatial organisation.

VI.1.4 Historical and iconographic sources

Obviously, the iconographic and historical sources describing architecture of this period are very limited. A handful of seal imprints exist with some kind of representations of architecture dating to the Bronze Age (Herzfeld, 1938). The white obelisk, a monument ascribed to either the 11th or the 9th century, is the earliest of its kind: a visual and textual recount of an Assyrian king's exploits (Sollberger, 1974; Reade, 1975; Pittman, 1996). It has multiple depictions of city fortifications, and possibly a temple, although the latter is depicted with exactly the same architectural features and style as city fortifications. The white obelisk is an early example of a long tradition, that comes to fruition in the period that the famous Neo-Assyrian palace reliefs displaying the conquests of kings are created. Likewise, these show images of conquered cities and sometimes even villages, and therefore useful as a source of information for the visual conceptualisation of these buildings. Across this long period from the Late Bronze Age to the Iron Age, there are no stark differences in the main architectural character of city defences. At closer inspection however, some architectural evolution is observable in the chronologic ordering of such images (see VI.11). Some very general architectural tendencies can be inferred from these images about the visual appearance of fortification architecture. However, since most depictions from iconographic sources are of cities or temples, they may not be representative for smaller fortification or architecture in rural centres such as the *Dunnu.*

Unless they are very specific, textual references to architecture are not that useful. There are no architectural treatises that discuss general principles of design. Babylonian mathematical texts occasionally use architectural cases as an example, for instance in building material calculations (Robson, 1996). These refer to wall dimensions of imaginary buildings. A more useful description of ancient architecture is found in the Garsana texts, which describe the construction of a fortified compound in southern Mesopotamia. Although much earlier in date (21st century BC) than the *Dunnu* of Tell Sabi Abyad, it is a similar sized venture and a family household complex owned and controlled by a high status individual (Heimpel, 2009). In the course of the detailed accounts of its construction, all relevant parts of the buildings are described, allowing for a fairly good conceptualisation of these buildings.

VI.2 Classification of constructional units

Constructional units are defined as groups of walls that are likely part of a single building intervention. These help us to understand how the built environment was structured from a constructional point of view. Together with vertical stratigraphy, this will also help us start to think about architectural phasing although, it does not entirely solve the question of contemporaneity between different constructional units. The classification of constructional units is done based on a number of criteria:

- Identification of main exterior walls and interior, partition walls
- Structural relation between walls: bonded or abutted
- Structural viability: a building generally has its own four walls at least in order to build and support the roof or upper floors
- Wall alignment: aligned walls are more likely to be structurally related
- Constructional properties: bonding, mud brick type/material, wall thickness
- Stratigraphic relations: constructional units are built in the same layer, modifications in a seperate

Each of these aspects have been discussed in the preceding chapters. The decision to whether a group of walls belongs to a constructional unit is a result of an assessment of a combination of the above factors. Naturally, the incompleteness of the data ensures there are many uncertainties. This is also the reason that multiple factors were taken into account, as a multitude of positive matches may reinforce the idea that certain elements should be considered a constructional unit. The results are shown in the figures Figure 126 to Figure 129.

VI.2.1 Analysis of constructional units

The visualisation of constructional units reveals how the *Dunnu* was built and composed of different larger and smaller elements. They also give some impression about phasing, because in the assessment, their stratigraphic associations are taken into account. For instance, the plans show the series of expansions of the *Dunnu* on its northerns side. In this area, the fortification wall have been moved north in several instances, creating new spaces within. Although these are clearly separate constructional units, their temporal relation – contemporary or not – remains elusive.

The tower is shown with a multitude of separate constructional units, although from a purely architectural standpoint, it is single unit that has been modified several times. The residence on the other hand is shown as a single constructional unit with some minor secondary constructional units: small blocking walls. These may or may not be contemporary as they appear later modifications due to their abutment to the main structure, but their identification as such is uncertain. At the same time, some large interior partition walls are abutted to the main structure, which could in theory indicate these are separate constructional units as well. But consideration of structural, material, stratigraphic factors and especially general architectural spatial design make their constructional relation to the bigger architectural context clear.

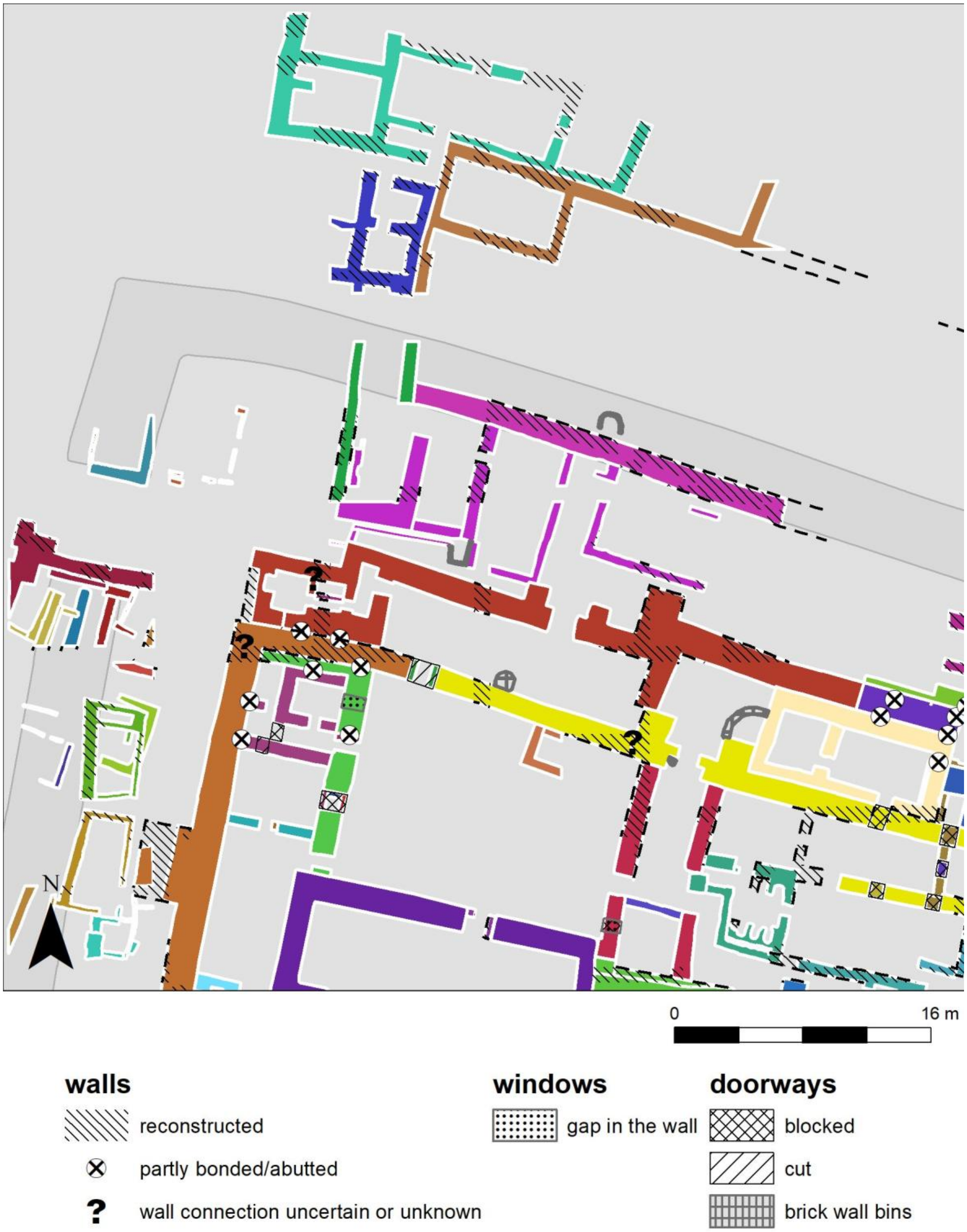


Figure 126. Construction units north-west.

Figure 127. Construction units north-east.

Figure 128. Construction units south-east.

Figure 129. Construction units south-west.

The fortification wall is not displayed as a single constructional unit, even though it would be logical if most of it was: an incomplete fortification would hardly be functional. The main reason that it is cut in several separate stretches, is that at some connecting points, the structural relation between the sections is very hard to establish. Either due to preservation issues, lacking detailed documentation, or apparent later modifications, the continuity of the constructional unit becomes hard to prove. For instance, halfway the eastern fortification wall, a tower-like projection is found, which appears to be stratigraphically later than the fortification wall itself, although the documentation on its stratigraphic relations is quite inconclusive. The possibility of such a later insert, in addition to other evidence for fortification modification in this area, creates large gap in the continuity of this structure. So, in this case it was chosen to split the north-eastern and south-eastern sections of fortification wall, although the contemporaneity of their original construction is still likely on logical architectural and defensive grounds.

The entire western section of fortification wall has also been assigned a separate constructional unit, but in this case, its apparent constructional separation could indeed be indicative of a later addition. The factors contributing to this notion are the orientation shift in the south and north, its heavier construction (4.5/5 bricks versus 3-3.5 elsewhere), its abutment to the southern fortification wall, and its placement on a different foundation layer than the southern fortification wall. This conclusion is however far from certain, as the interpretation of architectural contexts is inconclusive due to challenges presented by the archaeological record. In addition, its specific architectural features can also be explained otherwise: a difference in alignment may be the result of local topography, while the increased thickness may also indicate that on this side, the fortification wall was constructed higher than elsewhere. The latter would make sense in view of the fact that this would have been the side that visitors would see as they made their way across the fosse towards the main gate. In addition, the presence of the elite residence clearly marks this side of the *Dunnu* as the administrative and representative side. It may therefore be argued that this wall was constructed to impress, rather than explaining its unique features by being a later addition. Nonetheless, the latter may still also be the case. Hence, regardless the ambiguity of the reasoning and resulting conclusions, the wall has been assigned its own constructional unit.

There are few other important observations that need emphasizing. The first is that the heavier (two bricks wide) architecture built on the interior of the fortification wall, forms a structural unit with the fortification wall. This would indicate the fortification wall and most of these buildings were conceived as a functionally integrated unit and built in a single event. Especially a section in the southern fortification wall represents an interesting example of a large four-roomed building that is integrated with the fortification wall and includes small tower like projections.

Built against these integrated heavy structures, are a series of lighter walled structures. This is only the case in the north-eastern, eastern, and southern sections of the *Dunnu*, where sufficient space is available. In the north-west and western sections, the residence and central courtyard take up all the space. An especially interesting case is the series of walls abutting (?) the northern wall of the large building in the southern *Dunnu* (SW-8a). These walls have a somewhat irregular orientation, and shape. Their structural relation to the walls of the heavier building has not been clearly documented, but it would seem logical, if they were abutted. Although on face value these lighter irregular structures could have been all separate constructional units, this is unlikely. Their walls all structurally rely on each other if the hypothetical roofs are placed. Moreover, the particular morphological features of these walls suggest that a space was preconceived on both sides of each wall, except for the two walls on the western and eastern extremities. This all implies they were always thought of as a structurally and functionally integrated whole. Again, in terms of phasing, due to the sloping surface and minimal documentation of the earliest layers, it is very hard to tell whether the moment of construction of these structures is contemporary with or later than the heavy building. Purely in terms of construction sequence, the lighter architecture is later. Whether this is days or years, is unclear. Consequentially it is impossible to decide whether these are part of a single architectural intervention, or two separate ones spaced apart by a significant amount of time.

With regards to the extra-mural architecture, we may recognize several large constructional units. In the area between fortification wall and fosse in the east, one large constructional unit covers half of the area. The others may very well be part of a single event, but are separated due to abutment to the former. Nonetheless, it indicates that also here, a large unit composed of several smaller spaces was conceived as a single building. In the extra-mural area in the northern part of the *Dunnu*, the architecture is heavier, and very incomplete. Nonetheless, several clearly separable constructional units can be identified that may indicate a complex of several larger buildings. In some cases, lighter structures are appended to these, as was also seen with the lighter structures that are built against the heavier buildings in the intra-mural area.

VI.3 Reconstruction of building phases

It must now be clear, based on the chapter on the formation of architectural deposits (IV) that the *Dunnu* was not built at once, but is the result of various smaller and larger construction activities, demolition and decay. An important question is how the physical form of the *Dunnu* evolved over time. Inferences on this level influence how the reconstruction is made in different phases, which in turn has implications on how we may interpret our model of the (spatial) functioning of the *Dunnu*.

VI.3.1 Issues with the current settlement phase plans

The currently published phase plans (Figure 10), discussed in chapter III.1, can be used as start for a discussion about phasing. On these plans, the main Assyrian *Dunnu* is subdivided in two phases, called 'level 6' and 'level 5'. One may critique these plans for their simplified picture of settlement development they put forward. First, to speak about these phases as archaeological 'levels' does not reflect the reality of stratigraphic complexity. The use of the term 'level', implies we can observe a blanket phase across the entire site, which is then sharply cut following the creation of a new 'level' (Düring, 2012). As has been pointed out in chapter IV, the physical shape of the *Dunnu* was the result of a single large building event, followed by various more localised constructional interventions with a specific functional aim. Although it is clear from the previous discussion on constructional units, that certain building projects had a wide scope and may have affected large sections of the *Dunnu*, the stratigraphic evidence does not allow for reconstructing single phases across the entire site. Direct stratigraphic links between strata in different spaces always 'break' at some point, either because the sequence of deposition differs too much, because excavation has not touched a certain area, or stratigraphic documentation has not been sufficient. Stratigraphic unity within smaller sections of the site, for instance inside different rooms of the same building, or between a group of linked buildings may follow a synchronous development with similar deposits as a result. Also, even if a similar sequence is observed, indicating for instance dual phasing (e.g. level 6/level5), in the absence of direct stratigraphic evidence for the connection between the events, it is very hard to proof contemporaneity. Therefore, only localised construction sequences can be reconstructed with some degree of certainty. However, since not all areas follow the same sequence in the same way across the entire *Dunnu*, it seems plausible to suggest that we are looking at an asynchronous site development. That means that between two areas of the *Dunnu*, we may observe diverging construction histories, even in cases where the total number of phases is the same. Such diverging construction histories may even occur within a single large building such as the tower. On the other hand, larger construction projects may have affected large areas of the site at once.

An important cause for the uncertainties in building chronology, is that archaeological knowledge is not equally distributed for all phases. Therefore, especially the site plan for the original *Dunnu* (level 6) is very hard to draw reliably. First, not all 'squares' have been excavated completely until the oldest Bronze Age phases. We only know the oldest Bronze Age layer was reached, when finds or structures from the Neolithic tell appear. In addition, as is the tendency in archaeology, older phases of settlements are less well preserved than later ones, as they were affected most strongly by later building activity. As a result, we may question various aspects of the level 6 site plan. Some of the construction evidence of the fortification wall (0) may indicate it was nearly completely rebuilt at some point – although this is affected by interpretational uncertainty, as the evidence can be explained in alternative ways. And do the differences in width and orientation of the western stretch of fortification wall indicate it was a completely new addition? Perhaps added to the *Dunnu* when the residence was built, to make space for this large building? Such possibilities would completely overturn the plan of the early phase *Dunnu*.

The 'level 5' phase plan can be reconstructed more reliably. It seems that this is the final phase in an evolutionary process that was terminated by destruction, decay, and (partial) abandonment. The remains of this later *Dunnu* phase have preserved because the structures were allowed to collapse and fill up. Moreover, the people responsible for the subsequent reuse phases ('levels' 3 and 4) did not clear out the old buildings, but just added few new structures without interfering too much with the base of already standing walls. Nonetheless, even if the overall layout of level 5 is reasonably clear, there are uncertainties. These relate to the precise moment that spaces are partially filled, and a new floor level is created within buildings, and associated evidence for a new type of use. An example of this is the North-East corner, the area just west of the large courtyard. There is a list of corroborating evidence for the complete functional turnover: the raising of floor levels, the use end of a bathroom, discarding part of a large archive of cuneiform tablets, blocking an opening, adding a cremation burial, creating a new door elsewhere, and the construction and use of a pottery kiln. This evidence strongly points in the direction that the official and administrative functions of the area around the large courtyard have discontinued. This activity has been included in 'level 5', a phase that supposedly was part of the historical *Dunnu.* The large batch of cuneiform tablets buried underneath these raised floors, suggest however otherwise. even though it represents a complete break in function and floor level.

It seems that some kind of shift in social and economic use had already occurred that separates this phase from the primary *Dunnu* phase during which it was a centre of administration and representation. This has large consequences for instance in the north-western sector. If this phase of use indicating this shift should be separated from 'level 5', only a single floor or use level existed in this corner of the settlement that belonged to the primary *Dunnu* phase (covering both levels 5 and 6). Although there is a possibility that there are older Assyrian layers underneath the residence, court and new gate, some of this material is very inconclusive in its chronological assignation. In some cases however, such as "the office" (building NW-3) it seems Neolithic layers are found directly underneath, indicating a single floor phase, or level, prior to the collapse and contraction. This may imply that either the western fortified area of the *Dunnu* was a later extension or addition indeed, or that this area was simply kept clean and left untouched for an extended period. While at the same time in the eastern *Dunnu*, multiple renovations had taken place. Hence, it shows that it is very difficult to draw a sharp line between level 6 and 5, and that they together represent a single continuous use phase within which various modifications took place.

VI.3.2 Establishing alternative phasing

Rather than talking about a sequence of levels 7, 6 or 5, indicating uniform site-wide changes, we should adopt a model that considers the possibility of having alternative sequences of construction. In addition, it is preferable in this context to talk about construction phases, rather than levels. That said, multiple observations do suggest some kind of dual or tiple phasing of the *Dunnu*, although it, as argued above, impossible at the moment to link local architectural modifications to a grand scheme of events.

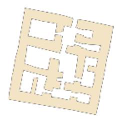
Probably the most important observation is that the *Dunnu* had two consecutive gates: the old gate and the new gate. The presence of the gates imply the existence of a closed ring of fortification, which must therefore also have existed at the same time. In the section analysing the fortifications, it is argued that there is a possibility of a shorter earlier version of the perimeter wall (VI.11.6). The construction of the new gate, corresponds structurally and stratigraphically to the closing of the old gate, and possibly to the extension of the perimeter wall. This was probably the most significant modification in the history of the *Dunnu*, as these gates determine the entire access and circulation pattern and therefore the way the *Dunnu* functioned as a spatial unit. We may thus create a chronological and functional division between an old and a new gate phase. An additional observation is that the old gate is oriented towards the tower, the new gate is oriented towards the residence. Stratigraphically and architecturally, there is a clear difference between the tower and the residence, which matches the observation in terms of gate sequence. The residence was definitely built after the tower, or at least the oldest version of the building.

In the newly proposed reconstruction of the phases, the residence, together with the expansion of the fortifications in the west, is constructed in a single time, including small supporting buildings such as “the office” (NW-3). They are added to an already existing large building, the tower. As has been discussed on multiple places in this dissertation, the tower is a heavily modified structure. The northern side of this large building was demolished and rebuild completely, including a new, larger staircase. Additionally, a large abutment was built against the eastern and southern faces. That this reinforcing abutment did not run around the northern face, is significant. It implies that this section was already strong enough, and didn’t require additional reinforcement. The question of contemporaneity between abutment and renovation of the north wall and staircase is a vexing one, causing a watershed of consequences. The building of the abutment along the south and east walls must have been contemporaneous with the construction of the residence. The east wall of the residence effectively has the structural role of this abutment on the west side of the tower. If we assume that the abutment was built at the same time as the northern renovation of the tower, then it also pulls the residence into this single large building event. The question then is, what is their sequential relation to the construction of the old gate and associated fortifications? The old gate appears to be built on an elevation that matches the foundation level of the renovation of the north wall of the tower, but there is no direct stratigraphic link. If contemporaneous, this would argue for the currently published level 6 plan: the construction of the old gate and the construction of the residence in the same phase. Nonetheless, their stratigraphic vicinity does not prove their contemporaneity. It is possible that both were constructed at different moments, some years apart, and still end up on the same base level.

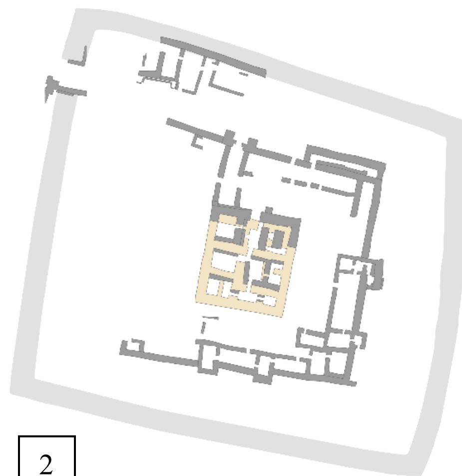
As has been discussed, there are other modifications of the architecture elsewhere in the *Dunnu* that affect a larger area. The north-eastern corner appears to have been modified three times, also involving the fortifications. It corresponds to significant functional changes such as the remodelling of a staircase into a bathroom (NE-5), and in a third building phase an extensive new addition to the exterior fortification wall was made (NE-6b). The oldest phase, related to the eldest fortifications, includes a large building with a mud brick floor, which, like the old gate, seems to be associated with the large renovations on the northern face of the tower. The final addition in this corner to the exterior of the fortifications appears to be even later than the construction of the new gate phase, although also here the stratigraphic link is not certain. The in between phase in which the staircase was turned into a bathroom, may thus be contemporaneous with the new gate phase. But they may just as well be unrelated, separate events.

In the south-eastern sector, extensive modification to the site plan also took place, changing the entire access structure of the area behind the postern gate (see VI.12.2). Whether we are dealing with a triple or dual phasing is unclear. The two latest architectural phases are stratigraphically very distinct, due to a conscious action of demolition, levelling and redesign (see V.6.4). Below the oldest well-known phase, some traces of even earlier surfaces appeared. But like the earlier surfaces elsewhere, such as below the residence or the paved courtyard, these are isolated. The explanation that would fit best, is that they belong to the phase of the earliest tower. The remodelling of the section in the later phase, most likely is linked to the creation of a new staircase giving access to the fortification wall (SE-6). This may be significant, and possibly links to the removal of a staircase in the northwestern corner as it was turned into a bathroom. Again, this is a hypothetical reconstruction of events, that may just as well be unrelated. Stratigraphically, the construction events cannot be connected as a large space (NE-4f) remains incompletely excavated.

The southern *Dunnu* is interesting for a different reason, namely that no large-scale modifications have taken place. A dual phasing is suggested, with in phase one the fortification wall with integrated multi-roomed buildings (SW-2 and SW8), and in phase two, the smaller, north-south oriented structures are added in the empty space. There is no indication that the addition of these structures occurred step by step, and it therefore seems they were all added in a single larger event.



1



2

3

4

5

6

Figure 130 (previous page). Alternative site phasing. This is just one of various options possible.

VI.4 Defining buildings

VI.4.1 Formal classification of spatial units

One way to approach buildings is to define them as spatial units, as opposed to constructional units, as has been discussed above (VI.2). Spatial units are groups of spaces that are related in terms of connectivity and access. For instance, a typical building has one main entrance, and from that single point it branches out into various subsidiary spaces. Such spaces may be arranged very hierarchically in a string like fashion, or in a non-hierarchical way all connected to the same central space. Because such spatial complexes have dead-ends, they may be recognized relatively easily. However, instead of dead-ends, some spaces are arranged on a ring, for instance due to the presence of secondary entrances. When ring structures are present, this may indicate strong spatial connections between the concerned spaces, which are therefore operating as a close spatial unit.

The classification of space has been executed by drawing circles around groups of spaces that are connected after a spatial split has occurred. So, for example we can take a courtyard-like space, that has connections branch out in three directions. After each exit, a circle is drawn around all spaces that can be reached from this point. In addition, circles are drawn around spaces that are arranged on a circle. This causes some spaces to be part of multiple overlapping rings. Because the *Dunnu* is a walled structure itself, with only two entry points, it formally counts as a building as well. However, for the clarity of the visualisations, this circle has not been drawn. Nor has a circle been drawn around the large ring like structure that connects all the spaces within the intra-mural *Dunnu*. Although this is an extremely important structure that determines how the *Dunnu* functioned spatially, our attention is now on the smaller spatial units that may be defined.

This classification has been performed for two possible phases of the *Dunnu*, an earlier and later one. The results can be seen on figure 131 - figure 133. Uncertainty regarding the presence or absence of doorways has of course a big impact on the analysis. This is considered by assessing the effect of the alternative option.

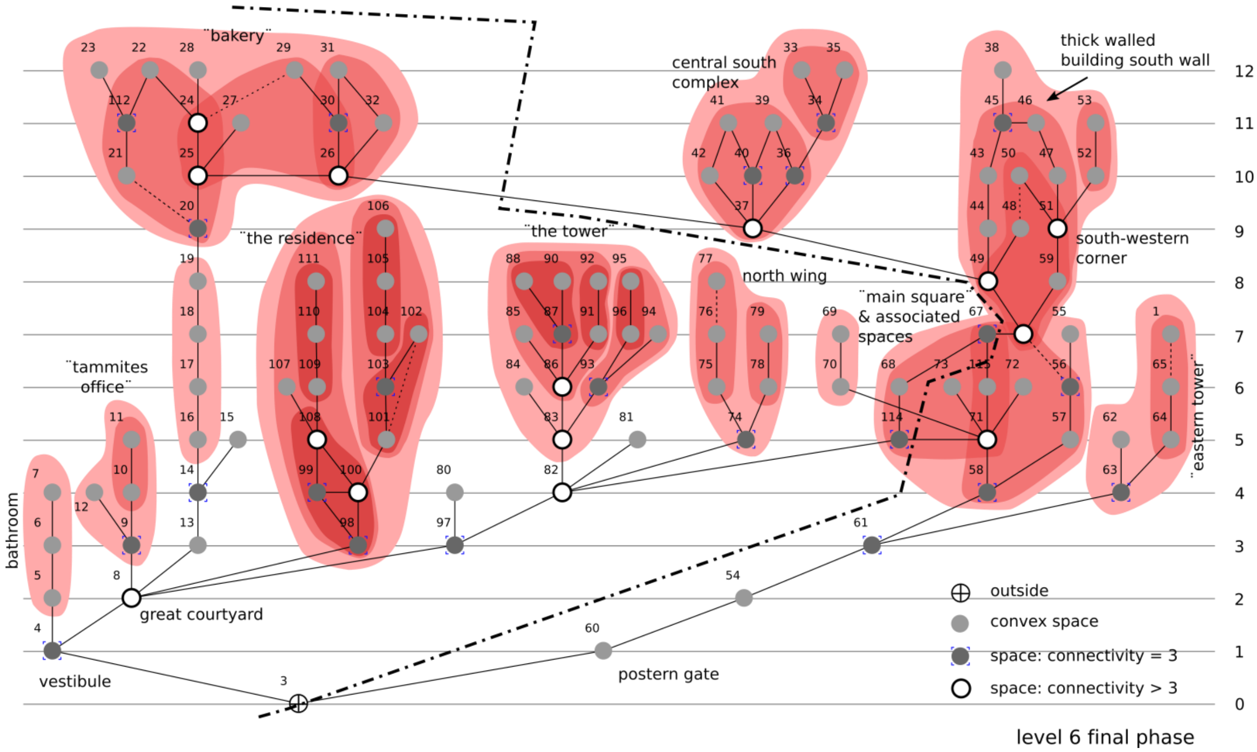


Figure 131. Spatial units as defined by connectivity graphs, early phase.

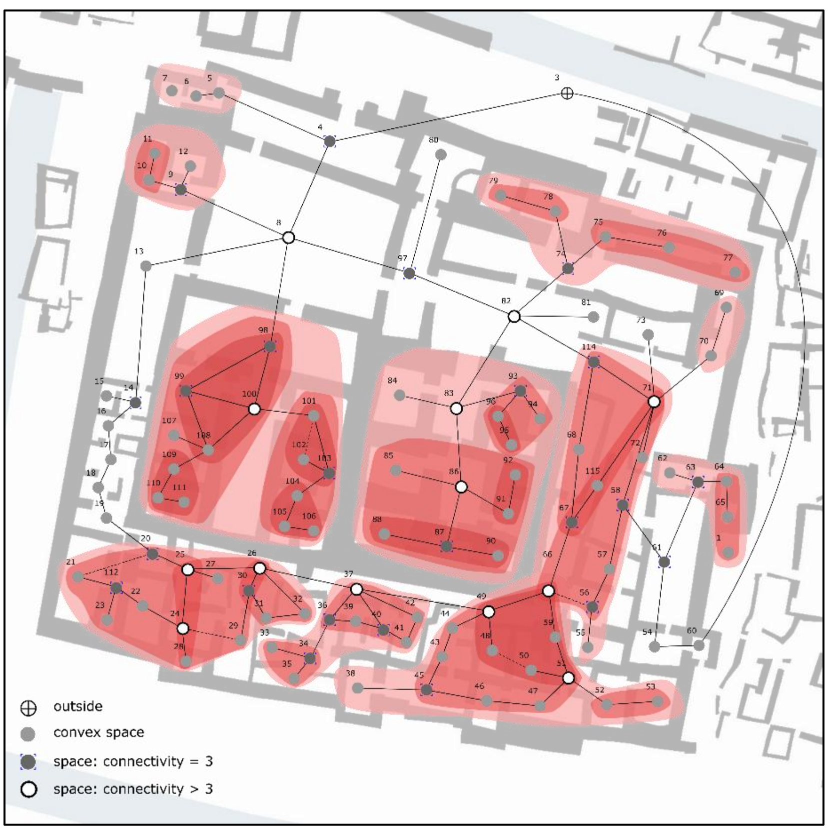


Figure 132. Projection of figure 131 on plan.

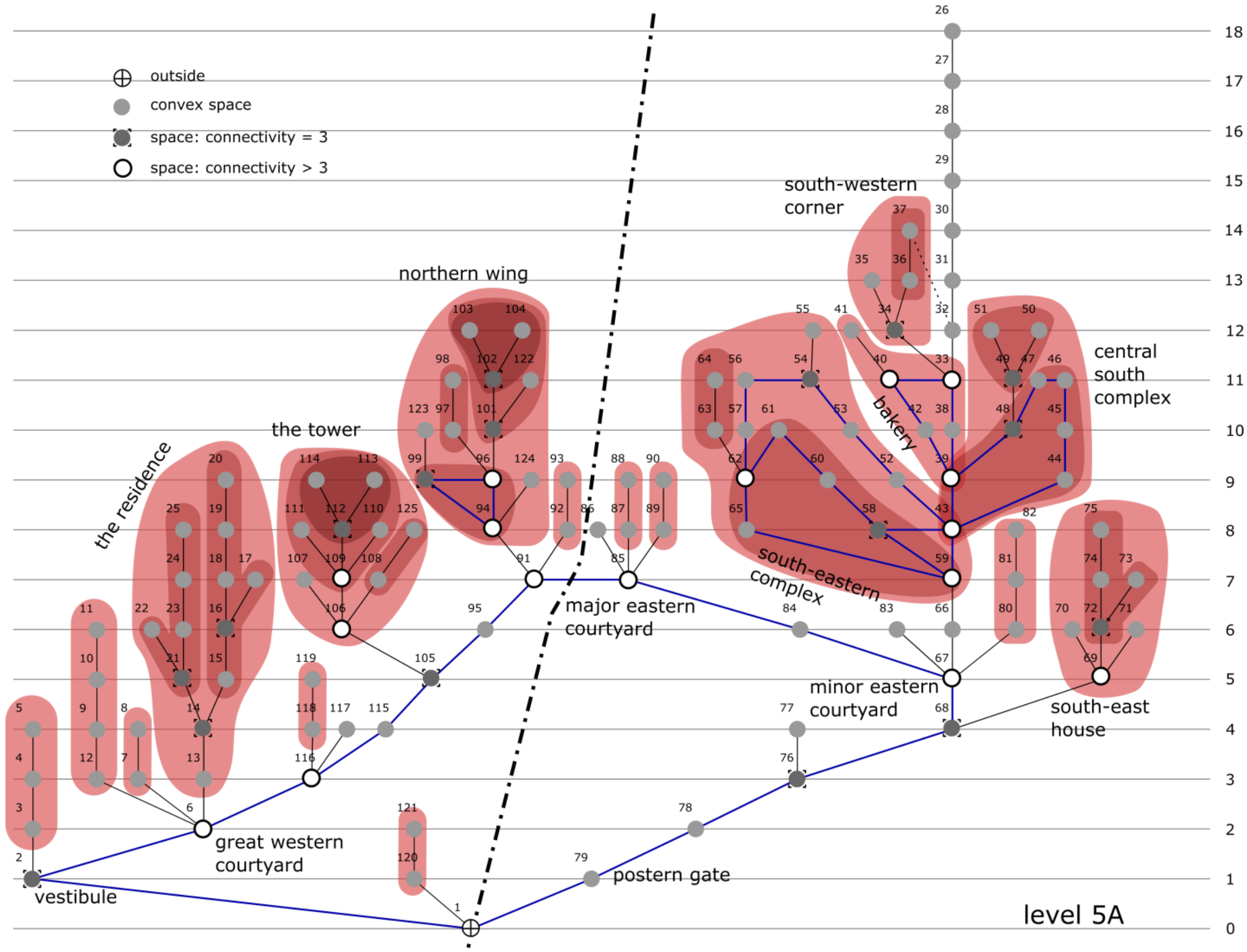


Figure 133. Spatial units as defined by connectivity graphs, later phase.

As may be expected, clearly defined construction units (VI.2) with a single entrance point, such as the residence and tower, correspond to spatially integrated units. In other cases, groups of spaces are spatially integrated due to their location in ring like arrangements. This often draws together multiple groups of spaces that may be structurally separate units. It even draws together potentially inside and outside spaces. Although theoretically interesting, as these differences in spatial integration and groupings of spaces point at the spatial functioning of the *Dunnu*, in-depth treatment of this topic has to await future study.

What makes a group of spaces a building is may be partly defined by whether a structure has a shared roof, and how it is related to open spaces. Due to the complexity that spatial rings add to the definition of groups, we may not get a clear view of this outside-inside difference. We therefore have to add a few more variables to the system to arrive at a good representation of outside and inside areas.

VI.4.2 Inside versus outside areas

For the interpretation and reconstruction of buildings, we need to be able to distinguish between outside and inside. In the case of the *Dunnu,* excavation notes and reports already refer explicitly to 'rooms' and '(open) areas'. Since this is nearly always a classification based on a first impression, within the small context of a single excavation square, this interpretation must be validated. Although in many cases such classification may appear obvious, it can potentially be hard to differentiate as is illustrated in Figure 134. Looking at settlements in general, there are many spaces that are not easily classified, such as covered alleyways, courtyards, or partially roofed areas. The archaeological data will also not always have been sufficiently preserved or documented to be able to prove the presence of roofs. Micromorphological methods that could potentially help to discover roof contexts (Friesem, Tsartsidou, *et al.*, 2014) have not been applied on Tell Sabi Abyad.

To formalise and validate the interpretation process, several variables are considered: constructional relations and structural requirements for roofing, the spatial grouping of spaces, direct physical evidence for roofed areas, and finally evidence for the use of spaces. These are discussed each separately in the following sections (VI.4.3-VI.4.8).

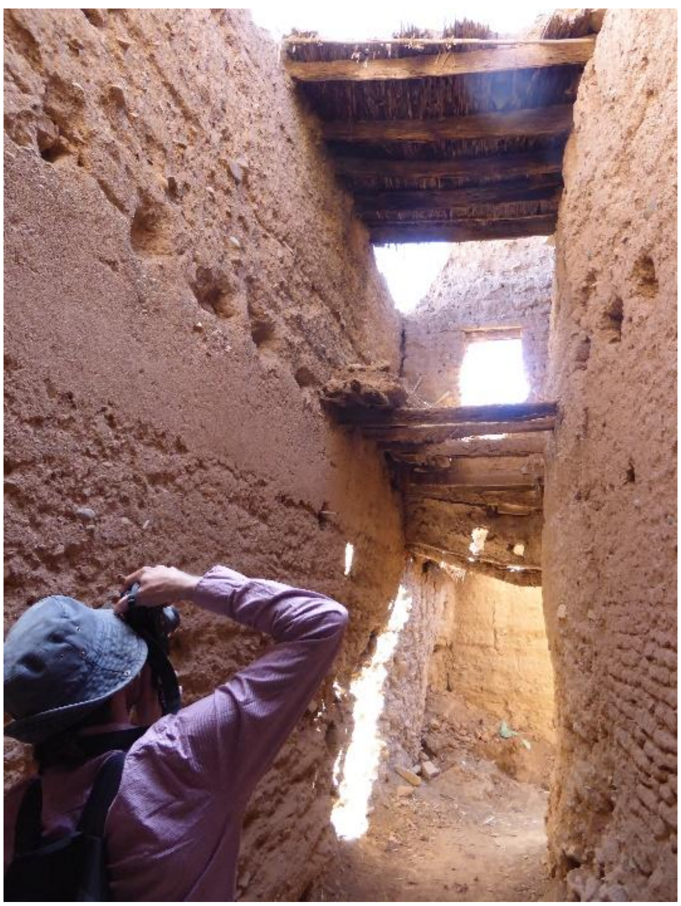


Figure 134. This alleyway in an abandoned walled settlement in south-eastern Morocco was once largely covered. The walking surface is that of an alley: untreated and irregular, with an erosion channel at the bottom. This would archaeologically not easily be identifiable as roofed area.

VI.4.3 Material evidence for roofs

Direct material evidence for roofs may be in the form of burnt construction elements such as beams, reed cover or loam deck. As there was a fire that ended the *Dunnu's* primary use phase, roof elements could potentially have been preserved. The distribution and nature of burnt deposits and features dating to this phase is displayed on Figure 135. Unfortunately, evidence for burning often includes just high concentrations of pieces of charcoal or grains, which is hard to link to roofs. Larger fragments that could potentially be identified as structural wood are rare, and never of a thickness that matches heavy beams. Nonetheless, as fuel for burning, the timber and reeds used in roof construction would have been the most readily available material (aside from remaining barley stocks, apparently). It is possible that remaining unburnt and partially burnt construction timber was later, taking the direct evidence away from our view. This scavenging activity, clearly evidenced by the post fire pillaging of materials in the large courtyard, would also have resulted in the presence of roof material in places that would not have been originally roofed, such as the large courtyard. As a result, with these caveats in mind, the map of Figure 135 can only be viewed as a very rough and incomplete indication of roofed area.

Figure 135. Recorded evidence for burning, burnt construction wood and reed impressions in the lower fill of level 5 spaces.

One case stands out. Space SW-9c, revealed partially crushed pottery, burnt material in the fill and even slabs of burnt loam that could very well be parts of the roof deck (Figure 136). Such contexts are however rare.

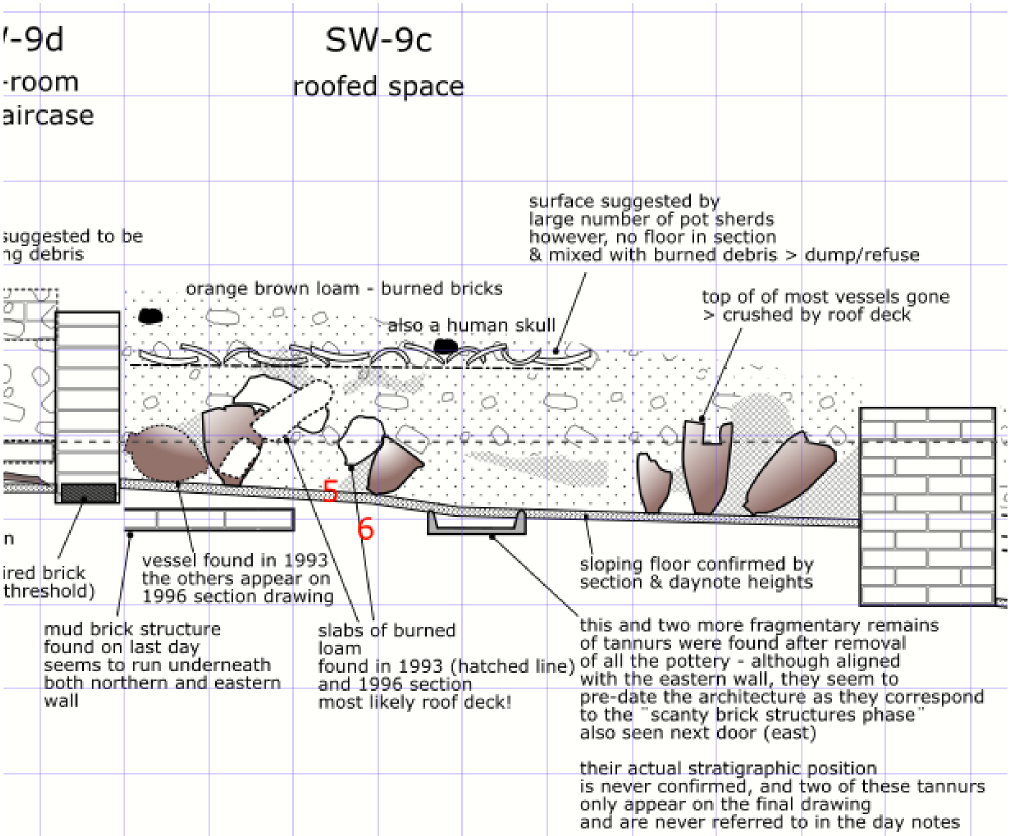


Figure 136. Deposit sequence graphs for space SW-9c, in which large slabs of burnt loam were noted that may very well be remains of a roof collapse.

VI.4.4 Differences in infill

The difference between potentially roofed and unroofed spaces may reveal itself in difference in infill processes. As has been argued in chapter IV, much of these differences may be attributed to architectural-climatic conditions or building/demolition activities. Outside areas collect more natural and human deposited sediments than interior areas, and gradually a layered fill pattern will develop, unless an area is cleaned. But even cleaned areas are at some point abandoned, and filled up in a way that indicates their exterior exposure. Interior spaces on the other hand may fill up with building collapse, possibly aided by intentional demolition.This model assumes that building collapse deposits always end up on the interior. Although general observations support this picture, reality is more complex. Building debris could end up on the exterior of the building in an outward debris fan, while a gap in a deteriorating roof may open the way for natural sediments to develop on the interior of a building. Multi-storey buildings on the other hand, with intermediate floors blocking such sedimentation, will again change the probability of certain types of deposits on ground floor level to develop.

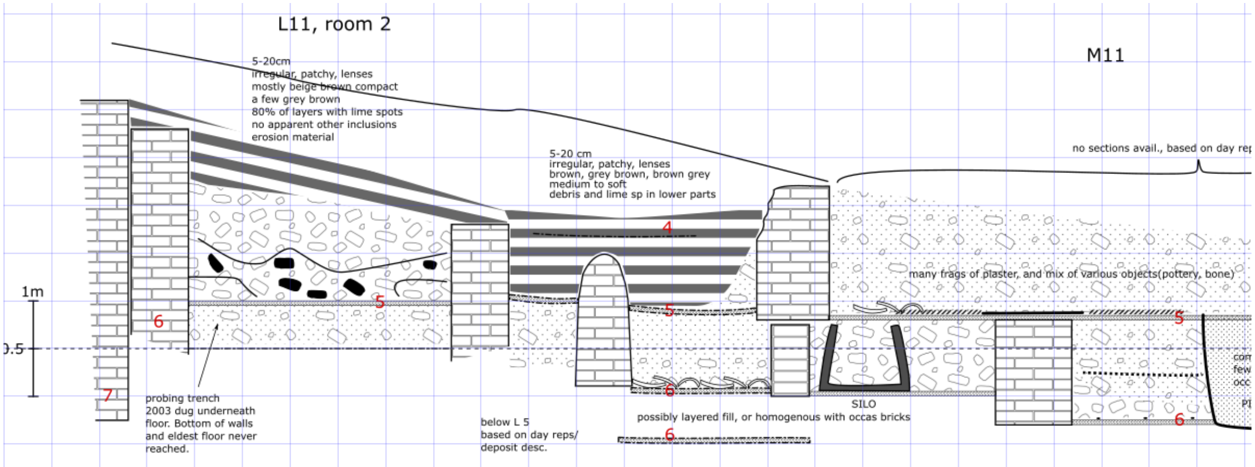


Figure 137. Typical difference between infills of potentially roofed and unroofed spaces. There is a marked lack of building collapse deposits in the middle space, and a presence of gradual (sedimentary) deposition associated with outside areas.

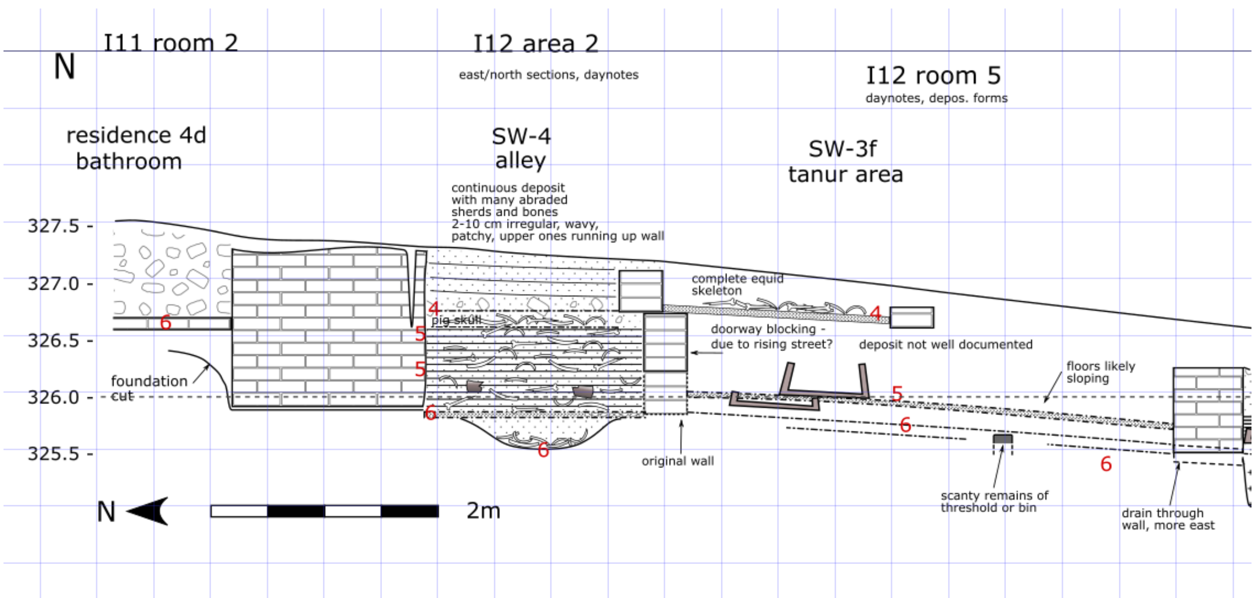


Figure 138. Deposit sequence graph, showing the difference between deposition inside a large building (left) and an open alleyway (right). The area on the right was most likely unroofed, as floor levels gradually raised, but the documentation did not allow to complete the graph drawing.

Despite these caveats, the pattern of deposition can in several cases be attributed to the difference between exterior and (formerly) interior spaces. Evidence for the gradual raise of ground surface is found in several areas (Figure 137, Figure 138). As has been proposed in chapter IV, it seems that some exterior spaces were kept clean, as we see a gradual infill process initiate only after building decay started. This would have been the case with the large tile paved western court. This is also the case with a small area between buildings in the eastern half of the *Dunnu* (Figure 137, middle area). Elsewhere in the *Dunnu*, the process of gradual deposition and accumulation of the ground level is clearly present before the fire. These are the alleyway in the south (SW-4a, Figure 138, middle area), and the large open space in the eastern *Dunnu* (NE-4f), which most likely functioned as some kind of courtyard. The infill pattern reflects that of what is seen in village contexts, and indicates the lack of roof coverage. However, these cases mainly confirm and strengthen expectations based on spatial and architectural criteria.

A unique case is room 5 of the tower (Figure 139), which initially reveals a gradual accumulation of deposits ('floors'). After a thin layer with building debris, possibly a levelling layer, new walls are put in against the interior faces of the older walls, followed by an end of gradual deposition. This could indicate the transformation from an exterior to an interior space. In this case the new walls specific purpose would have been to support a roof. A similar pattern of building modification occurring parallel to a change in the mode of deposition is observable in room 2 of the tower.

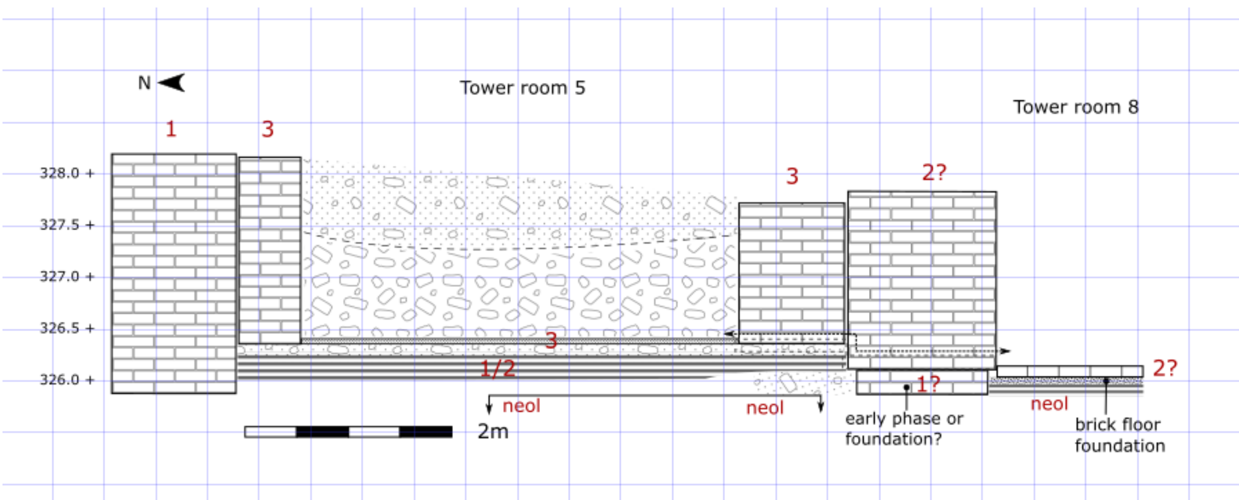


Figure 139. Deposit sequence graph of tower room 5.

The analysis of deposition processes in chapter IV also showed a marked differentiation in the density and the volume of the mud brick debris layers. Several examples are illustrated in the figures below (Figure 140, Figure 141). The difference may be attributable to the absence of a roof in the spaces with lower densities and lower volumes of collapse. A good example is the large, tiled space of the residence (Residence-1), which contains much lower amounts of brick debris in its fill than the other rooms of the same building. However, in other cases, it may be hard to attribute the difference in debris volume to the absence or presence of a roof, as building height may be the main factor contributing to a certain volume and density of the brick debris. For instance, it is still a question of how to distinguish between walled open enclosures and single storied light walled buildings in the absence of a gradual surface accumulation deposit. In both cases, we may expect a similar pattern of low density and low volume debris deposit. Examples may be some of the lighter walled but roofed architecture in the south-eastern corner (building SE-5), or in the south. It is yet unclear whether such contexts are well distinguishable based on deposit pattern analysis, since a walled open enclosure and a light-walled roofed building may be very similar in terms of total brick construction volume.

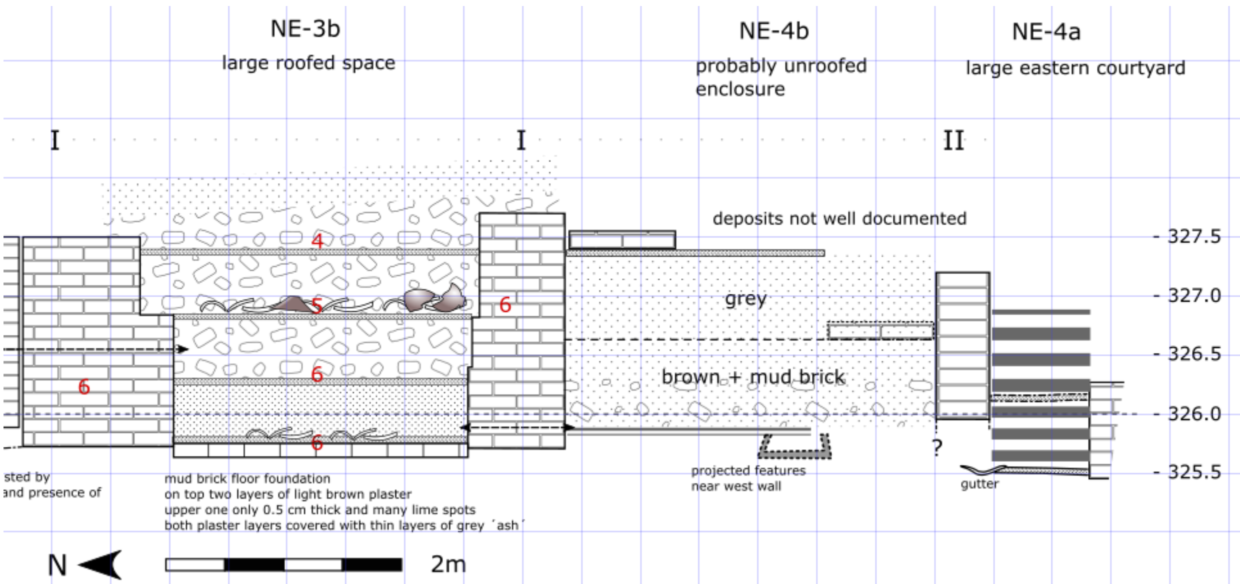


Figure 140. Deposit sequence graph showing the difference between a building with a high volume, much debris (left), and an area with significant lower concentration of debris (middle), and a courtyard (right). Based on this infill pattern it is uncertain whether the middle area was roofed or not, but it likely was a single floor roofed space filled with debris and erosion products from adjacent heavy architecture.

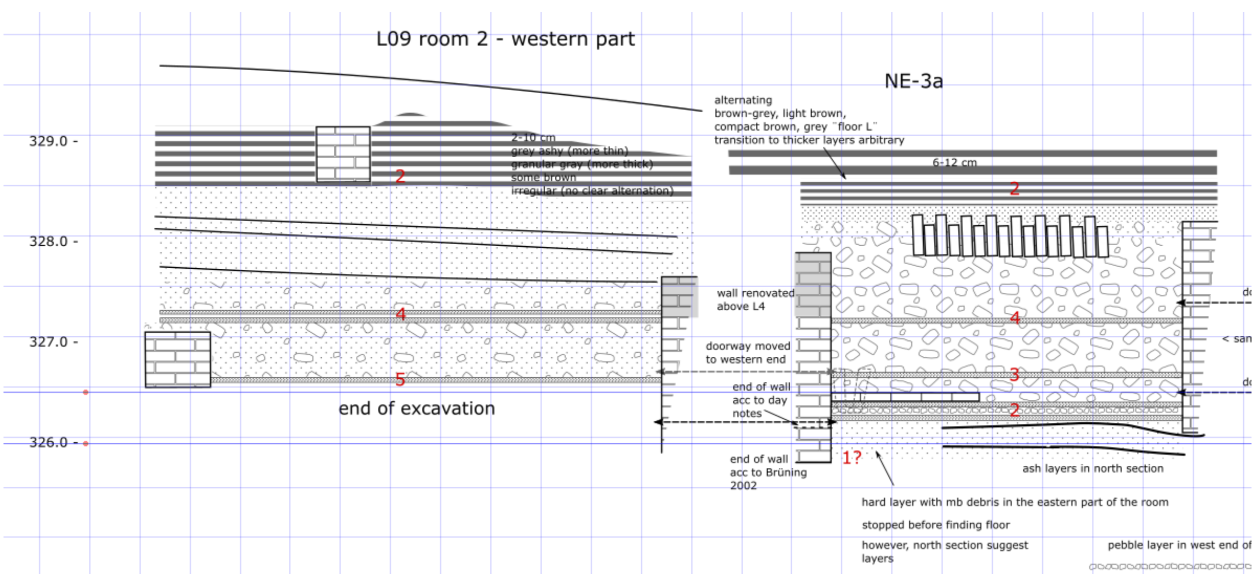


Figure 141. Example of two adjoining spaces showing a distinct difference in infill pattern and wall preservation, most likely attributable to the difference in roof coverage. Relative size of the spaces, and the presence of the old fortification wall on the right may however also have played a role.

VI.4.5 Material properties of surfaces

Material properties of surfaces can potentially be a very good indicator of the difference between outside and inside, as has been found in the ethnoarchaeological study of an Iranian village (Kramer, 1979, p. 149). The distinction can be made both in respect of construction materials and methods, and degree of messiness. Exterior surfaces are generally unconstructed, weathered, irregular surfaces, and hardened by regular usage while interior surfaces are more likely to be constructed floors using finer materials. Erosion gullies, pottery shards and pebbles may all be indicators of exteriors, while smooth loam, whitewashed or plastered surfaces are features of interior floors. Within messy outside places, there is an additional distinction between courtyards and village commons and alleys, the first kept cleaner than the latter two. The cleanest places would be those areas used for habitation, sleeping or administration, which generally takes place inside.

Figure 142. Recorded surface characteristics in the Dunnu.

Floor construction and types have been discussed above (V.5.5). Irregular or stony surfaces often associate with spaces that are already thought to be outside or semi-outside areas based on other characteristics of these spaces. Therefore, it strengthens mostly already current hypotheses. The gullies that were found in the alleyway in the south probably drained the water of the roofs of these buildings (VI.7), and implies it was open. The absence of this gulley a little bit more to the east is interesting, and may indicate that part of the alleyway was covered. However, the excavation did probably not reach deep enough here to uncover the level of the gulley.

In some larger areas in the *Dunnu* we find tile paved surfaces. Tile paved surfaces in general are thought to be an indicator of status, and therefore restricted to the more representative spaces. However, they are also found in bathrooms, where they are used together with bitumen to make water-resistant surfaces. In the case of the larger pavements, there is evidence of a drainage system (VI.7), which would imply the absence of a roof. Mud brick surfaces are also constructed. Although their purpose is not entirely clear (§VII.5.3), most likely they served as a foundation layer for well-made interior plaster floors.

White plaster floors or loam floors with a white mineral element mixed in, occur in various areas. We may argue based on observations in recent traditional village contexts that white plastered floors are applied in neatly kept interior spaces. In some cases, such as the oldest phase of the tower, this can be confirmed by the architectural context. On the other hand, the spaces in front and behind both the old and new gate also received such treatment, which indicates that white plaster was used in open spaces as well. It may have served as surface reinforcement in areas of high traffic, and additionally to symbolically emphasize areas with a representative function, such as main entrance gates.

VI.4.6 Doors and thresholds as markers of spatial transitions

Closable doors and thresholds are usually a marker for a spatial transition, and indeed often this transition is from outside to inside. Looking at the distribution map of thresholds, post holes or pivot stones, many appear to confirm such an association (Figure 103). On the other hand, a number of pivot stones are located near doors that should be classified as interior doorways on other grounds. Although some of the pattern may be explained by preservation, dug-in pivot stones are probably least affected by such issues. However, we must also consider the possibility that they were missed in excavation if it stopped at floor level. In the absence of pivot stones, it is also possible that such spaces were closed off with lighter door constructions. But in this case, it would confirm the hypothesis that there is a material, and by extension a symbolic and functional, difference between interior and exterior passages. As regards to thresholds, their presence on transitions between outside and inside is well-explainable by the fact that their purpose is to both keep dirt out, and as ledge to securely fix a door against.

As can be seen on the map, many interior spaces do not seem to have been closed off by doorways, for instance in the case of the two main multi-space buildings, the residence and the tower. However, the details of the exact location of pivot stones in both buildings are interesting beyond being a potential indicator of transitions from out to inside. In the case of the tower, the main entrance seems to be an open gate, while the closeable doors are located one step deeper into the building. Does this point at a special access arrangement, or at the fact that the room behind the main entrance could have been an open space?

VI.4.7 Structural limits of roof span

Considering the static weight of a loam terrace roof, which is in the order of 500-600 kg per m^2, there are limitations of what can be built with the local timber (see V.3.8). As discussed in V.3.8 the most widely used tree species for roof construction in this region is poplar. This is not the strongest of woods, generally classified as a very soft ‘hardwood’, having worse structural performance than softwoods like pine and fir (Dalokay, 1966; Aydin, Yardimci and Ramyar, 2007). Additionally, the girth of poplar trees is generally found to be limited in the range of 15 to 25 cm (Dalokay 1969, 37; Margueron 1992, 89). This means that roof beams must be put more closely together than were they made of stronger wood. As discussed in the section on roof construction, a 3 to 3.5 meter maximum for roof spans with these types of wood, although this may be extended to 5 meters under certain conditions (see V.3.8). Access to good quality timber resources is an important factor.

Figure 143 below shows the width of each space in the *Dunnu.* This image reveals that most spaces could theoretically be roofed. Very few spaces exceed the 5-meter limit, confirming their status as ‘open areas’. Additionally, there are several spaces that fall in the 4-5 meters category. Those in the residence are interesting because on other grounds, these spaces are probably roofed. The large spans observed here, correspond to the high status that is assigned to this building. Some of the other spaces in this category are probably unroofed, while for others, this is less clear. The image also makes clear that many spaces that we would characterise as outside spaces, could theoretically have been roofed. We may consider for instance the possibility of partial roofing or creating passages across the narrow alley like spaces in the south and east. This would also allow us to take a very different perspective on accessibility and circulation within the *Dunnu*.

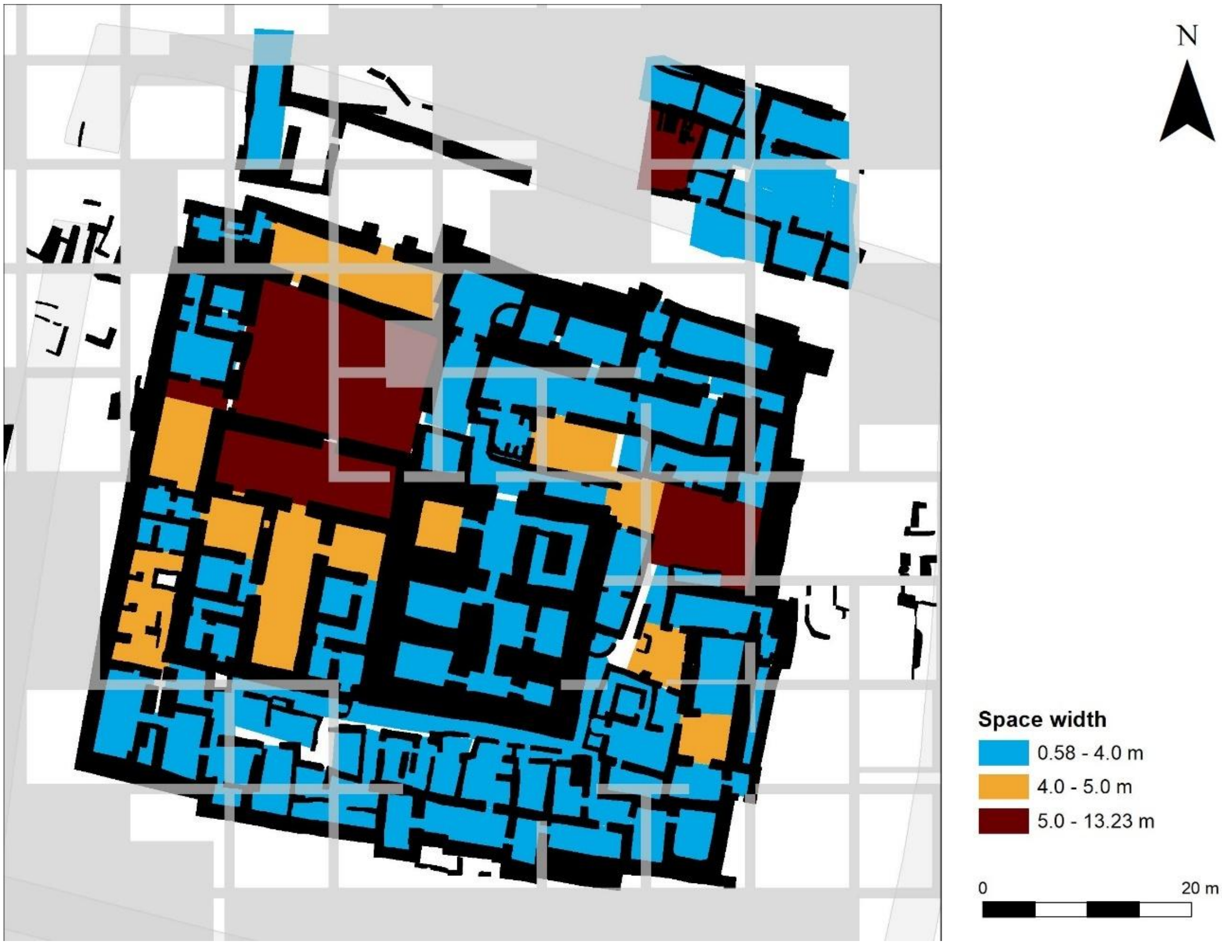


Figure 143. Width of spaces in the Dunnu.

VI.4.8 Determination of roofed space

For establishing which spaces were roofed the following criteria were used:

1. Direct evidence: evidence for roofing in the form of loam slabs, reed imprints or constructional timber. 1 point for a lot of evidence. 0.5 point for a little evidence.
2. Wall independence: does it form a structural unit with related walls on 4 sides? 1 point if all four walls belong to the structure, or three walls belong to the structure with at least two long walls, or is part of larger spatial unit joined by bonded exterior walls, and several internal partition walls. 0.5 point if some walls belong to adjacent buildings. 0 points if none of its walls belong to the space.
3. Enclosed space: does it form an enclosed space? 1 point for walls on all sides, 0.5 point for walls on 3 sides, or fourth side partial wall. 0 points for walls on less than 3 sides.
4. Walls on long sides: roof beams most likely placed across width of space. Requires two long opposing walls over entire length of space. 1 point for two opposing long walls. 0.5 point if one long wall is missing, but room is short enough to be roofed across its length (< 4m). 0 points if neither is the case.

5. Building plan shape: is it conceivable considering the form of the plan to roof the area? Very irregularly laid walls, or diverging walls cause a space to be of irregular width. These spaces are less likely to be covered with beams. Regular rectangular shape: 1 point. Diverging long walls: 0.5 point. Very irregular shape/inconsistent width.
6. Span: is it conceivable to roof the area without the use of additional support? Widths below 3.5 meters are considered roofable (1 point). Width between 3.5 and 4 meters are considered likely roofable (0.75 point). Widths between 4 and 5 are considered roofable if certain conditions are met (presence of very strong and thick timbers) (0.5 point). Over 5 meters: 0 points.
7. Character of floor: rough, irregular surfaces are more likely to be exterior spaces. Neatly laid loam or white-plastered floors are more likely found in interior spaces. Tile paved spaces (except bathrooms) on the other hand are, based on comparative evidence, more likely unroofed exterior spaces. -1 point for rough, irregular, or paved spaces.
8. Character of infill: gradual infill layers and multiple floor surfaces indicate sedimentation and thrash disposal. High density mud brick debris fill directly on floor: 1 point. Thinly layered gradual infill or low density/low volume mud brick: 0.5 point. Thickly layered gradual infill: 0 point.
9. Fire-related activities: more likely to take place outside. However, single hearth or oven on interior is common. -1 point for presence of more than one hearth or oven, or a pottery kiln.
10. Spatial function: Spatial distributors like courtyards are less likely to be roofed. Courtyards function as spatial distributor and as light shaft for adjacent buildings. -1 point if a space has 3 or more exits.

A visualization of the tabulation is shown on Figure 144. The blue shades indicate spaces that are very likely unroofed. The brown, yellow and orange shades indicate areas that may have been roofed with increasing likelihood. In some cases, contextual information that is not properly conveyed by the statistics may however still alter the likelihood of a space being open or roofed. The midrange values show areas that can easily go both ways, which therefore represents significant doubt. The figures are however also influenced by the of absence of data for instance on floor type or space fill. Moreover, one should take in mind that even spaces with a high roofing factor may still have been unroofed, and vice versa: spaces with a low roofing factor may still have originally been roofed. As has been concluded based on absolute roof spans, most spaces can theoretically be roofed, and the other factors such as floor type and presence of large amounts of burnt wood can have other explanations as well. This range in roofing likelihoods are taken into consideration and used to create alternative reconstructions. The impact of these on the potential function and uses of the *Dunnu* will be assessed in the conclusion of this chapter.

Figure 144. Roofing factor.

VI.5 Building heights

In this section a model of the original heights of buildings will be developed. It is assumed that this information is partly encoded in the plan as wall width. Besides this, the presence of staircases and wall reinforcements point at a lost world of upper floors. Additionally, large collapsed fragments of wall have been excavated, which can be used to reconstruct a minimum original wall height. And last, comparative evidence can help us with possible and plausible ranges of wall and building height.

VI.5.1 Wall preservation

Figure 145. Preserved wall height.

Differences in preserved height may be a first indication for differences in original wall height. There is a large variation in the preserved height of walls in the *Dunnu,* ranging from a few cm to 3.5 m (Figure 145). Looking at the figure we can see that the wider walls, which supposedly also carried taller architecture, are on average better preserved than lighter walls. This is as expected. However, looked at more closely it becomes apparent that preserved wall height does not strictly reflect original wall height. There are additional factors at play as well. For instance, the heavy fortification wall on the southern side is much less well preserved than the fortification wall in the north, and is even completely gone at several locations. Another example is the relatively heavy architecture in the north and east, outside the terrain enclosed by the moat, which is only preserved to a few decimetres at most. Preserved height has therefore been influenced by multiple other factors aside from original wall height. The erosion susceptibility of the location is likely to be big factor: walls in the south are certainly more eroded due to their location on the south slope of the summit of the tell. The terrain towards the north and west on the other hand is more level. A very important factor is the presence of later building phases on top of the ruined remains of the *Dunnu*. Later building phases add another layer of decaying building brick material that forms a protective shell covering earlier phases. From the archaeological evidence it appears that later habitation and use focussed on the northern half of the *Dunnu*, where preservation is best.[56] Another factor is demolition. Parts of the *Dunnu* architecture were demolished and levelled at some point in time, which may effect the preservation both negatively and positively. The consequence of levelling is that the lowest parts of the walls become encased in mud brick rubble, preserving part of the wall base. The preserved height reflects the height of the wall stumps that the demolition team decided to leave standing, which may have been lower than if natural processes had degraded the walls. A last significant factor in wall preservation is the presence of heavy architecture in the vicinity. The brick collapse and sedimentation flows that come from heavy architecture preserves surrounding lighter architecture. This is the case for the structures that were built directly south and east of the tower. Under these conditions, these structures are better preserved than would be the case if they were standing isolated in an open field.

Record heights are reached at the intersection of walls of the tower and residence, where the excavated wall remains reach 3.5 m above founding level. The building that is preserved best is without doubt the tower. Although as probably the highest building on site it was relatively exposed, the sheer mass of its walls ensured that a significant part of the building withstood the ages. Since the conditions of later re-use were the same as in the northern part of the residence, and the area directly north of the tower and residence, it seems reasonable to assume that the disproportional preservation of the tower reflects the disproportional original height of the building. Another indication for the original scale of this building is that in level 1, 2 and 3, new building activities had already taken place on top of buried *Dunnu* architecture of the northern fortification wall. At the same time, a small part of the tower was still visible as is clear from the stratigraphic relation with level 1, 2 and 3 activity surface areas (Figure 146). With a height from floor to preserved wall top of 2.5 to 3 meters, possibly the entire ground floor of the tower was preserved, at least in the northern part of the building. However, no direct evidence of the ceiling, for instance log holes, has been found. This could imply these rooms originally had a relatively high ceiling. However, the evidence shows that after the fire, one room filled with a 50 cm thick deposit of debris caused by either collapse or demolition that must have destroyed the upper floors and roof of the building. As the collapse/demolition

---

[56] Although there is a possibility that in the south later phases were also represented, but that the evidence was obliterated by erosion.

deposits had raised the floor level, it is likely that in any later use phase, the ceiling would have been raised as well, possibly removing evidence of earlier ceilings.

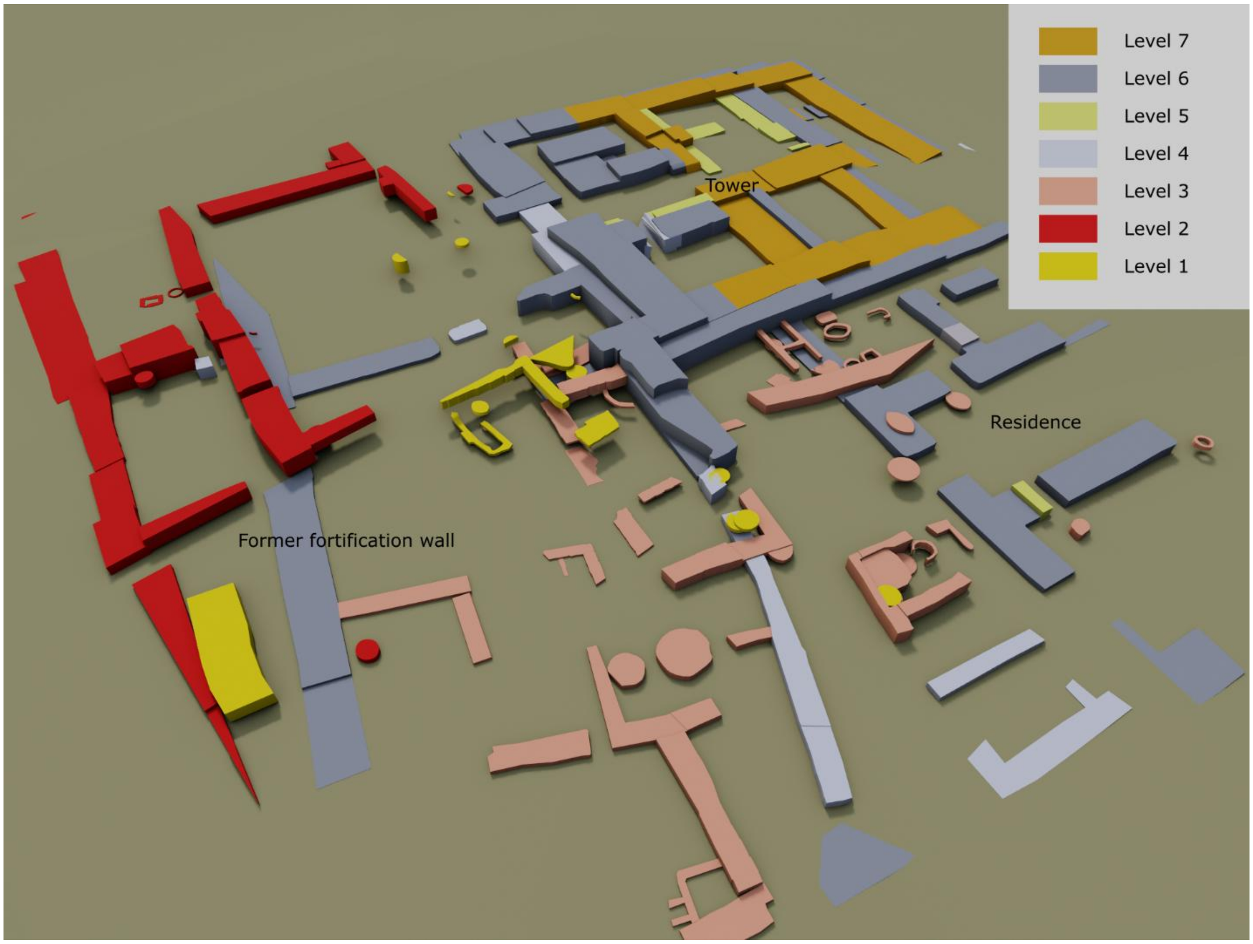


Figure 146. Approximation of level 2/3 walk surface and visibility of older architecture. Except for the tower, all other heavy architecture of the former Dunnu is now buried and overbuilt.

VI.5.2 The relation between wall thickness and building height

Variations in thickness of excavated walls may give a somewhat more precise indication of variations in building height. The main assumption is that higher buildings require thicker walls, both for increased carrying capacity and for wall stability. We may learn from earlier studies that applied such an approach. A possible factor of distortion is that walls may have certain thicknesses for other reasons than structural height, at least in the view of some scholars. However, in their analysis of the walls of the citadel of Neo-Assyrian Khorsabad Loud and Altman (1938, p. 19) argue that there is a consistent relationship between wall thickness and building height, while discarding other possible factors such as thermal performance and roof weight. Thermal performance is no significant factor, as good performance starts with a wall thickness of 40 cm. At this thickness, the wall mass is enough to cause the so-called thermal lag effect, absorbing heat during the day while radiating it back out during the night. Thicker walls will mainly cause this cycle to be longer than a day, which does not improve thermal performance from a human point of view. Heinrich and Seidl (1968) proposed an alternative theory that the thickness of the walls corresponds to the relative weight of the roof, which increases as room size increases. They argue that the edge pressure on the walls, caused by the flex of the beams under the weight of the roof, must be countered. However, Heinrich and Seidl's own tabulations of space to wall ratios of various temples, houses and palaces at different places and times, show no clear correlation between the variables. Although the transfer and distribution of the weight of the roof to the loam walls is certainly a factor that builders must deal with, edge pressure can also be resolved by application of stone or wooden wall plates, bond beams, or decreasing the distance between the joists (McHenry, 1984, p. 141; Houben and Guillaud, 1994, p. 282). Such solutions are very widespread in traditional loam architecture.[57] Another building method to decrease the span of roof beams, is the application of braces, also suggested by Margueron (1982) for Mesopotamian palatial architecture. These points lead to believe that it unlikely that the width of walls is strongly determined by the increased weight of the roof at larger spans. In the absence of a good explanation, Heinrich and Seidl (1968, p. 5) propose therefore that the overly heavy walls in buildings such as palaces, temples and larger residential buildings have a symbolic meaning, a suggestion also offered by others (i.e. Wright, 2000, p. 40). Although symbolic expression of power through the thickness of the walls may in some cases be justified as possible factor, the pattern that Loud and Altman already found in the citadel of Khorsabad seems to indicate a variability that cannot be reasonably ascribed to symbology. This does not mean that there was no symbological meaning ascribed to heavy walls, but this may have followed afterwards; it was not the main cause for the thickness of walls. In other words, the structural requirement preceded the attribution of meaning.

Looking at mud brick structures for domestic vernacular architecture, walls are generally also thicker than structurally strictly necessary. A rule of thumb ratio for safe construction is 1:10 width to height ratio (see Table 5). When applying this ratio to architectural examples from village contexts, we may conclude that most single storey houses with a wall thickness of 40 to 60 cm could theoretically support buildings 4 to 6 meters high. The actual height of such walls is around 3 meters, and therefore just support a ground floor. In Asvan, Turkey, both single and dual storey houses are found, but there are no significant differences between wall widths (Hall, McBride and Riddell, 1973). All houses have walls between 50 and 60 cm. On the other hand in the study by Carol Kramer (1979, p. 148, 1982, p. 99) study of Kurdisch villages in Iran, the difference is noticeable. Walls may be widened from average of 50 cm to about 1 meter when the family outgrew their house and the decisions was made to add a storey on top. With a storey height of 2.5 meters,

---

[57] However, in some building traditions, such as in Northern Syria (Dipasquale, Onnis and Paglini, 2009, p. 347), timber is not used for wall reinforcement. This may relate to the limited availability of wood in these areas.

we can conclude that also in traditional building practice the tendency is to keep an securer ratio of 1:8 advised for earthquake prone areas (see Table 5). As many places in the Middle East have to deal with occasional earthquakes, building traditions most likely have adopted to these circumstances. On the other hand, many still standing mud brick structures constructed with traditional materials and methods, testify that it is possible to construct buildings with 5 to 8 storeys on walls between 1 and 2 meters thick.[58]

Although wall or building height clearly influences wall width, there are other structural factors at play. In higher buildings, tapering or stepped walls may be employed. This decreases the weight of the upper building and stabilizes the entire structure. Using this manner of construction, many contemporary mud brick or other loam constructed buildings reach respectable heights of 10 meters on walls less than a meter thick. Other important factors are wall slenderness and unsupported wall length of (see V.3.7). These are influenced by interior wall configuration, exterior buttresses, and rigid floor frames. The higher the frequency of these features in a structure, the more wall thickness may be decreased. As has been noted before, wall stability was probably the primary concern of the ancient builder, not the wall's compression strength for the support the weight of the upper building.

[58] Such as the famous 'sky scraper' city of Shibam, where the tallest mud brick buildings have 8 storeys and are 30 m high on foundations 1 to 2 meters thick (Breton, 1985). Tower houses were common throughout the Arabic peninsula (King, 1995) and also in ancient Egypt (Lehmann, 2013). Measurements taken by the author on the ground floor of a large rammed earth building, a Kasbah in Ouarzazate, Morocco, reveal that the width of the walls on ground floor was 0.90 to 1.40 m, while the building is 12 to 18 m high.

Figure 147.Widths of walls of the Dunnu.

VI.5.3 Common building/storey heights

For the reconstruction of original building and storey heights, we may look at the range found in traditional architecture. Building and storey heights vary according to location, function, social status and cultural practice. Looking at houses, there is a rough differentiation to be made between rural and urban settlements. Houses in rural settlements are generally low, single storey buildings, while in more affluent cities houses and buildings in general may rise much higher. Additionally, in the Western Asia, a marked divide can be observed between rural habitation in the highlands and in the river planes. Rural houses in the planes are generally low constructions, while in the highlands we frequently find houses with two storeys in addition to common single storey houses. Climatic factors as well as building technology shaped by natural resources have caused this pattern. Common heights for single storey rural houses both in southern Turkey and in northern Syria are between 2.60 and 3.30 (ceiling between 2.30 and 3.00) (Table 7). In the traditional architecture of the lowlands in northern Syria guest houses, community buildings with a special social status and use, are significantly higher than common dwellings (Pütt, 2005). Such buildings range in height between 4.5 to 5.6 meters, with ceilings at about 4.20 m to 5.30 m. Pütt (2005) observed a trend towards larger and taller buildings, that has been connected to improved access to building materials and resources in the course of the 20th century. Double storied houses in Asvan, Turkey, have recorded heights between 5.5 to 6.20 meters. Heights of individual stories vary and are not necessarily equal for ground and first floor. Ground floors are in this settlement, often used for livestock and food storage, and are generally somewhat lower than first floor habitation level. In practice these floor heights match the ceiling heights of regular single storey houses. The height difference of these buildings may be reflected in wall thicknesses, but not as a rule. In Asvan, Turkey, single storey houses rest on walls 45 to 55 cm thick, while double storeyed houses have walls 60 to 65 cm thick. As the difference is too small to indicate a choice for either single or one-and-a-half brick walls, these dimensions imply that different sized bricks were used for buildings of different heights. Also from the North Syrian house plans published by Pütt (2005), we may conclude that the taller guest houses have somewhat thicker walls than regular houses. However, there are too many inconsistencies to think of this as a rule. In one example of one farmstead in Ṭāwī (Table 7), a higher part used for habitation had thinner walls than the lower part of the structure, used for cooking. A new addition for family extension, also used for habitation, had even higher walls (corresponding to the trend to increase building dimensions), but the same wall width as the lowest part of the older structure. All are mud brick structures with flat loam roofs.

With regards to taller, multi-storeyed buildings seen in across Western Asia and North Africa, these may have a ground floor that reaches 5 meters in height (Table 7). Storey heights are generally reduced on the higher levels, but this is not a rule. A couple of Qal`ats documented by Heinrich (1950) have relatively modest fortifications walls 3 to 4.5 m high. but with a taller central building (6 m). Obviously, buildings with higher social status (palaces), or religious functions (temples), or that need to host large crowds (market halls, stadia etc.), may be as high as fancy desires and resources and human ingenuity allow.

Site	Type	Height building	Width wall base	Reference
Qal`at Hağği Zlēf (Iraq)	Fortification, strategic	Central building wall top: 6.0 Central building roof top: 4.40 Fortification wall: ca. 3.0-3.30 Towers: 4.15	Central building: 0.95 Fortification wall: 1.05 (tapering)	(Heinrich, 1950)
Qal`at Meğnūne (Iraq)	Fortification, home-/ farmstead	Fortification wall: 4.5 Tower: 9	Fortification wall: 2.15 (tapering) Tower: 1.50	(Heinrich, 1950)
Shwaki (Afghanistan)	Fortification, farmstead	Tower: 10.30 Fortification wall: 7.70 Gate house ceiling: 4.95 Gate door: 2.81	Ca. 1.05-1.20 (tapering)	(Hallet and Samizay, 1980, p. 139)
Tadoula (Morocco)	Fortification, homestead/political base (“Tighremt”)	Tower roof: 15.95 Fortification wall: 13.35 Roof top storey: 10.85 Storey 1: 2.70* Storey 2: 2.50* Storey 3: 3.05* Storey 4: 2.60* * Take 30 cm off for ceiling height	Towers: 0.70-0.80 (tapering) Connecting walls: 0.55-0.60 (tapering)	(Nijst *et al.*, 1973, pp. 205–207)
>> (Morocco)	Fortification, homestead (“Tighremt”)	Tower roof: 18 Fortification wall: 14.35 Roof top storey: 10.85 Storey 1: 3.72* Storey 2: 3.60* Storey 3: 3.67* Storey 4: 2.90* * Take 30 cm off for ceiling height	Towers: ca. 0.75 (tapering) Connecting walls: ca. 0.70 (tapering)	(Nijst *et al.*, 1973, p. 202)
Agadir n’Gouj (Morocco)	Fortification, homestead (“Kasba”)	Higher walls: ca. 14.50 -15.0 Lower walls: ca. 9.0-11.0 Gate structure: 7.75 Gate arch top: 5.0 Towers and fortification wall equally high	Higher walls: 1.10-1.30 Lower walls: 1.0-1.10	(Nijst *et al.*, 1973, pp. 214–215)
Manzoroglu köyü (Turkey)	House, single storey	Building 1: ceiling: 3.16, roof: 3.50 Building 2: ceiling: 2.57, roof: 2.85	Exterior: 0.65 Interior: 0.50	Koyunlu 1976/Aurenche 1981
Baalbeck (Libanon)	House, single storey	Ceiling 3.0 Roof: 3.30 Stone/loam	0.80 (stone core)	(Ragette, 1980, p. 17)
Baalbeck (Libanon)	House, single storey	Ceiling: 3.80 Roof: 4.10 Stone/loam	0.80 (stone core)	(Ragette, 1980, p. 17)

Asvan (Turkey)	House, two storeys	Ceiling storey 1: 2.24 Ceiling storey 2: 2.88 Roof: 5.44	All walls: 0.60-0.65	(Hall, McBride and Riddell, 1973, fig. 4)
Asvan (Turkey)	House, single storey	Ceiling: 3.30 Roof: 3.60	All walls: 0.55	(Hall, McBride and Riddell, 1973, fig. 3)
Asvan (Turkey)	House, two storeys	Roof: 6.10 Ceilings unknown, ca. 3.05 each storey.	Exterior: 0.60-0.65 Interior: 0.45	(Hall, McBride and Riddell, 1973, fig. 2)
Asvan (Turkey)	House, single storey	Ceiling: 2.80 Roof: 3.0	All walls: 0.45	(Hall, McBride and Riddell, 1973, fig. 5)
NS (Syria)	House, single storey, flat dome	Ceiling: 2.72 Roof: 3.16	0.65	(Dipasquale, Onnis and Paglini, 2009, fig. 32)
NS (Syria)	House, single storey	Ceiling: 2.60 Roof: 2.80 Parapet: 3.05		(Dipasquale, Onnis and Paglini, 2009, fig. 64)
Tell Mišhan (Syria)	Guest house, single storey	Ceiling: 5.30 Roof: 5.60	Exterior: 0.45 Lesenes: 0.60 Interior: 0.45	(Pütt, 2005, fig. 256)
Rectangular house type Syria, typical	House, single storey	Ceiling: 3.0 Roof: 3.30	Single brick: ca. 0.35-0.50	(Pütt, 2005, fig. 363)
Ṭāwī (Syria)	Farmstead, single storey	Old part high roof: ca. 3.20 Old part low roof: ca. 2.35 New part roof: ca. 3.75	Old high: ca 0.25-0.30 Old low: 0.40-0.45 New: 0.45	(Pütt, 2005, p. 108)
Aliabad (Iran)	House		0.5 single storey 1.00 two stories	Kramer 1982, p. 99, 125
Baghestan (Iran)	House, flat dome	Ceiling:2.80-3.20 Roof: 3.30-3.70 (domed)	Standard: 0.80-0.85 Range: 0.70-0.90	(Horne, 1994, appendix 1)
Baghestan (Iran)	Fortification, homestead, domed	Ceiling: 3.60 (single storey) Roof: 4.60 (single storey) Two storeys: Ceiling storey 1: 3.0 Ceiling storey 2: 2.80 Total wall height: 6.40 Total building height: 7.70	Exterior: 1.40 Interior: 8.80-1.0	(Horne, 1994, appendix 1)

Table 7. Measurements for various building types.

How does this bear on the heights of buildings in the *Dunnu*? It is unlikely that the builders of the *Dunnu* have much in common with any existing local architectural tradition, nor is its architectural form and function the same as an average rural settlement. From an architectural comparative point of view, it may be closer to the sub-regional phenomenon of fortified farmsteads or manors. Such settlements are often characterised by structures of various heights, including single and multiple storeyed buildings. A wide range of building heights may thus be expected. The light-walled buildings that appear to have been used for habitation mainly, may have had a height common for rural habitation, i.e. about 2.5 meters. We have to assume that buildings with walls thicker than must have been higher. This is also what is confirmed by the data collected from collapsed walls.

VI.5.4 Wall thicknesses at the *Dunnu*

With the caveats discussed in the previous section in mind, we can start to look at the thicknesses of walls in the *Dunnu.* The wall thicknesses of the buildings of the *Dunnu* vary from 1 to 5 bricks, or 40 cm to 2 meters. All brick widths in this range are represented: 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 and 5. There are thicker walls than this even, but such thicknesses rose out of building expansion or wall reinforcements and are therefore no single constructions. Variations of thicknesses within buildings, such as in the tower or residence reflects a concern with wall stability. Walls on the terraced south slope were constructed one brick thicker for instance. While walls constructed against already standing structures were kept as narrow as possible considering the common loads of a loam terrace roof. Also, there is an observable difference in width between the exterior walls of a building, which ensured main building stability, and interior partition walls, which are shorter and therefore inherently more stable. But these exceptions aside, much of the wall width variations between buildings most likely bears a strong relation to building height.

Any of the walls found in the *Dunnu* could have been used for roofed architecture, as the minimum of 40 cm corresponds to known wall widths from traditional mud brick construction. Although in theory 40 cm mud brick walls take the load of a two-storey building, it is unlikely that they did, with the assumption that the conservative approach to construction seen in traditional village contexts is also applicable to the *Dunnu*. However, the archaeological and architectural evidence suggests that many of these single brick structures were probably open enclosures. The exceptions to this have been discussed in the section on wall construction in the *Dunnu* (V.3.7), and there are plausible structural explanations for them. As these are probably unique situations, we may propose that in general single brick walls in the *Dunnu* were used for open enclosures, or buildings with lighter roofs that were not meant for carrying live load (i.e. activity areas). In that case, 1.5 brick walls were the basis for most single storied architecture. Again, this is a conservative estimate, as this thickness (60 cm) could easily have supported two storeys. The architectural form, evidence for use and fill of these structures does indeed often suggest that a roof cover is likely.

If 1.5 bricks is the baseline for single storied buildings, any thicker walls potentially supported a multi storey structure, buildings with very high ceilings, or high enclosures. Two-brick walls are found used for several larger buildings, constructed against the interior of the fortification wall. These buildings seem to be part of the original design and planning of the fortifications. It is reasonable to assume, also in view of other archaeological evidence, that these buildings had at least two storeys. A smaller 2-brick-wall building found in the north-western corner of the *Dunnu* has various indications of being multi-storied is the structure. Here, the remains of a relatively low, vaulted ceiling on ground floor were found, which in itself could imply at least one other floor on top. The means of entry to this second floor was however not found on the interior but was most likely been located on the exterior of this building (VI.5.6). This building is jammed in between two other massive walls which provided stability and structural strength, and therefore allowed for thinner wall construction. Therefore, it is even conceivable that additional stories were present. There are also various large 2-brick structures in the extramural *Dunnu* on the eastern and northern sides. Although preservation is much worse here, there is no reason to assume that these fairly wide walls did not support two storeys.

2.5 bricks are found in a limited number of walls, mainly as part of the fortification wall. They do not seem to reflect a certain height of construction, but a functional choice by the builders. These walls are supported laterally by other heavier walls, which reduces the minimum required wall width. In one case in the north-western corner, wall form, short stretches and multiple corners, may have played a role in increasing structural stability so wall width could be reduced. These examples clearly show the rational approach of the builders, saving time and materials where possible and at their understanding of construction.

Walls with 3 bricks and over (1.20 m – 2.0 m) are only used in the fortification wall, the residence and tower. These were certainly the highest structures of the *Dunnu*. With regards to the height of the fortification wall, see (VI.11.6). The residence's outer walls are 3.5 to 4 bricks wide. As this building may be viewed as representational and elite architecture, high ceilings can be expected, but it is not certain whether it would have had a storey on top. In the first place, buildings such as these would have had a staircase, which has not been found. Additionally, it causes problems with the lighting of the central hall (also see VI.6.3). Nevertheless, both issues could be resolved in some way, but it complicates construction and access and is therefore considered less likely. The even thicker walled 'tower' certainly had an additional storey, and most likely multiple (see below). It is conceivable that the various modifications seen in this building, mainly wall reinforcements, indicate the construction of an additional floor at some point during its use history. With an original wall thickness of 4 to 5 bricks, and an expanded thickness of 5.5 to 6.5 bricks, this was most certainly the highest building of the *Dunnu*, probably towering above the fortification wall. If we apply the general rule of thumb of wall thickness to width ratio, the building could easily have been 25 meters high, or 20 if constructed earthquake proof. But this extreme wall thickness could have had another explanation than building height alone. A larger than usual static load could have been another. And considering the likelihood that somewhere in the *Dunnu* large amounts of barley must have been stored, this could have been the reason for the immense thickness of these walls (Klinkenberg and Lanjouw, 2015).

VI.5.5 Collapsed walls

Figure 148. Locations of preserved large fragments of wall collapse.

In several places, large segments of collapsed wall were found in room fills (Figure 148). By adding the length of these collapses to the preserved height of standing walls, a minimum wall height can be reconstructed. The calculation followed a standard procedure and considered several precautions. As brick walls might fragment and spread out on hitting the ground, to reconstruct the length of a collapsed fragment the number of preserved brick courses found intact were counted and added up. The height of a single brick course, including the brick and the mortar, is based on a measured sample of preserved walls in the *Dunnu*. Both the average (11.64 cm) and the median (11.2 cm) are used, which gives us a range for the reconstructed height of each fallen wall segment. This number is added to the height of the preserved wall that is the most likely origin of the collapsed fragment, which results in the absolute minimum height of a wall.

There are a few things to take into consideration when assessing these reconstructed heights. First, it is not always entirely clear whether a section of collapsed wall is from an original *Dunnu* wall, or from a restored wall of a later building phase. In certain cases this is clear, as the collapsed segment is found in the initial collapse deposit of the room. In a few cases however, the collapse is located above or on top of level 4 floors, during which the character of habitation had changed and the *Dunnu* architecture may have been abandoned, repurposed, and remodelled. Therefore, if these walls were renovated or modified in a later phase, they are not informative on the earlier phase. In addition, it is certain that a certain part of these walls has not preserved. Therefore, an unknown amount of height must be added to any of these reconstructed walls.

Figure 149. Photo and field notebook sketch of a collapsed wall in L08.

On this basis it appears that parts of the fortification wall, and other tall walls had a minimum reconstructed height of between 4 and 5 meters. This is just the part for which there is physical evidence, so we may be justified to add another meter or more. This figure matches the heights of fortification walls known from other places (Table 7). Regular or lighter structures such as M10 wall C have a reconstructed height of 2.21 – 3.30 m[59], which is probably the height for a single storey structure. The collapsed fragment of wall R in H08 would add up to a reconstructed wall height of 3.07-3.12 m. As the ground floor of this building had a partly preserved vaulted ceiling at 2.10 m above ground level, the collapsed segment must have come

[59] The large range is the result from uncertainty about how high the preserved part of the *in situ* wall is, as it was not excavated to floor level.

from above the level of the vault. This is another indication that this building in the north-western corner of the *Dunnu* was multi-storied.

Square	Room	Wall	Context	Reconstructed wall height	Notes
H08	room 14	wall B	Exterior of vaulted building.	3.07/3.12 m	Vault is at 2.10, therefore collapse implies presence of second floor.
I07	room 1	wall R	Wall of paved court.	4.19/4.49 m OR 4.39/4.69 m	
K09	room 3	wall P/CL	Inside square structure attached to tower. Unclear from which wall.	4.79/5.17 m (speculative)	Collapse from northern wall, or from tower? Single column of bricks. Perhaps no wall collapse.
L08	room 1	wall Q-1/Z	Inside roofed building, but possibly part of fortification wall.	4.24/5.50 m	On top of massive prior collapse deposit, therefore, original wall height must have been much higher.
L09	room 1	wall AO	Old phase fortification wall.	3.56/3.85	
M08	room 2	wall E	New phase fortification wall.	1.86/2.24 m	Very eroded, possibly level 4 wall.
M10	room 2	wall C	1 or 1.5 brick width wall of enclosure attached to building.	2.21/2.80 OR 2.71/3.30	Possible staircase.
J12		Wall A	Light architecture.	Uncertain whether wall collapse.	Single column of bricks, vertical position, 1.5 brick wide. No bond.
K12	alley	Wall H	Alleyway between tower and lighter structure.	Uncertain whether wall collapse.	Single column of bricks, 1.5 m long.

Table 8. Reconstructed heights based on collapsed walls. Numbers are based on the median and average of a sample of measured mud brick wall sections. Median: 11.2 cm, average: 11.64 cm.

VI.5.6 Staircase height reconstruction

Several staircases have been identified in the excavated structures of the *Dunnu* (V.5.7). Staircases are used for getting up to a roof top, or to additional roofed floors. Although it is uncertain to where a staircase led, or how many floors it went up, there are some indications found in general staircase placement, type and usage in more recent traditional architecture. For instance, exterior staircases often lead up to a rooftop, while staircases on the interior of a building more generally lead up to a second floor (or more). Also, a heavy, wide staircase construction like the one found in the tower is unlikely to have just led up to a roof. In fact, the time investment of constructing a vaulted spiral staircase with such a heavy spill wall may only be justified if it had to go several floors up. The length of staircases may be used to calculate the height it originally reached to the next level, using averages for tread (step length) and riser (step height).

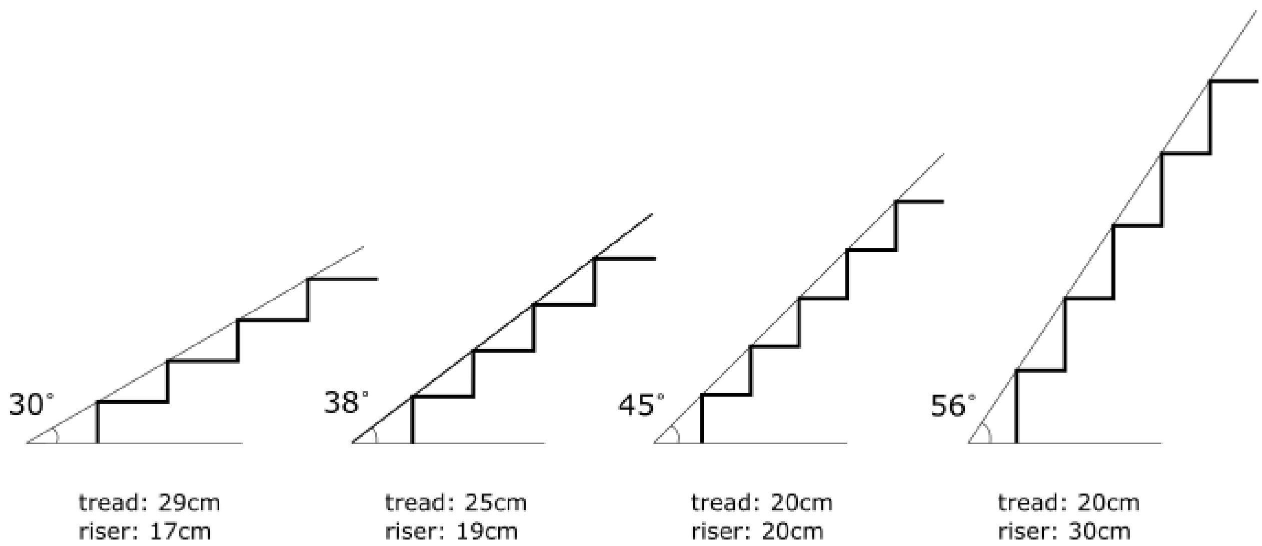


Figure 150. Step dimensions and incline. The two on the left are common dimensions of stairs in modern houses in the Netherlands. In the past, house stairs were steeper.

Modern houses have a riser of 17 to 19 cm, and a tread in the range of 25 to 29 cm, resulting in an incline of 30° to 38°. Stairs in older houses in the Netherlands usually ascent more steeply and have inclines of 45° or more. Steeper inclines can also be expected for ancient house stairs, although it probably varied quite a bit since there were no standards that we know of. However, we should take into account that in mud brick architecture, steps are generally made of mud bricks. This means that the height of steps is a fixed multiple of the height of an average mud brick. Mud bricks generally range in thickness between 8 and 11 cm, so two mud bricks on top of each other would make the perfect step height. Miglus (1999, p. 66) collected the dimensions of some archaeological examples from Ur and Nippur, which more or less adhere to the comfort of use zone: most stairs have a riser 18-20 cm although quite a shorter tread that lies in the range of 20-25 cm. However, various examples from Ur and Assur have shown a steeper incline, with a step consisting of a 20 cm riser and a very short 15 cm tread, or a 30 cm riser and 20 cm tread. This amounts to a steep incline of up to 56°, resulting in steps that would be perceived as awkward to the modern user.

VI.5.7 Staircase tower

Of most structures identified as possible staircases in the *Dunnu*, no steps have preserved. The exception is the staircase of the tower. Parts of three steps have been identified, and possibly an additional two. However, erosion and excavation has taken away much of the original surface of these steps, which should be taken into consideration for a reconstruction.

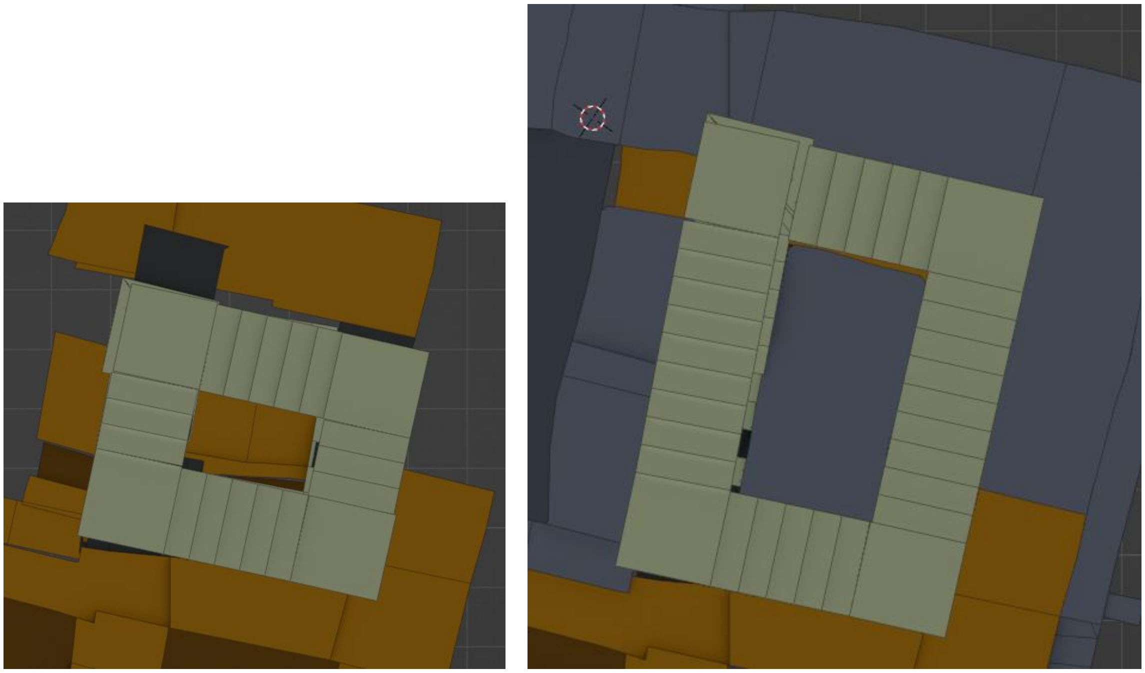


Figure 151. Plan comparison between earlier and later phase staircase.

Looking at the preserved steps, the rise between them is 35 and 42 cm, which is too high for common use. Also, the tread of the steps as excavated is impractical. It is therefore probable that the surfaces of the steps were too eroded to recognize and identify as such. However, as we have a good indication of the absolute heights of the south-western and south-eastern landings, the number of steps may be reconstructed. With this in mind, a reconstruction as shown on Figure 152 can be made. Between the approximate elevations of the south-eastern and south-western landings, 5 steps can be placed, 43 cm long and 19 cm high. Which is roughly a mud brick deep, and two mud bricks high. If 6 steps were to be placed, the tread would become 36 cm and the riser 15 cm. This may be an option with the smaller bricks generally associated with the early architecture, although the riser would become very shallow. In either case, the evidence suggests an easy incline of 27° for these stairs. Although this diverges from the averages noted above, a longer thread could be sensible in view of the usage of this staircase to carry heavy goods to the upper floor. Both the old and the new building would have had this incline and total rise on the north and south sides of the staircase. The length of the east and west sides was however increased as a result of the northward expansion. In the earlier phase, only three steps of the aforementioned dimensions would fit on one flight, while in the later phase 9 steps would fit on a flight if they covered the full length of the newly extended stairwell.

The staircases of the old and new building imply a completely different storey height. In the earlier phase, the reconstructed height of the ground floor is 2.79 m. and the reconstructed height of any storey on top would have been 3.38 m. In the new building, the ground floor would have been 3.16 m. high, while any storey on top would have been 5.65 m. Considering the utilitarian functions this building most likely had, this seems rather high. We may therefore consider the alternative option that instead of a full rotation to reach the next level, a floor was constructed at every half rotation of the stairs. This would imply that the access/exit point to the staircase switched location every floor. In that case, the floor to ceiling height would have been 2.70 m for every storey above ground level.

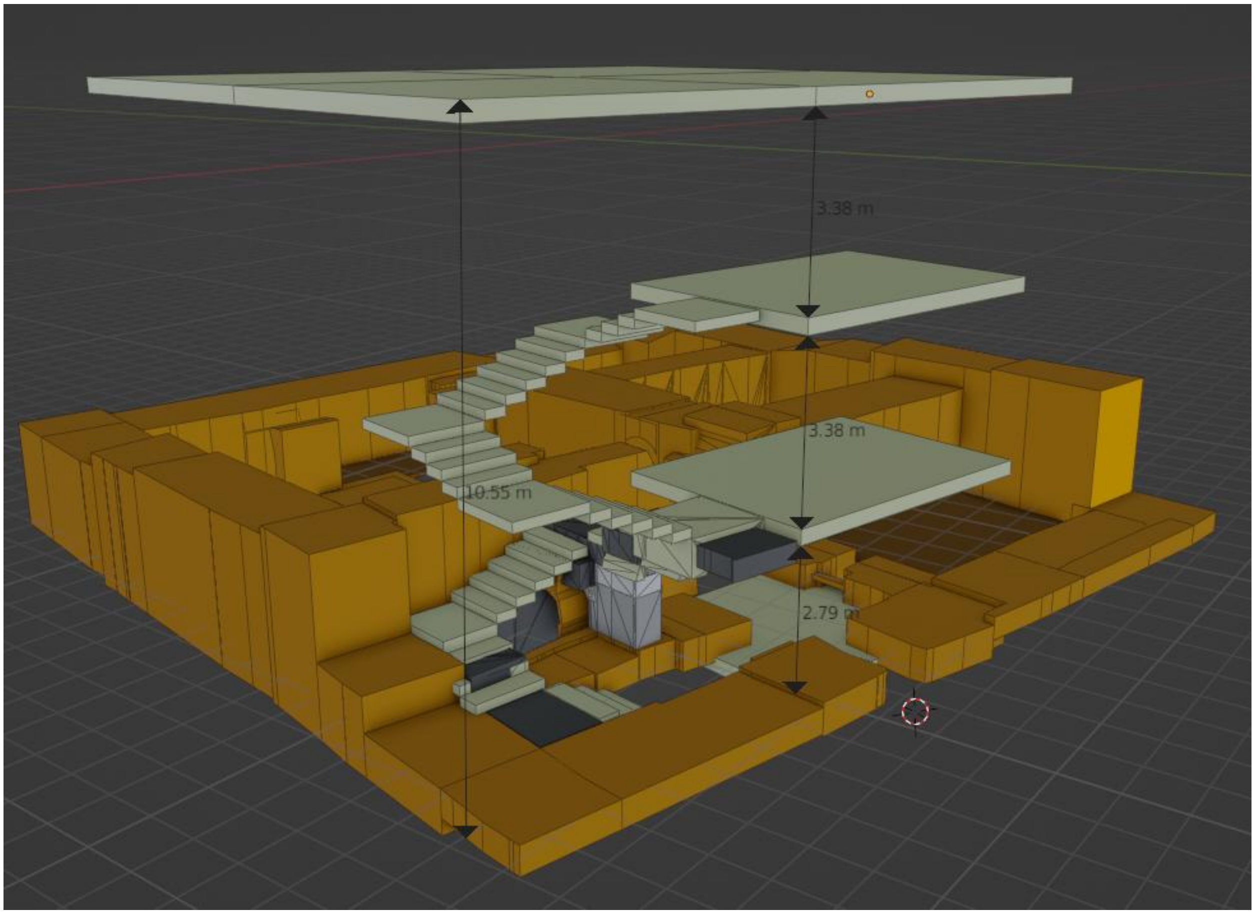


Figure 152. Reconstruction of staircase of the tower in the earlier phase.

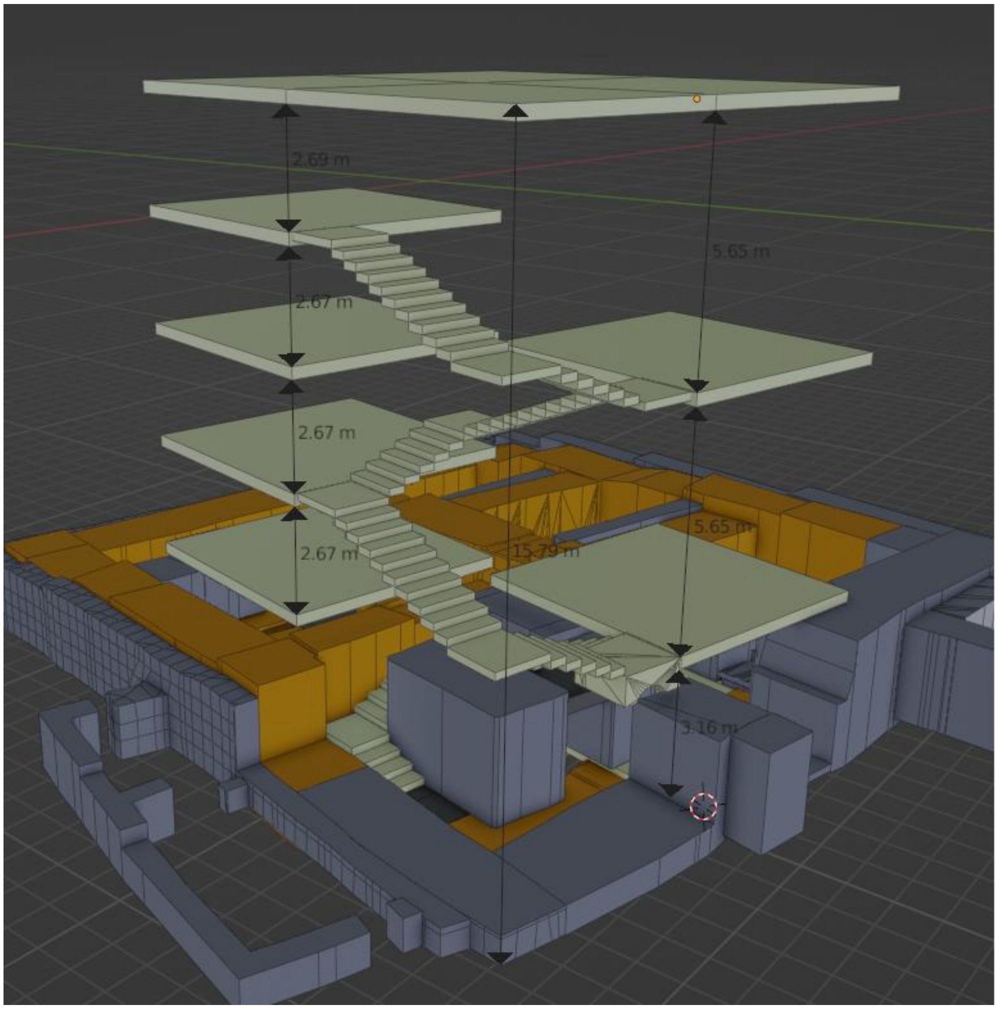


Figure 153. Reconstruction of the staircase in the later phase, with on the right the interdistance of the floors matching a full rotation of the stairs, and on the left the interdistance matching half a rotation.

It is uncertain how many storeys this building originally had. However, the scale and type of this stairwell construction is better justified if there are multiple stories above the first. A minimum height estimate of the earlier building would therefore have been 10.5 m., based on the assumption of three storeys (ground, 1st, 2nd). The later building was most likely higher, and is estimated at ca. 15.79 m., with the stairs making 3 rotations to get to the roof top. As is suggested, the later building may have had a floor every half rotation of the stairs, which would bring the total number of storeys at 5. These are conservative estimates as the thickness of the walls of both buildings would easily support several additional floors. As noted earlier, based on wall width, the older building could have been between 15 and 20 meters high, while the younger version of the building could have been between 20 and 25 meters high.

VI.5.8 Staircases fortification wall

Although no other staircases with preserved steps have been found, there are several structures which are plausibly identified as staircases (V.5.7.2). Two fairly certain cases, and possibly two additional ones can be identified against the fortification wall: one in the north-eastern corner, one in the south-eastern corner, and two in the south-western corner.

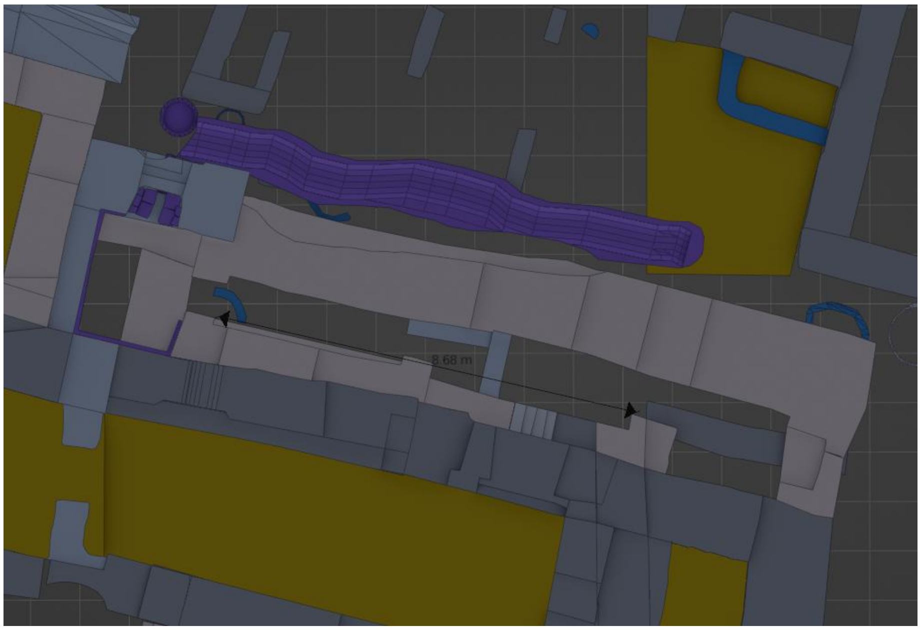


Figure 154. Elongated room with abutment constructed alongside the old fortification wall in the north-eastern corner of the Dunnu.

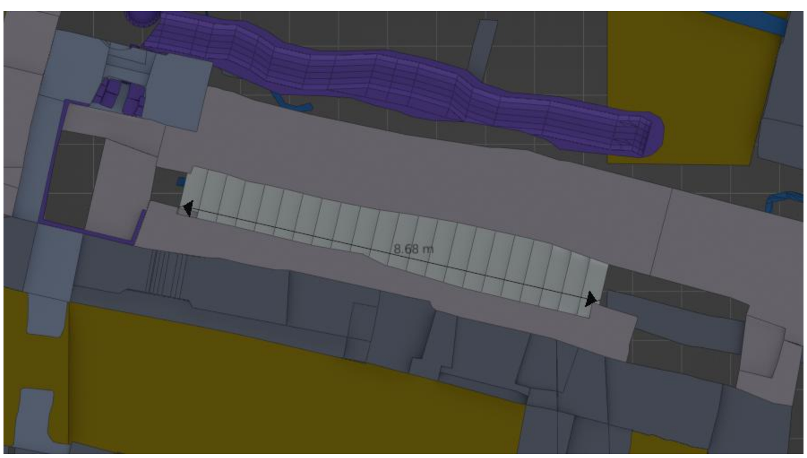


Figure 155. Placement of the steps in the ca. 8.70 m long space.

First, we need to determine the coverage of the stepped area in the stairwells. Where the steps start and end, has significant effect on the height they lead up to. In the case of the staircase in the north-eastern corner (Figure 154-Figure 155), judging from the extend of the abutting wall, the minimum length of the staircase was about 8.70 m., although a reconstructed length of 10.20 m. is also justifiable. The steps in the south-eastern stairwell probably covered a length of 9.5 to 10.5 m. The similarities of the lengths of these spaces reinforces the idea that these housed stairs that go up to the top of the fortification wall, which presumably had a uniform height.

The second characteristic that needs to be established are the dimensions of the riser and tread. If we take the riser and tread that was inferred from the staircase of the tower, the stairs would have had 22 to 24 steps reaching up to a height of 5.20 m. to 5.70 m., +/- 50 cm. These numbers up add some confidence to the figures found by reconstructing collapsed wall fragments (VI.5.5). The range of fortification wall height suggested there was 4.20 m. to 5.50 m. However, since we are assuming a thread of full mudbrick (40 cm), which is much longer than average, there is a good chance these staircases led up to even higher walls. If we consider a riser of 20 cm (two mud bricks), and a more common thread of half a mud brick (approximately 20 cm), the angle of incline would be exactly 45°, which is a common incline for ancient stairs (VI.5.6). Thus, with an average length of 9.5 m, these stairs would also lead up to a height of 9.5 meters. The two more speculative staircases in the south-western corner will not be considered in detail here. It is however worthwhile to note that these also fall in the range of 9-9.5 meters in length, which allows for the same reconstructed height as the other staircases.

Since these narrow stairs would not have been used in the same way as the stairs in a 'warehouse', a steeper incline is likely, especially if this falls within the common range of steps dimension. It is also not unlikely that the fortification height figure inferred from collapsed wall fragments is too low, as not the entire wall may have been preserved in the collapse. Therefore, a fortification height close to 9.5 meters seems plausible.

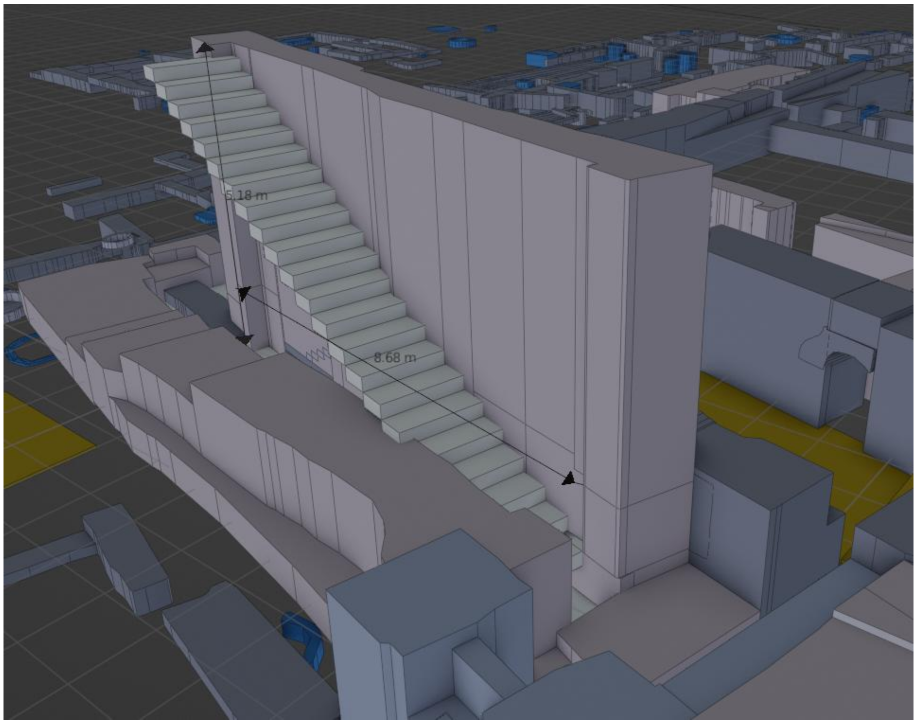


Figure 156. Hypothetical reconstruction of the staircase in north-eastern corner. Riser is 20 cm (two mud bricks), and tread is 40 cm (one mud brick).

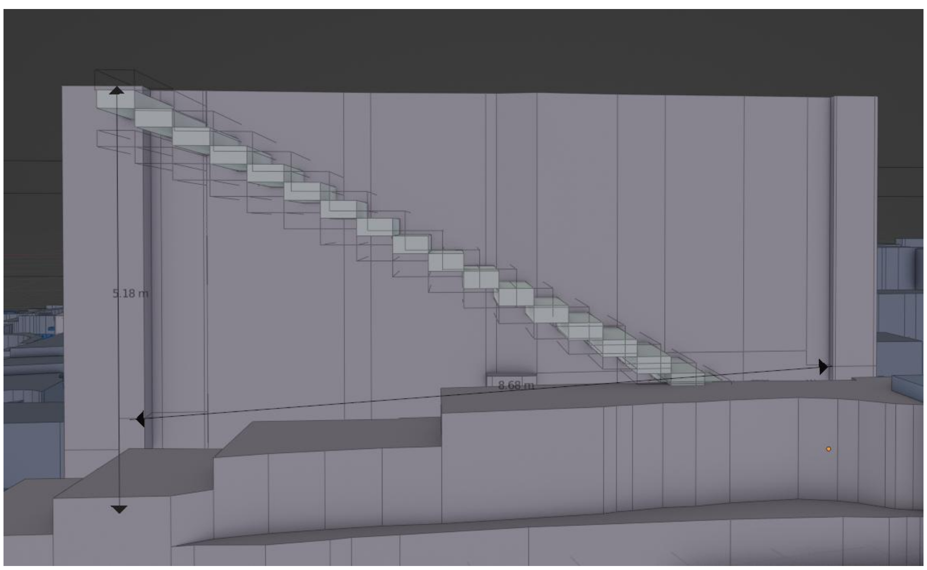


Figure 157. Visualisation of reconstruction range, using different riser and tread dimensions. The lower option has a reduced riser height (18 cm instead of 20 cm). The higher has both an increased riser height (22 cm) and tread length (42 cm).

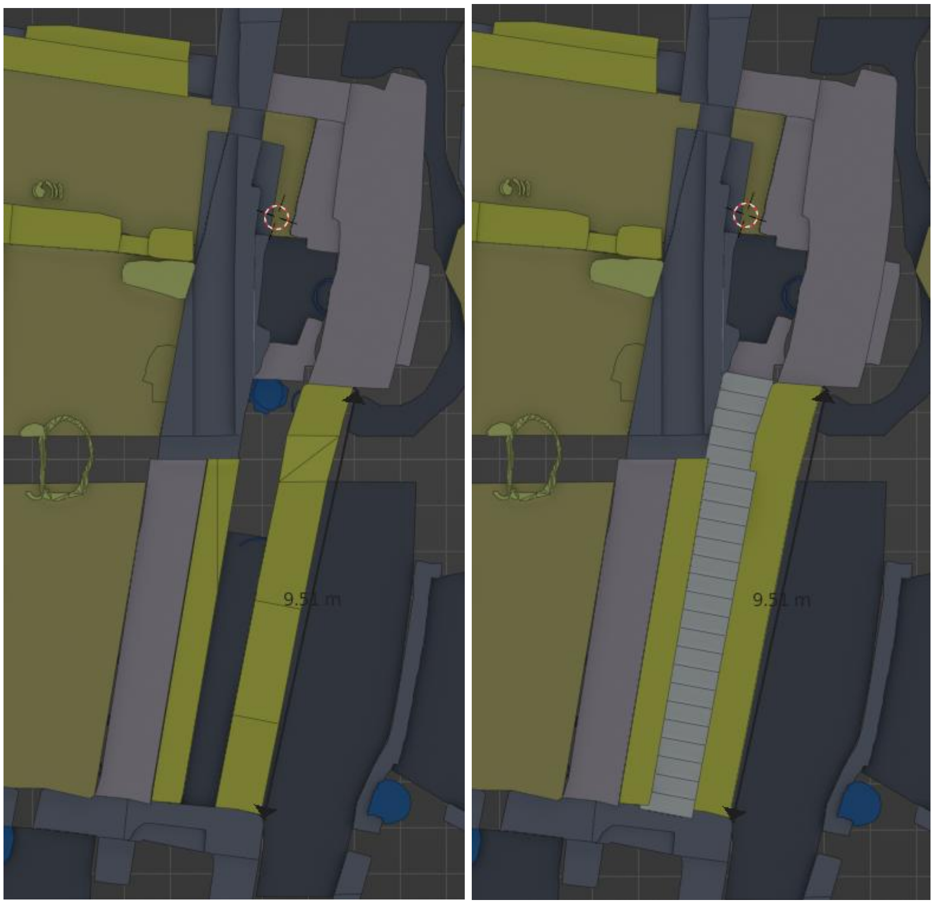


Figure 158. Construction most likely identified as a staircase in the south-eastern corner of the Dunnu. Left: reconstructed archaeological remains, right: reconstructed steps.

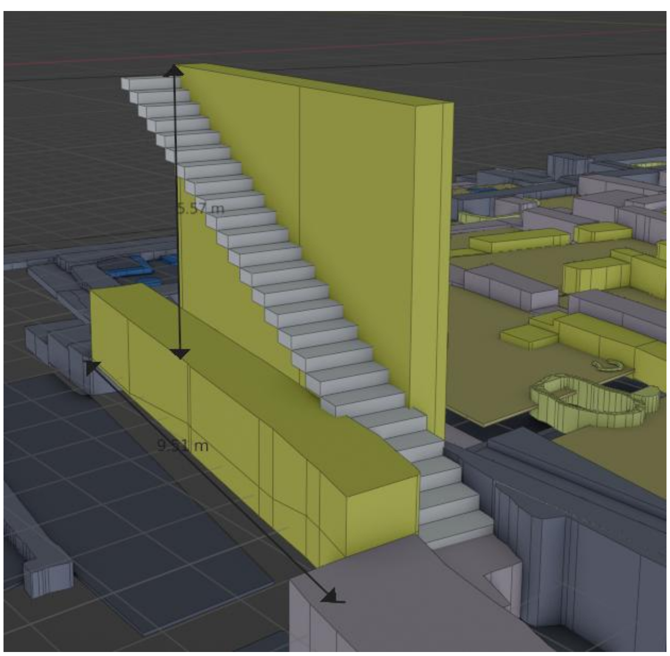


Figure 159. Reconstructed height of the staircase in the south-eastern corner.

VI.5.9 Staircases of other buildings

It is quite likely that some narrow spaces constructed on the exterior of buildings are the remains of staircases (see V.5.7). These spaces are 4 to 4.5 meters in length. With the same rise and tread as used for the larger stairs, these would lead up to a 2.20-2.40 m. high roof. This appears like a realistic roof height for regular buildings used for domestic, administrative and production activities. However, this tread size (40 cm) is very uncommon for regular domestic stairs, which are generally much steeper due to a shorter tread ranging from 20 to 25 cm (V.5.7). With a shortened tread the roof can be estimated at 3.80 m. (25 cm tread) to 4.80 m. (20 cm tread). If the latter would have been the default height for buildings in the *Dunnu*, it also becomes more likely the fortification wall was higher than the reconstructed minimum of 5.5 to 6 m.

VI.5.10 Building height model

Using the data above, building heights are estimated. Heights are assumed to have been in kuš, established earlier to be around 47.34 cm. For the maximum building height, the common 1:8 ratio for wall width versus height is observed. This was converted into kuš and rounded down. The maximum building height is therefore still a conservative number that does not reflect the structural limits of the building material.

Based on various reconstruction methods presented in this chapter, the fortification wall is set at 12 kuš, or approximately 5.88 m. Since various approaches converge to a height between 5 and 6 meters, this is a plausible figure. The figure of 5.88 m would however still exclude a parapet. It is likely there was one, since the stairways suggest access to a wall-walk. The parapet should be of a height equivalent to a full-grown human. This, of course, assuming the fortifications were built for real defensive use. The fortification wall including the parapet, was therefore possibly around 14 - 15 kuš or 6.86 – 7.35 m. It is assumed that no other buildings except for the tower and the residence were higher than the fortification wall. Therefore, any multi storied building build against the fortification wall, cannot have been higher than 5.88 m. Taking into account space required for the thick loam deck roof construction, and floors, this renders it unlikely that these buildings had more than two storeys. Three storeys would only be possible if a low basement or attic is allowed for. There is however no evidence for basements or ground floors with low ceilings in the *Dunnu*, and we assume that attics were not present.

Wall width (bricks / cm)	Storeys	Height based on width:height ratio 1:8 (m)	Estimated building height (m)	Construction types
1 / 45	1	3.60	0.98 – 2.94 (1-6 kuš)	Open enclosures, or single floor roofed
1.5 / 70	1-2(?)	5.60	2.94 (6 kuš) 5.39 (11 kuš)	Small buildings with heavy duty roof Some two storeys?
2 / 90	2	7.20	4.90 (10 kuš) - 7.20	Large/heavy walled buildings
2.5 / 110	2	8.80	5.88 (12 kuš)	Buildings integrated in fortification wall
3-3.5 / 140 – 160	1	11.20-12.80	Fortification wall: 5.39-5.88 (11-12 kuš) Residence: 12.8-14.4	Largest part of the fortification wall, monumental architecture residence and courtyard
4-4.5/170-200	3	13.60-16.00	Fortification wall: 5.6 13.6-16 (building)	Heavier part of fortification wall, heavier part of residence, lighter walls old phase of tower, northern wall young phase of tower
5 / 200-210	3	16.00-16.80	5.6 (single wall) 10.5-16.8 (building) Lower value = staircase recon. Higher value = 1/8 ratio. Possibly no difference from 4-4.5 bricks. Back wall of tower heavier perhaps for extra stability reasons.	Heavier walls old phase tower, fortification wall sw-corner
6-6.5 / 260-300		20.80-24.00	15.6 – 24	Reinforced walls of the young phase of tower, reinforced stretches of fortification wall

Table 9. Building heights for different wall thicknesses of buildings in the Dunnu.

Differentiation of wall thicknesses indicates buildings with strongly varying heights. The buildings integrated with the fortification wall always have relatively thick walls, measuring 2 to 2.5 mud bricks in width. This sets them apart from the light walled buildings in the *Dunnu*, which have walls 1 or 1.5 mud brick(s) wide. It is very likely that this differentiation is related to building height, and therefore number of floors. The lowest buildings, often corresponding to domestic use, may have had a height of between 2 and 3 meters. The height for the reconstruction is set to 2.45 m. or 5 kuš. In such buildings, the ceiling would already be at 2.15 m., if a 30-40 cm of loam deck roof is accounted for. It is also possible that we add the 30-40 cm of roof construction to the storey height of 2.45 m. as walls were specifically dimensioned using kuš for the sake of construction material calculation. It is likely that the roof was viewed as a separate construction, added on top of the walls. With 2.45 as base storey height, the heavier architecture build against the fortification wall is therefore estimated at 4.90 m. or 10 kuš. This leaves 1 m. between the rooftop and the top of the fortification wall. Again, we may fill part of this space with the roof deck construction, but it is also possible that these buildings had a higher average storey height than 5 kuš. With a theoretical total height of 12 kuš (2 x 6 kuš), these buildings would exactly match the height of the fortification wall.

With these conclusions, most buildings in the *Dunnu* are covered. The question remains to what degree the extramural architecture also obeyed to these rules. Since also there a range of walls with widths up to 2.5 mud bricks can be observed, it is conceivable that there were buildings with multiple storeys there as well.

How about the two large buildings in the centre of the *Dunnu*, the residence and the tower? Their walls are thicker than all other buildings, which must reflect their original height. Using the 1:8 width to height ratio, the residence could have been easily 12 meters high, and the tower over 20 meters. As for the tower, this is theoretically possible as it has a large staircase with a convenient rise.

VI.6 Ventilation and light: windows and other openings

VI.6.1 Evidence for windows

Although wall preservation has been significant, there is very little evidence for the presence of windows or other openings in the wall for ventilation or light. A few features have been identified as some sort of window. Only one has survived completely (Figure 160, Figure 161). It was found in the north-eastern sector of the *Dunnu* in the northern wall of one of the larger rooms of the complex (NE-3b). This wall is part of the exterior fortification wall in the older phase, but gets superseded and loses that function. The window was also blocked at that time, as a wall was built on the exterior face of the former fortification wall to construct a stairwell. The window had a typical arched construction, also seen used for small doorways, and was located about 1 m. above ground.

Other potential windows were found in the western wall of the large court, although its identification is quite uncertain due to various modifications of this structure (Figure 162). If this was a window, it is connected two open spaces, and might therefore have had a practical function in the social and economic transactions taking place in this area, or related to view control. However, it may originally also have been a doorway.

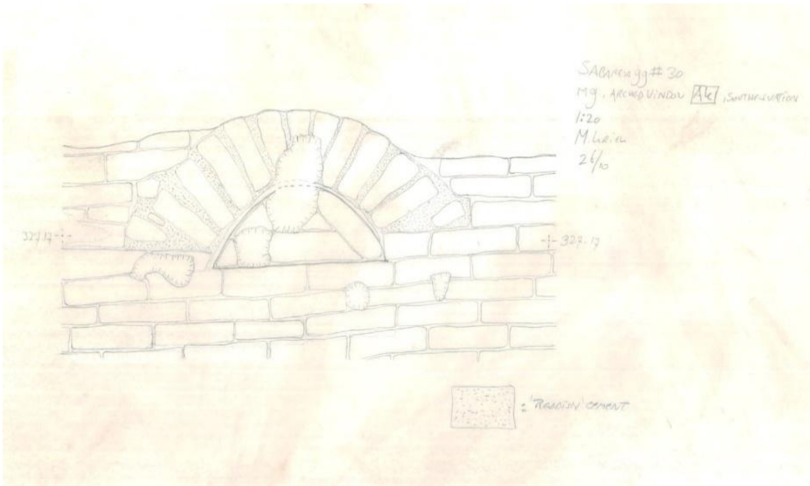


Figure 160. Window in the older phase fortification wall in M09.

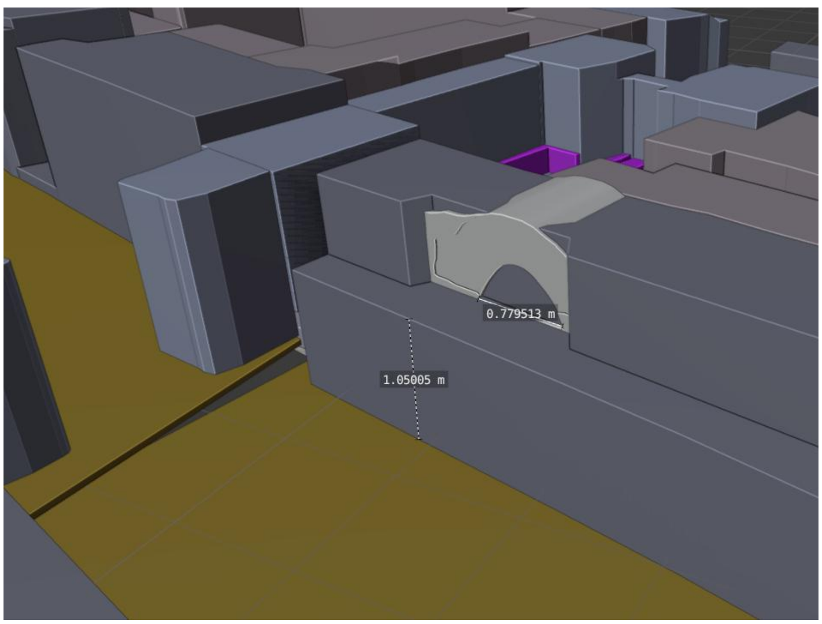


Figure 161. Architectural context of the window in M09.

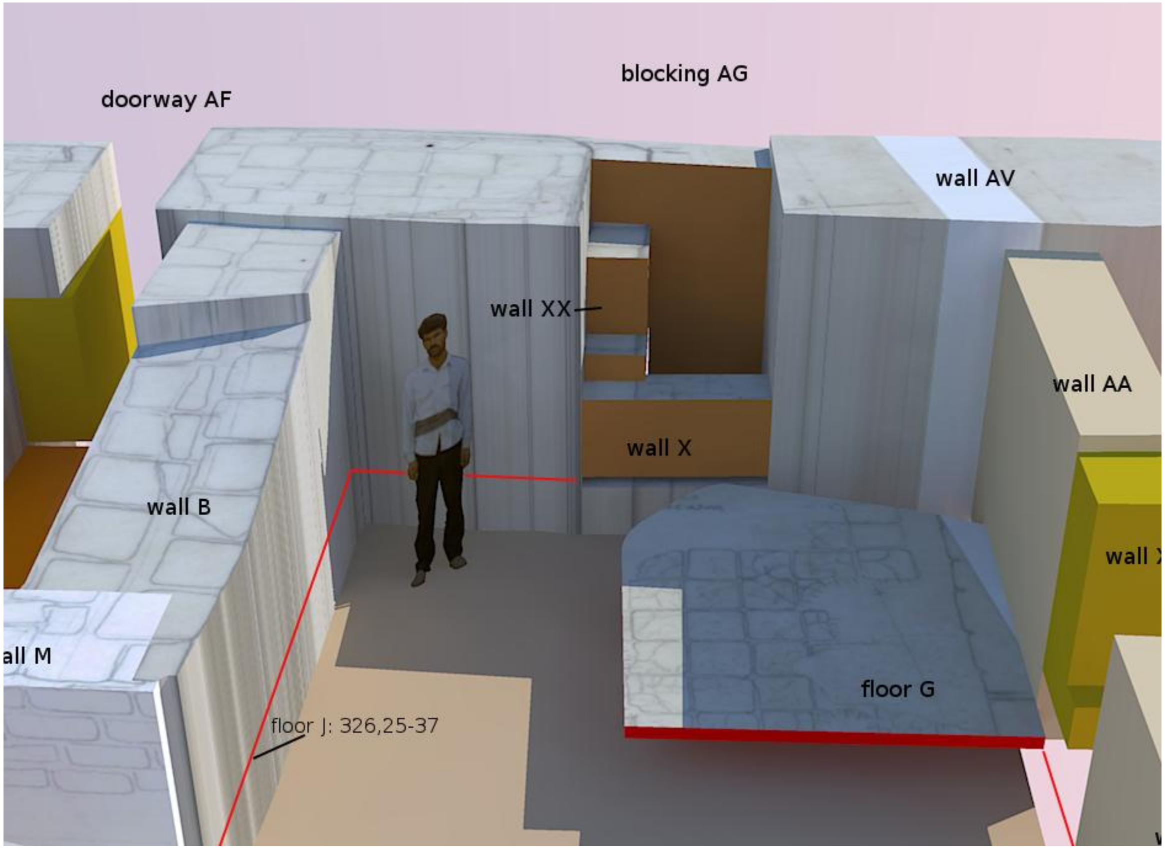


Figure 162. Window or doorway between central court (at the back) and space west of it (in front). It has odd blockings or modifications, sometimes even being characterised as 'stairway', in the excavation documentation.

Two additional features, equally ambiguous in interpretation, are found in room 2a of the residence (Figure 163). We seem to deal with modified doorways, although it is possible that for one of them an original ‘window function’ was intended (the one on the right on the picture). The latter would have been an interior window, and therefore probably somehow related to the practical functioning or visual control within this building. As these are later modifications, they may relate to a phase that the residence had lost its original functions and therefore hint at a change of use. They may simply be considered as doorway blockings rather than creation of windows.

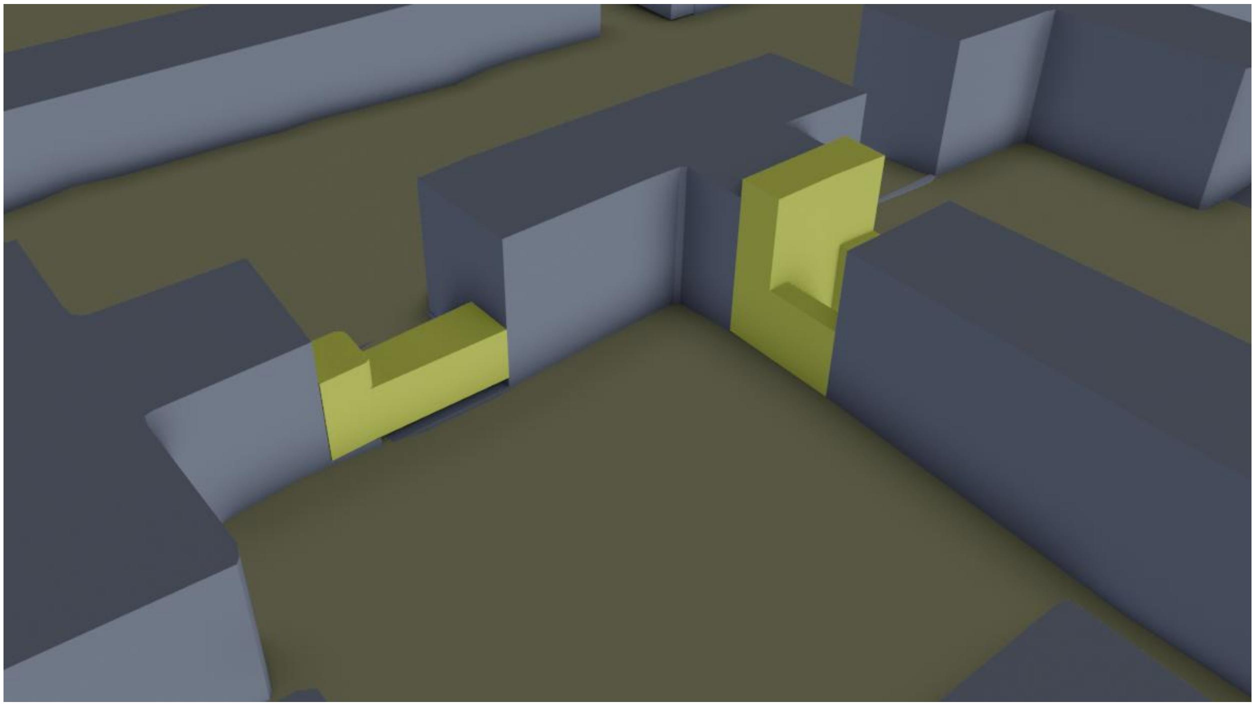


Figure 163. Two features potentially identifiable as windows or modified doorways in the largest 'private room' of the residence (2a).

Figure 164. Windows or doorway blockings in residence room 2a (photo by Peter Akkermans).

Although not everywhere walls have preserved to a sufficient level to ascertain the presence or absence of windows, the evidence suggests very limited usage of ground level openings. It is remarkable that there is not even evidence for smaller ventilation holes often seen near ground level in traditional architecture in Northern Syria (Pütt, 2005). However, such ventilation holes function better in open settlements, where houses are exposed directly to available wind currents. In urban architecture, or more cramped building manners in general, this natural advantage would be absent. The general absence of windows and openings on ground level may also imply the presence of a second floor, which was primarily used for habitation, as is frequently seen in west-Asian domestic architecture, both in urban and rural environments (Figure 165). On the other hand, even a building that we know of had a residential function on ground floor, did not have openings near ground level in most of its rooms. Hence, we may infer that such openings were located near the ceilings, commonly referred to as 'clerestory windows'. Due to the thickness of these walls, they would have let in very little direct sunlight. For optimal lighting, it is theoretically possible that these windows were created in elevated sections of the roof in the middle of a room. In many other cases where we had inferred the possible presence of a second floor (VI.5.10) from relative wall thicknesses, it may be very well possible that ground floor walls lacked windows.

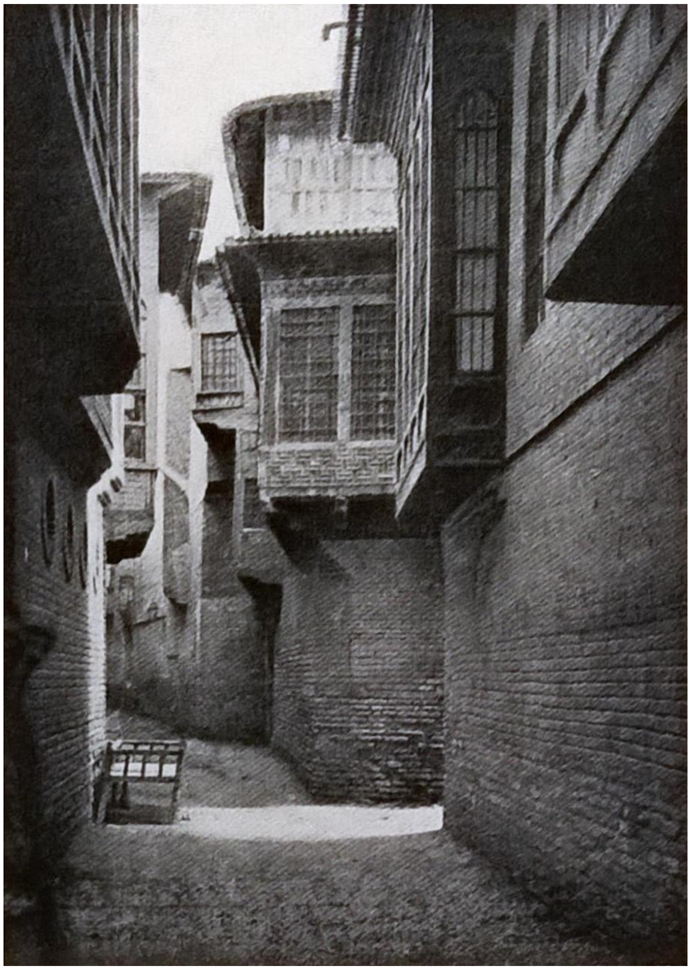


Figure 165. Street in Bagdad around 1900 showing no windows on ground level. Habitation occurs mainly on the first floor, which is amply fitted with the typical bay windows or mashrabiyyahs (after Reuther, 1910, fig. 76).

VI.6.2 Hypothetical lighting and airflow as a basis for architectural reconstruction

In the absence of electric lighting and air-conditioning, the form of architecture is to some degree shaped by the human requirements of lighting and ventilation. An assessment of these can therefore help us to understand better the functioning of the built environment, and to make better decisions in the reconstruction of the architecture (Margueron, 1999a). With free standing single roomed structures, such as smaller dwellings, access to light and air is generally guaranteed through the main door, and often with additional small openings located on strategic locations in the walls (Figure 166). In the rural architecture of Northern Syria architecture, ventilation holes are strategically placed on the side of the dominant wind direction to catch a breeze for the people sitting or lying on the floor inside the house (Dipasquale, Onnis and Paglini, 2009, p. 341). The fact that simple dwellings often have no windows in this region, but do have ventilations holes, is a response to the hostile climate (sandstorms, heat and cold) and exposed position of such dwellings. At the same time, this may also be an effect of access to building materials that allow construction of larger openings.[60] In different environments such as walled towns or mountains, where wood is also more readily available, inhabitants may opt for larger openings. When a building becomes more complex, with additional spaces attached horizontally or vertically, maintaining air and light supply becomes slightly more challenging. It must be assumed that a situation in which a space is entirely encapsulated by other spaces, therefore lacking direct access to air and light, is undesirable if the area is used for habitation and various (domestic) economic activities. It can be argued that many traditional architectural forms such as the courtyard house have evolved in response to these human needs (Ragette, 2003, p. 87). The grouping of spaces around an open area is a smart strategy to optimize access to air and light on both sides of each space (Figure 167). Also seen through this lens, dense urban settlements may be described as rhythmic occurrence of groups of covered spaces interjected with open areas in various shapes (Figure 168). The entire built environment is therefore for a large part shaped by these factors, in addition to others such as privacy and territoriality.

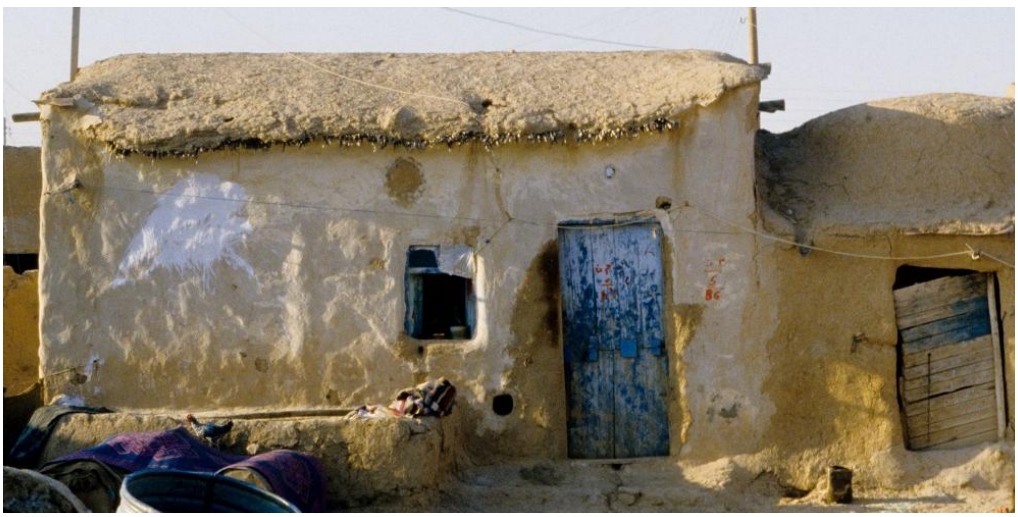


Figure 166. Simple single-storey dwelling in northern Syria. This house has one window next to the front door and a large ventilation hole at the bottom (photo by P. Akkermans).

[60] It is probably significant for archaeological interpretation, that in the evolution of North Syrian rural house types in the 20th century, the earliest houses generally have small windows and that these became increasingly larger as access to building materials became better (Pütt, 2005).

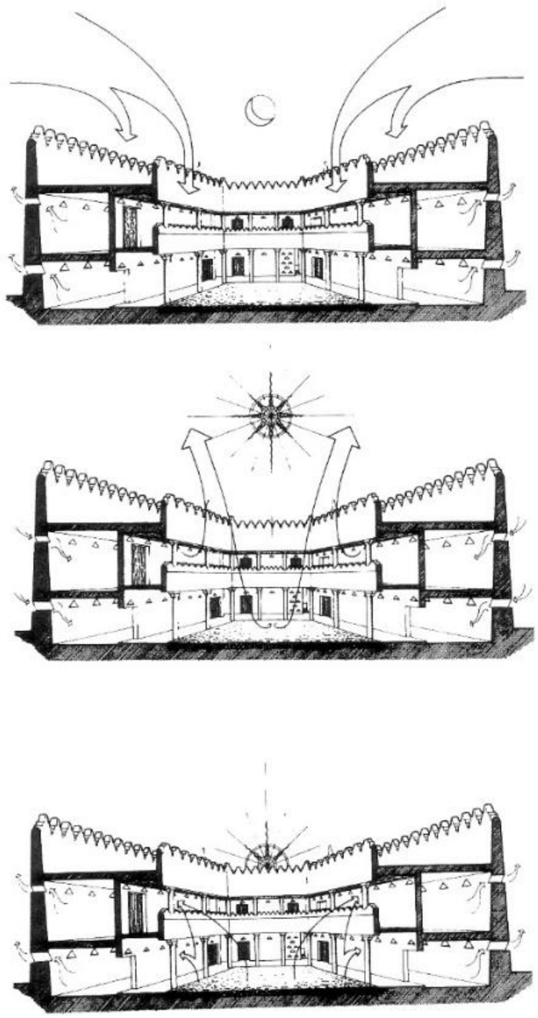


Figure 167. The function of a courtyard as airflow regulator. From top to bottom: at night, noon and sunset.

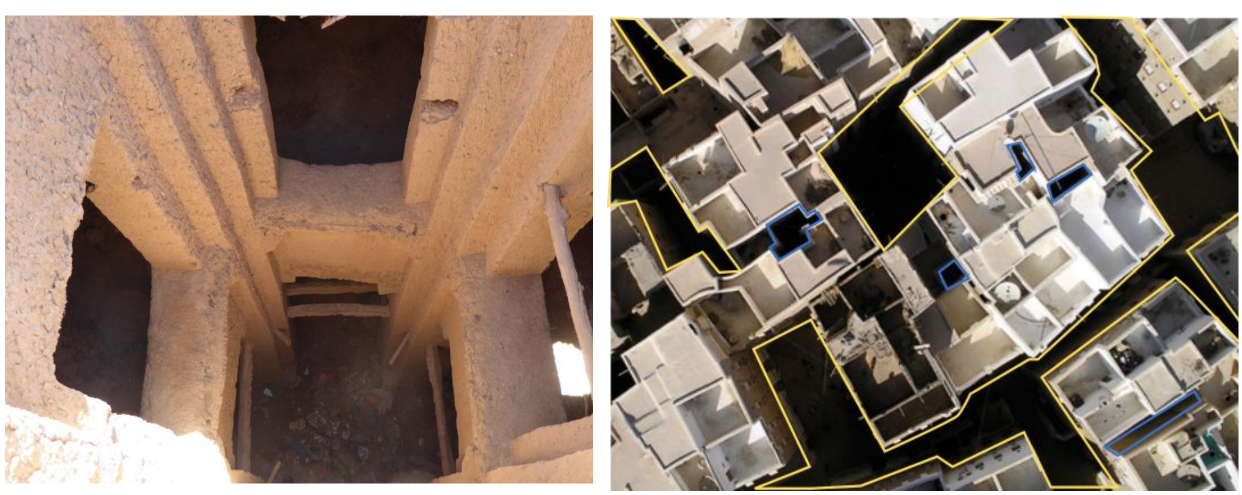


Figure 168. Air and light wells in recent architecture. Left: small central courtyard or light well in an abandoned town house, southeast Morocco (photo by author). Right: City of Shibam, Yemen. Lines indicate where light and air wells are placed. Yellow are public spaces (small squares, alleys), blue are internal light/air wells or small courtyards (photo: Shibam Urban Development project, http://archnet.org/sites/5215. Lines drawn by author).

A consideration of air and light has influenced the reconstruction of ancient palatial complexes, most explicitly so in the work of Margueron (1982, 1996, 1999a). From the study of these palaces, we may derive two main ways that access to light and air was guaranteed. The first is the use of light shafts or wells. These may take many different forms and sizes, from small shafts to entire light corridors and larger courtyards. A second strategy was probably used for spaces that are entirely enveloped by other roofed spaces. In such cases, varying the elevation of the roofs would create some space for clerestory windows at the top. Even before Margueron's formal formulation of this approach for reconstruction of these buildings, varying the heights of roofs was a common feature of architectural reconstructions of excavated palaces (figure 169)[61]. The elevated roof is a feature also frequently seen in reconstructions of archaeological building plans that have a tripartite main structure. In this building class, an elongated middle space is often bordered by groups of spaces on its long sides. To get additional light and air in this space, an elevated roof is often conjectured to be part of this architectural type (Figure 170).

[61] Also Delougaz Tell Asmar (1967), (Kreppner, 2013, p. 330), (Loud and Altman, 1938)

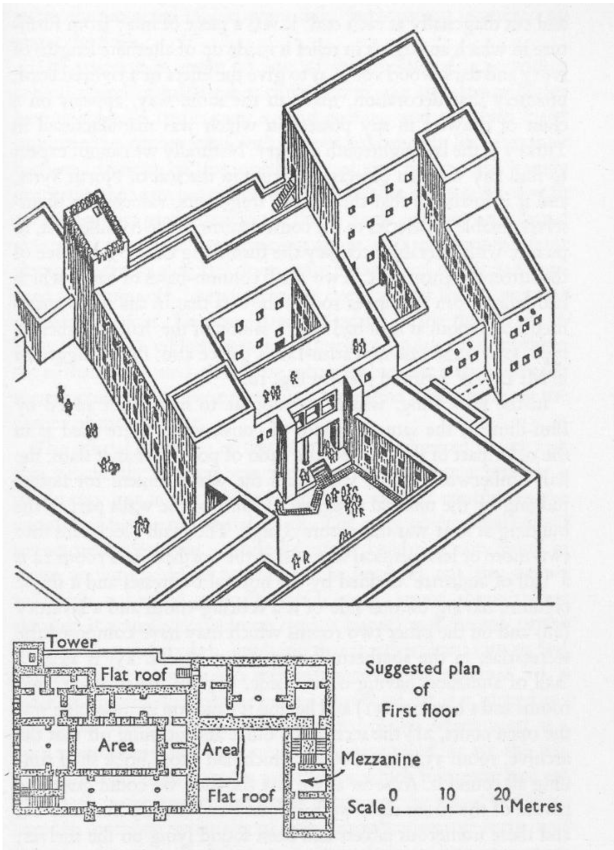


Figure 169. Reconstruction of the palace of Alalakh showing varying roof heights. This helped to ensure entry of light and air circulation in interior rooms (Woolley, 1955, fig. 16)

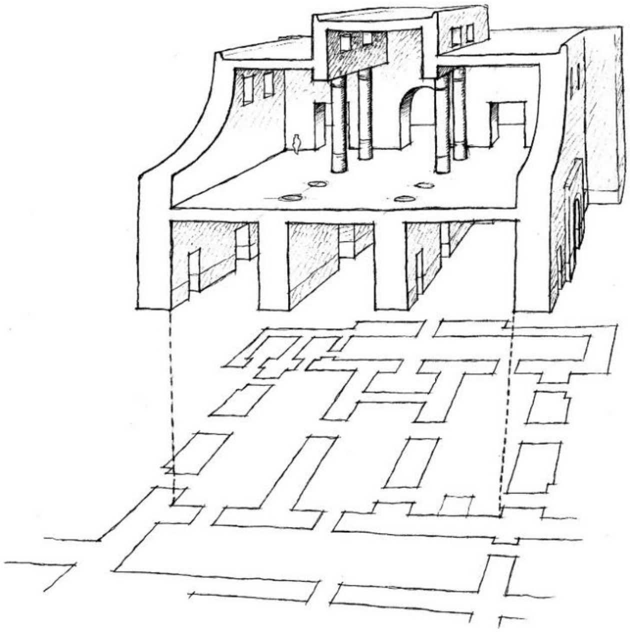


Figure 170. Tripartite architectural structure at the palace of Khorsabad, interpreted by Margueron with raised central roof and clerestory windows. According to Margueron, the lower floor was uninhabitable and was mainly used for circulation of people and storage. The dual floors and colonnade on the first is a tentative interpretation (Margueron, 2005).

VI.6.3 Lighting and ventilation in the *Dunnu*

Since it is justifiable to argue that for most internal spaces, some access to light and air is required, it may be interesting to look at the plan of the *Dunnu* from this perspective. The *Dunnu* has many entirely locked in spaces that would require some architectural solution for their light and air supply. It is likely that either of the two discussed architectural strategies, creating light wells or varying with roof level heights, might have been used. These have an impact on our thinking of how the *Dunnu* functioned in relation to human requirements, and therefore influence the reconstruction. An example that illustrates the effect of different reconstruction scenarios on interior light conditions is shown in figure 172. The example shows that if no consideration is given for lighting and ventilation, and if everything is roofed at the same level, certain spaces would be locked off from lighting and ventilation completely. With roof height variation, however, first floor spaces gain access to light and air, but for the ground floor the situation would remain the same. There is some ground in reality for such a scenario. Many traditional houses, both in urban and rural environments in geographically dispersed regions, have a habitation level on the first floor (e.g. figure 165), while the ground floor is used for storage and livestock. The reasons are a combination of climate, security, privacy and practicality. An interesting consequence of this scenario is that it would give additional support to the theory that many buildings had upper storeys. Without it, the proper functioning of the buildings may be called into question. The last scenario is a courtyard model, that alternates covered spaces with open ones (figure 171). In this scenario the lighting and ventilation of both ground and first floor would be optimal.

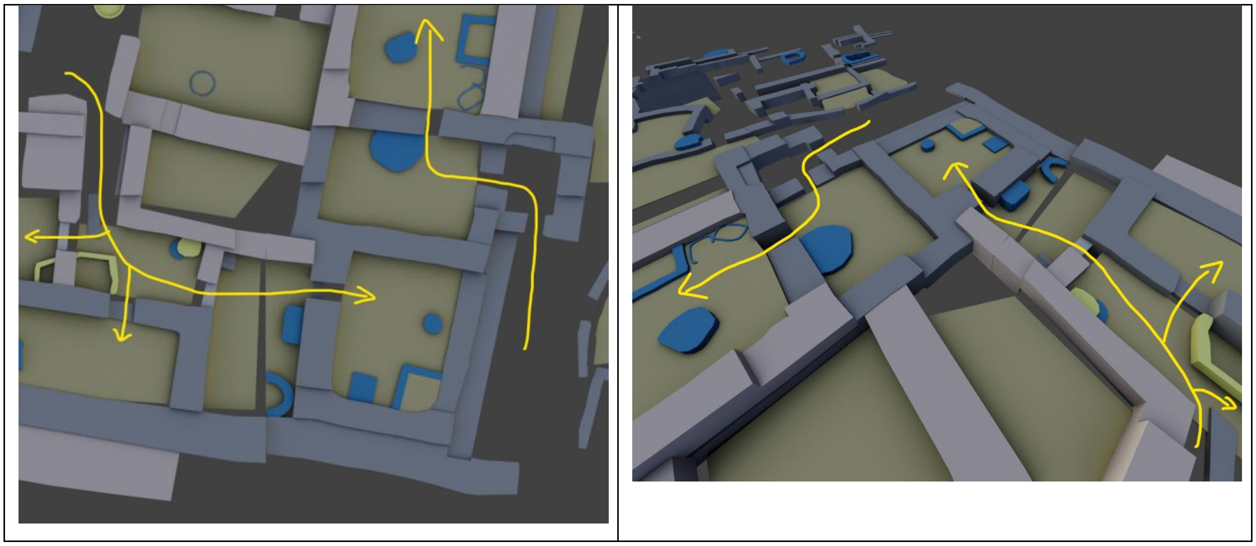


Figure 171. Building in SE corner of Dunnu, 3D reconstruction of excavated remains and access structure.

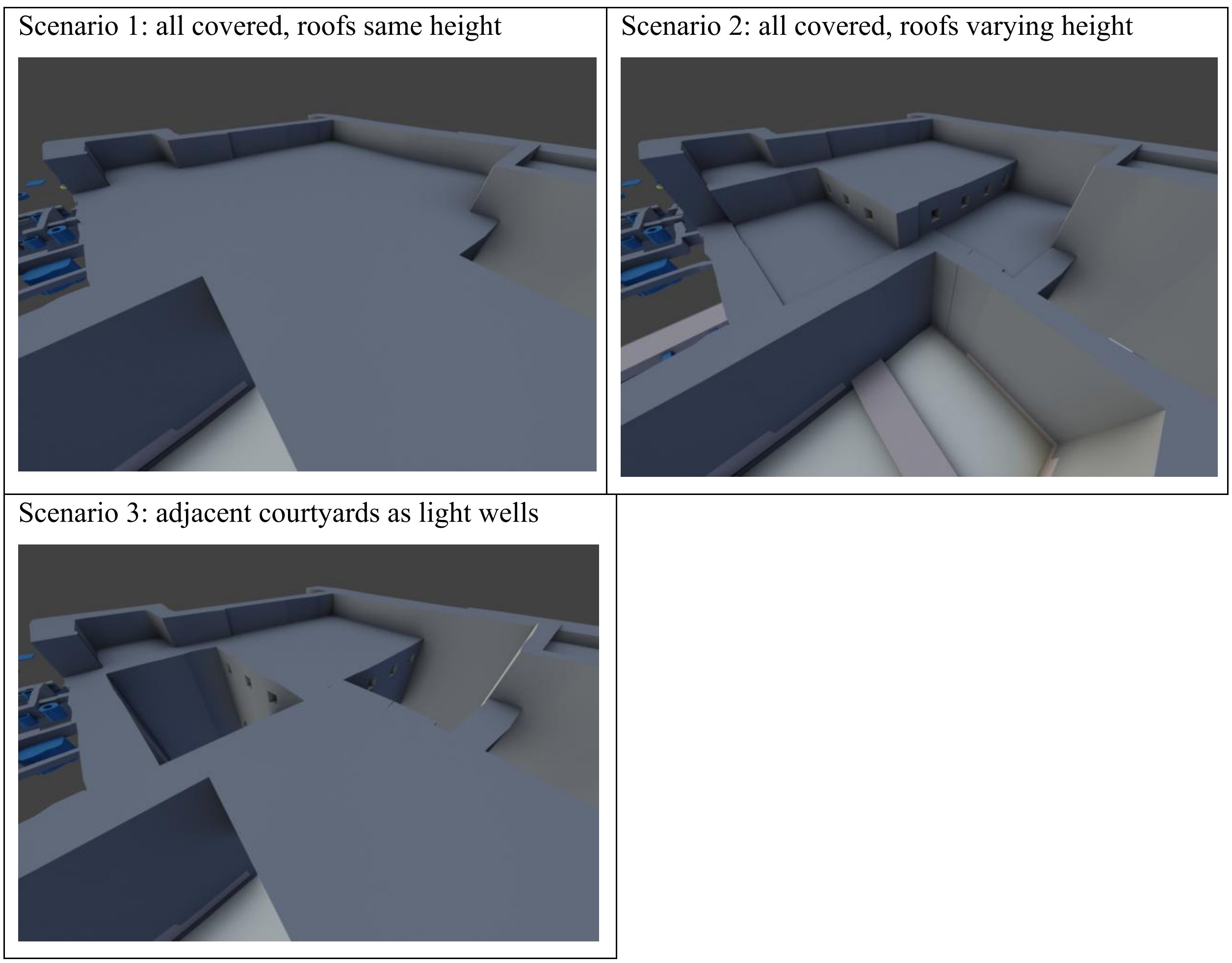


Figure 172. Alternative reconstruction scenarios have a significant effect on interior light conditions in building SE corner.

We can classify the *Dunnu* building plan based on the assumption that optimal conditions were strived after for all buildings. That means that for roofed buildings, it should be possible to create openings on at least two sides. Looking purely at logical positions for light wells, it becomes apparent that in some cases, certain areas would be very useful as light wells, therefore decreasing the possibility these spaces would have been roofed originally. In the case of the example discussed above, the space directly west of the reconstructed building would have been such a case (space SW-10a). This is also supported by other constructional arguments such as the absence of independent load bearing walls. Nonetheless, such spaces may still have been roofed, but on a lower level. Another example is space NE-1a, which could theoretically be roofed, but has no independent constructional elements. It could be classified as a 'left over' space created as a result of adjacent constructions. It makes however sense as a light well for space NE-2a. Building NE-2, consisting of spaces NE-2a and NE-2b, would be entirely locked without the presence of a light well in space NE-1a. The lighting and ventilation of this building would nonetheless be difficult since it is squeezed in between two different phases of the fortification wall. This would also be for any upper storeys, except if a third storey was present that was raised above the fortification wall.

In general, for many spaces some kind of adjacent exterior space can be found that would have allowed to manage lighting and ventilation to a degree. There are also indications that the variation of higher and lower rise architecture helped in this regard. There is a repeating pattern of heavier architecture (2-2.5 bricks) built against the fortification wall, and lighter (1-1.5 bricks) architecture built against the heavier. This means that the ground floor light and ventilation options of the heavier architecture are somewhat limited by the presence of the lighter buildings, but a hypothetical first floor would be served well. It therefore adds some strength to the hypothesis about the existence of multiple storeys on some buildings.

Interesting lighting problems are offered by the two large central buildings, the tower and the residence. In the case of the residence, a very convincing argument can be made that it was intended for elite social use and habitation. The two mirroring 'en-suite' apartment wings fitted with a main room, a secondary room and a bathroom imply the high status of the users. The large elongated central space of the residence could have been supplied using a raised roof, following frequently seen reconstructions for tripartite building plans. The raised roof would have allowed for rows of clerestory windows all around. However, the manner in which lighting and ventilation would have been arranged for the side rooms in the apartments is not directly apparent. Especially the eastern apartment, which is locked in by the tower and the large central hall, lacks adjacent exterior spaces. In addition, the heavy walls of this buildings would in principle not allow for much light inside, using the small window types that were probably in use. One possibility would be to vary the roof heights for the individual rooms of the apartments, so each could be fitted with individual clerestory windows, at least on one side. The reconstructed height could be made dependent on the relative 'importance' (size) of each room, creating an interesting, terraced effect in the reconstruction of this building.

The tower poses even larger issues with its thick walls. An interesting observation is that in the early phase of this building room 5 (the central room) and room 2 (the entrance room) could have been open spaces. Both the formation of specific deposits and later architectural modification suggest this (IV.3.4). This would have supplied the interior of the building with light and air, and with it to some degree also the adjacent interior spaces. This may indicate that the earliest version of the tower had a domestic function. The later roofing of the area as is indicated by the construction of new wall against the interior of the old, would have made the building less habitable. Perhaps this is indicative of a functional change of the building, in which storage would have become its main function, at least on ground floor.

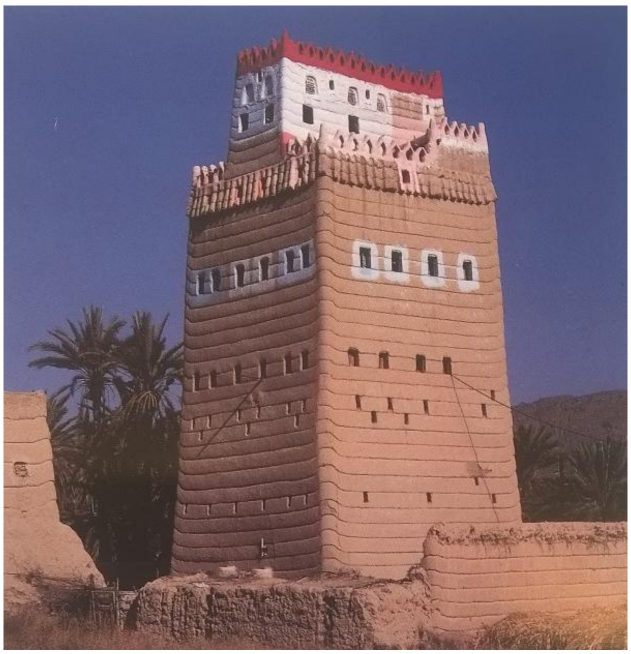


Figure 173. A tower house in Saudi Arabia. The ground floor has a few ventilation holes, but real windows are only found high up, where the living quarters are. Still, windows are small (King, 1998).

VI.7 Drainage

Drainage is an essential functional feature of architecture, even in the generally dry environmental conditions of the North-Syrian steppe. Heavy rains may occur in winter (see II.6.2), which has a strong impact on the decay of architecture, and the usability of exterior walking surfaces. Water that falls on the roof of buildings must be disposed of in a controlled manner, especially in densely built-up areas. It is therefore an inherently three-dimensional question that forces one to think of how the settlement was organised in both a horizontal and vertical way, and how the buildings and roofs related to the varying elevations of the sloping tell surface.

Common features of mud brick buildings are cylindrically shaped wooden gargoyles, and white plastered runnels. Both ensure that water is disposed to minimise damage on the lower part of the walls. Gargoyles perform by discharging the water some distance away from the wall, while runnels ensure controlled water flow along a reinforced plastered vertical gutter in the wall. On ground level some additional procurements may be taken in the form of shallow gutters. However, often these are naturally formed through erosion.

In the *Dunnu*, the crowded construction and presence of a fortification wall as main barrier, offers an additional challenge of disposing water in a controlled way. Some evidence for the water discharge system has been excavated, although it appears to be far from complete (Figure 174). Most of them are in the form of naturally formed erosion gulleys, although some evidence exists of attempts to physically control their direction. Most of them also seem to be associated with the bathrooms found on site, which may rather identify them as part of the waste flow management rather than water discharge. However, these separate functions were probably aligned and combined.

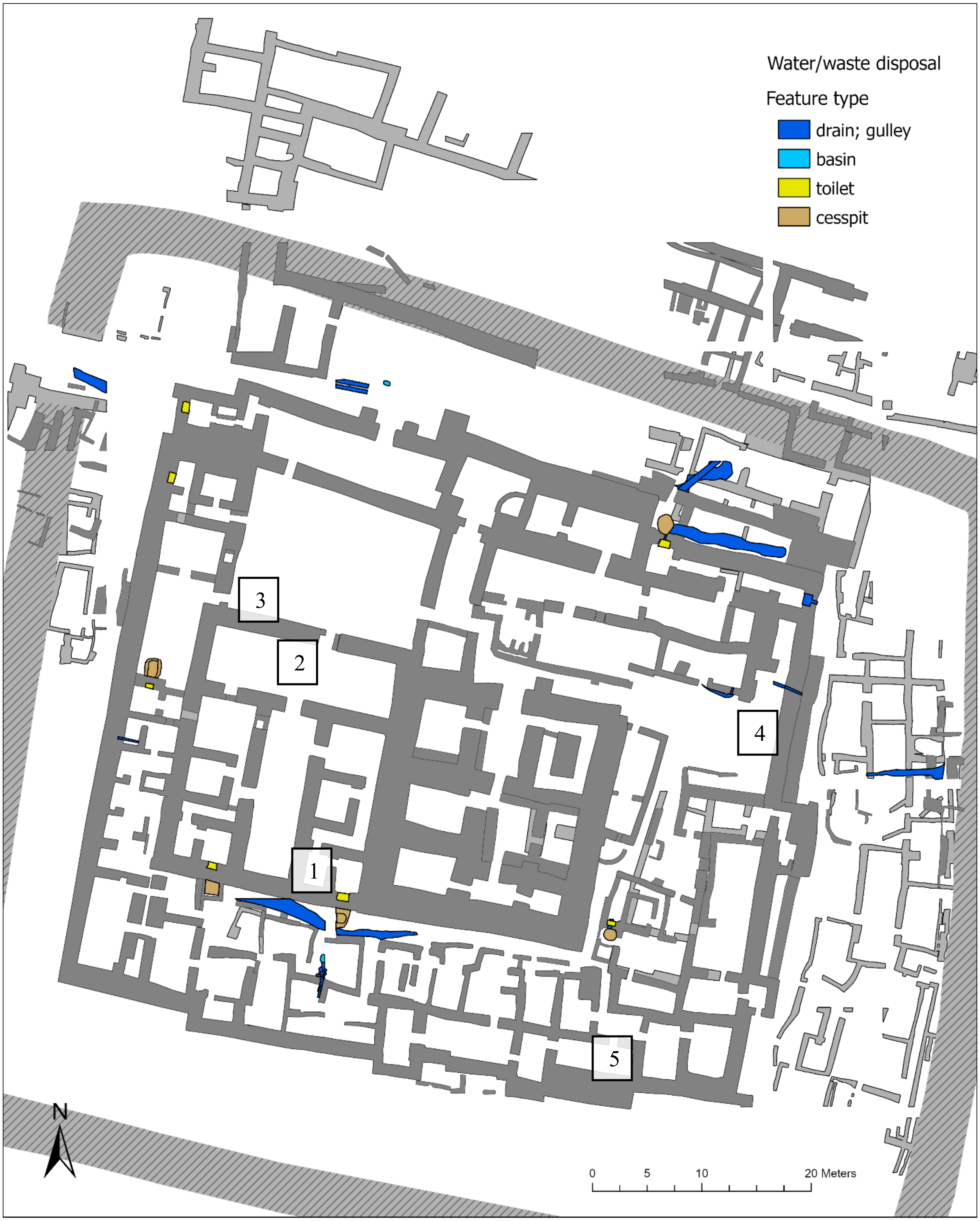


Figure 174. Excavated water and waste disposal features with numbers referred to in the text.

One example that implies the presence of some sort of rain (and waste) water management system is found in the southern *Dunnu*, behind the two large buildings in the centre (Figure 174: 1). Here, two gullies run along the foot of both buildings, and converge at a point in the middle, where it may be connected to a system made out of a dug in basin, a narrow gutter and specifically placed rocks which suggests they were aimed to control water flow. Traces of the continuation of this system further south through the fortification wall have not been found, possibly due to bad preservation conditions. The gullies are located in the narrow open space between the large buildings in the centre and the lighter architecture directly south of it. That this 'alley' functioned as the main drainage channel from water fallen from the roofs of the large buildings, is additionally suggested by the presence of wall reinforcements and door blockings found in this area. It suggests that the lighter architecture suffered from its vicinity to the water discharge from the roof of the larger buildings. Note that the main concentration of bread ovens is located here, which must have been vital for the survival of the *Dunnu.* The presence of two cesspits[62] belonging to the bathrooms of the elite residence, further ameliorate the situation and create a very pressing motivation for architectural modifications that serve to control the flow of water and protect the interiors of these spaces.

Additional evidence for a system of water disposal comes from the smaller courtyard inside the residence (Figure 174: 2). It is clear from mapping the elevation points on this surface, that this tile floor was constructed with shallowly sloping sides, that come together at the point of the gate towards the large courtyard (Figure 177). This therefore suggests that this area was drained through this gateway, practically the only way out for water. There is additional evidence for further disposal of this flow just outside the residence, in its north-western corner (Figure 174: 3). Here is a passage that connected the large courtyard with the area directly to the west of the residence. The passage has a threshold constructed from tiles with a gap left in the middle, some sort of narrow gutter (Figure 175). As a location, this would have made sense, since this this is a point of exit where the original tell surface started sloping. Although both pieces of evidence hint at water management, the picture is incomplete. Nonetheless, the necessity of having a drainage system in place is apparent, as both the main courtyard and the smaller interior courtyard of the residence had originally brick tile pavements, and were surrounded by walls. Without drainage, these areas could have become shallow pools during heavy rains.

---

[62] The cesspit of the bathroom in the north-western corner of the *Dunnu*, had two gullies associated with it, interpreted as flood streams. As these cesspits are not that deep, overflow may occur during heavy rains.

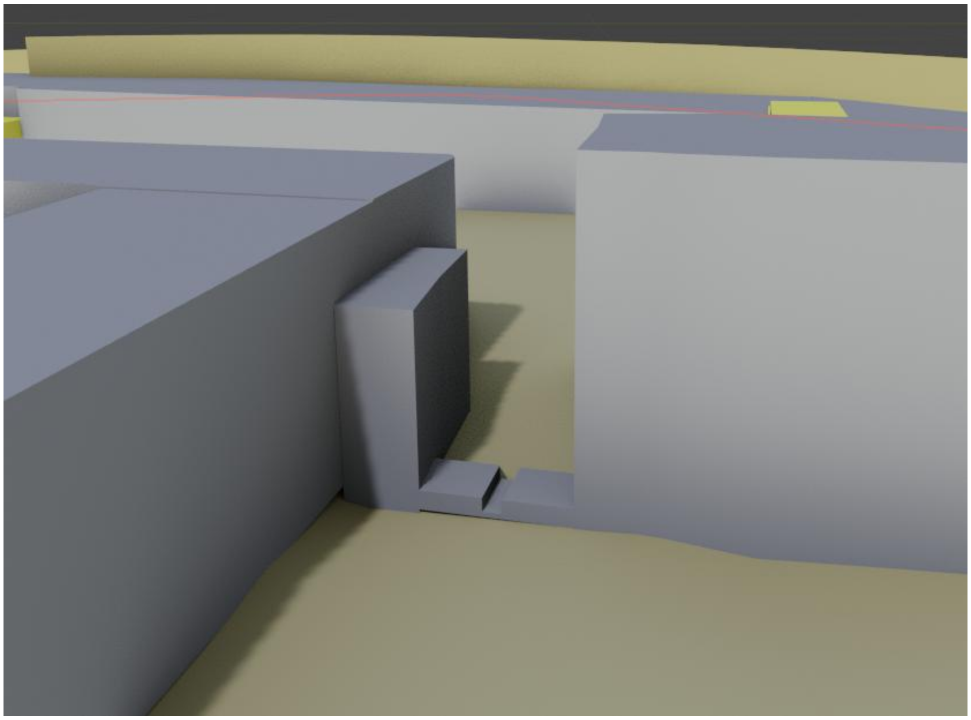


Figure 175. Drainage channel in threshold of passage in south-western corner of the large courtyard. Location is indicated on Figure 174: 3.

The evidence for drainage gives an incomplete view of the entire water disposal system that must have existed in the *Dunnu*. Considering the lack of space, there are only few logical locations for the discharge and drainage of water flows from the roofs of buildings. The two large central buildings drained at least part of their roofs in the alleyway in the southern *Dunnu*, as has just been discussed. Just one drainage point would not have been enough, and it is clear that the residence had also outlets on its north side, considering the evidence for controlling water flow in its northern courtyard and beyond. For the tower, no such evidence was found on its northern side, but the most likely location for collecting water would have been in its north-eastern corner. The large unpaved open space, the eastern courtyard (NE-4f), that was located here, would have been used to either absorb or further channel the water beyond the fortification wall. Unfortunately, this area has not been excavated completely. Some evidence for the use of gutters or drainage gulleys has however been found on the northern side of this courtyard (Figure 174: 4). Although these may not be related to the tower, it proves the general usage of this space as a node in the drainage system.

As regards to the other buildings, it may be expected that the buildings constructed against or integrated with the fortification wall had roofs that discharged on the other side fortification wall. This would have been most sensible, as it allowed for further drainage along the natural slope of the tell, where it may be expected that further drainage led into the dry moat. The roofs of the lighter walled architecture in between the fortification wall and the central buildings probably made use of the same drainage system as the large buildings. However, for several buildings in the south-east, it is not apparent how this would be arranged. A potential 'water trap' can for instance be identified in space SW-10a (Figure 174: 5, Figure 176). As this was probably an open space at the end of a series of open spaces that each had slightly lower floors due to the local surface topography, water would have naturally flown into this space. It was trapped here against the fortification wall. If this was indeed the end of an intended drain, precautions must have been taken to take it through the fortification wall. However, it is also possible that all the surrounding roofs were constructed in such way that none of them drained into the small alleyway and courtyards, and that it only had to deal with water directly falling into the open spaces. Since no evidence for erosion gulleys was found here, this may have been the case.

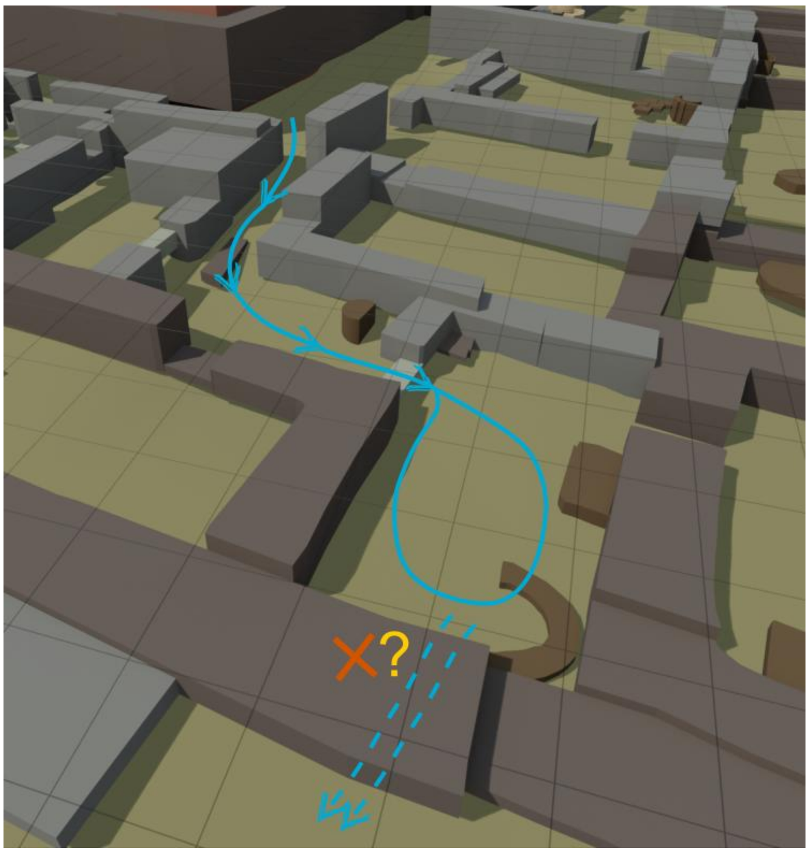


Figure 176. Potential water trap in space SW-10a. Location indicated on Figure 174: 5.

Another potential problem was identified in space NW-4d, the large wide room after the main gate in the new fortification phase (Figure 177). If this space was open, it would have had some issues in periods of rain. It did not have a tile paved surface like the large courtyard and private court of the residence. Although no roofs drained into this space, it would still collect significant amounts of water during winter rain bursts. It could have been that this was absorbed by the ground, which inevitably lead to muddy surfaces. It is possible that this situation was accepted. But that begs the question why this area was not fitted with tiles, as were the other large open spaces in this sector. It may also have been that the space was roofed after all.

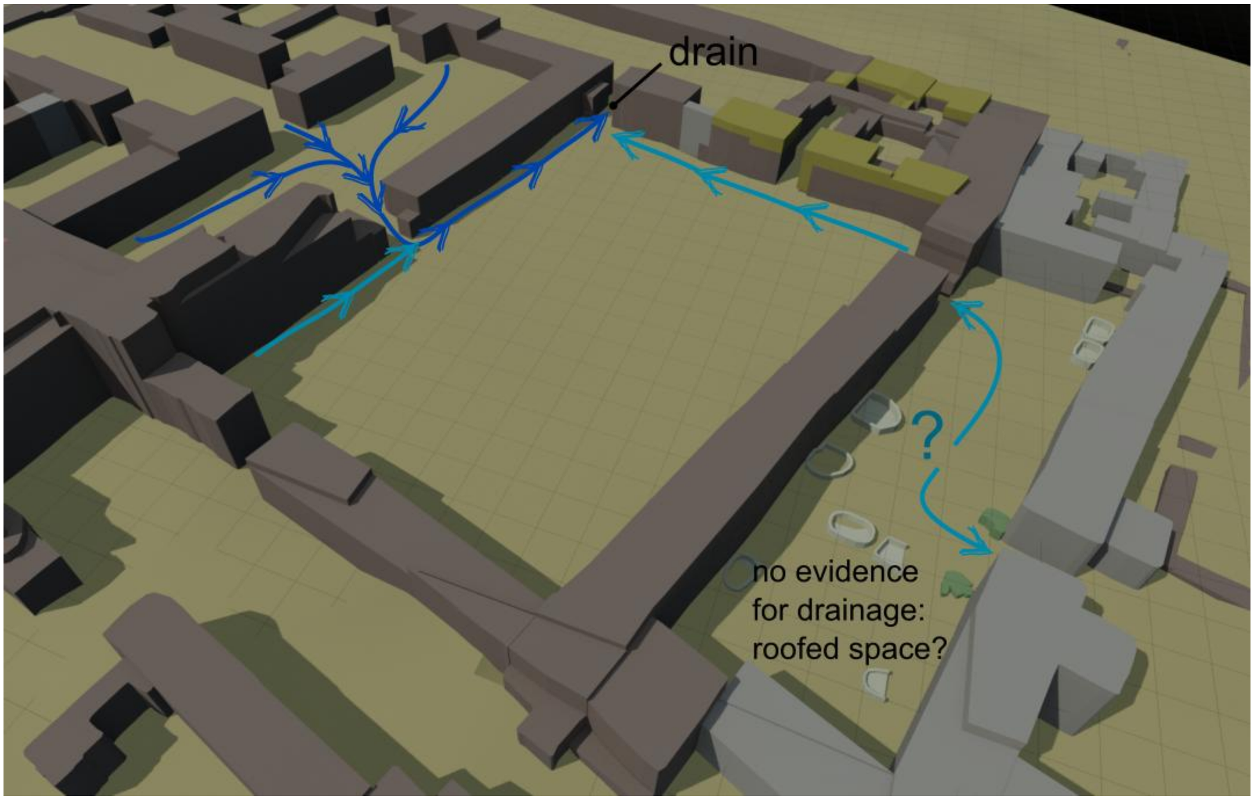


Figure 177. Drainage system of the large courtyard area. Blue = suggested by elevation data. Teal = hypothetical.

VI.8 Fixed features

"Fixed features" is a term used for smaller constructions or installations that are not part of the architectural construction. In the archaeology of the *Dunnu* these are primarily different types of bins, fireplaces, ovens and kilns. According to the theory of the relationship between people and the built environment by Rapoport (1990), it is primarily the fixed features that play a role in the use and meaning of spaces. For archaeological interpretation they have a big advantage over portable items, as they are less affected by activities such as scavenging and reuse on a different location. We know therefore for certain that a bin or an oven was used in the specific space it was found.

Fixed features, as constructions, may be viewed as part of the architecture. They may also be influenced by and influencing the architecture, in terms of placement, types and number. Nonetheless, the degree to which fixed features influence the reconstruction of the architecture is probably limited. In some cases, such as the fire features it may be argued that high concentrations of them are unlikely to have been placed inside, thus influencing the likelihood a space was originally roofed (VI.4.2). Fixed features are important as physical obstructions. As will be shown, they significantly influence access by blocking or limiting movement in various spaces. Finally, more in line with their traditional usage in archaeological interpretation, fixed features also give indications that can help us understand the function of spaces, and spatial organisation of activities in the settlement.

VI.8.1 Bins & cesspits

Bins are a broad category of container-like structures assumed to have a storage function. In total 84 features have been classified as bins across the levels 7 through 5. Bins at the *Dunnu* come in different shapes and building materials, which has been used as the basis for their classification (Jachvliani, 2015). Most bins are puddled loam, clay, or mud brick constructions, but a minority was built with white (lime or gypsum) plaster, baked brick or a combination of mud brick and loam. In terms of shape, they vary from square, square with rounded corners, oval, circular to semi-circular. The large majority is square (mud brick) or square with rounded corners (loam/clay).

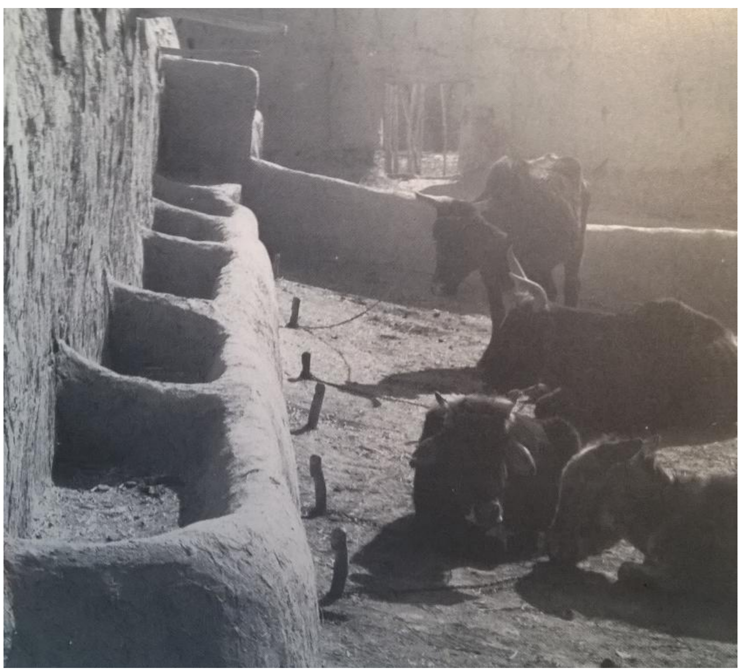


Figure 178. Feeding bins outside a fortified farmstead or Qala in the Bamiyan valley, Afghanistan (after Hallet and Samizay, 1980, p. 130).

There are very little indications of their use, although some have been interpreted in the field as silos or basins based on their shape and building material. Indeed, sunken features lined with thick layer of lime plaster may be related to liquid storage. Apart from storage, bin-like structures could have functioned as feeding bins for animals (Figure 178). Some bin-like structures are clearly associated with the drains of toilet installations, and are therefore most likely interpreted as cesspits. Quite interesting are those of the bathrooms of the residence, which are in the narrow alley at the back of the *Dunnu*, hindering movement, and blocking views. They are also bordering an important food production area with many bread ovens (see VI.8.2). Considering such cesspits are known to overflow at times, this is a slightly sub optimal situation from the point of perspective of the modern observer used to current standards in hygiene.

For the other bins, their location in the *Dunnu* may give additional indications of their use. There are a number of interesting clusters. Two are located in the space behind the main gate, and the postern gate. The cluster in the main gate strongly influences movement by the placement of the bins (see below: VI.8.4). The presence of bins behind these gates is probably significant. Expected usage may be temporary storage for items brought into the *Dunnu*, or like the example on Figure 178 used as feeding bins for animals. Considering the functions of the *Dunnu* we know from the cuneiform sources, animals would have been brought in, and may have had to wait further handling in the administrative or security procedures. Animals were anything from cattle to be consumed in the *Dunnu*, pack animals, or horses of soldiers or the elite owners and visitors. Temporary storage of items or brought in goods may be another use. For instance, one tablet refers to the distribution of sickles to farmers. If those farmers came to the *Dunnu* to collect their tools, they could have received them in a place like the vestibule, where they were temporarily stored in the bins found here. Naturally, this is a speculative assertion, but it is worth thinking about other practical uses of such bins in relation to recorded practices. There is however still the question about whether these bins belong to the phase of original use and function or that they belong to a late use phase of the *Dunnu*, which made use of the same floors. In the case of the vestibule of the main gate, this is difficult to tell. However, the space behind the postern gate had those bins only during the use of a deep floor level. After a renovation, these bins did not return, suggesting here at least, the bins belonged to an earlier phase of the use of the *Dunnu.* Another interesting bin cluster can be found in the southwestern corner of the *Dunnu* (figure 181). Here the bins are associated with a cluster of ovens, which suggests they played a role in food production.

Figure 179. A row of four bins at the large space behind the postern gate. The three smaller are hand modelled clay or loam structures. The large bin is made of mud brick. Note its similarity with the bins shown on figure 178 (photo by P. Akkermans).

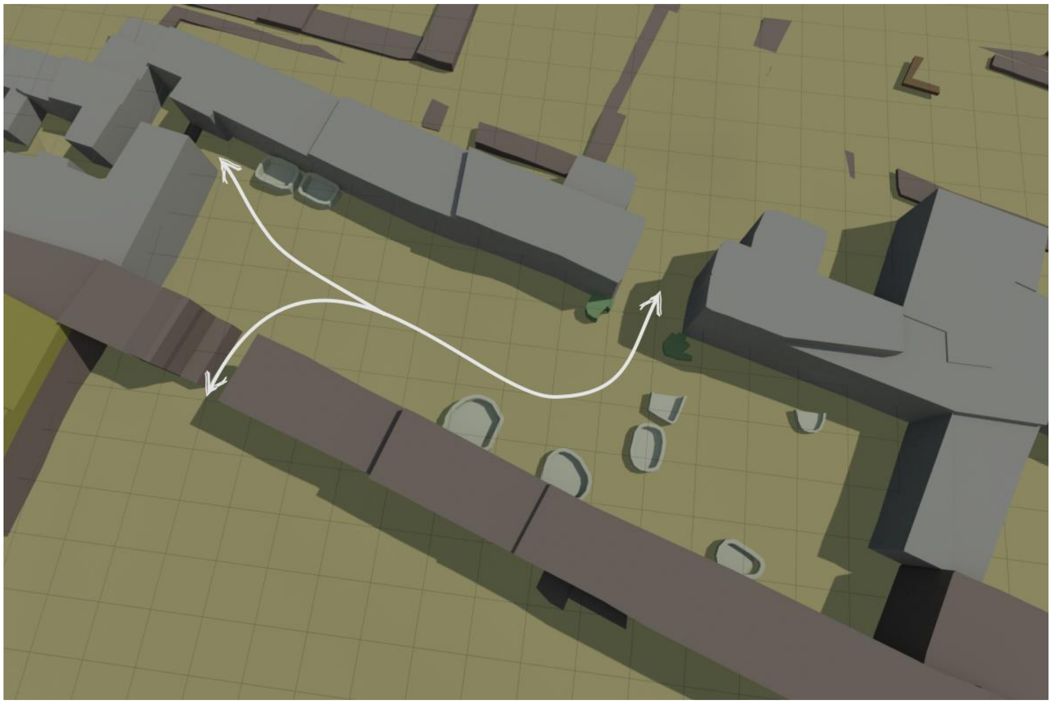


Figure 180. Bin cluster and path of movement in vestibule of the new gate.

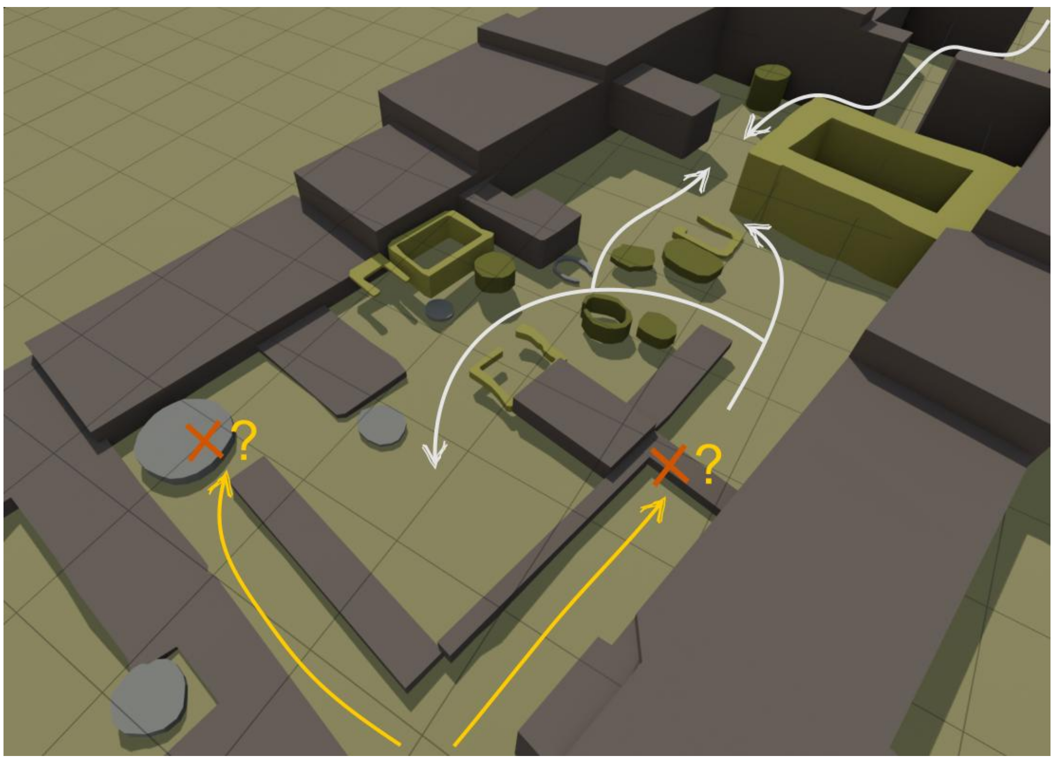


Figure 181. Cluster of bins and ovens in space SW-1a-d, which offers some interesting challenges in terms of access. Some sequencing is suggested by their stratigraphic order, allowing for more space per phase. At least two phases are visualised simultaneously.

VI.8.2 Ovens and fireplaces

The ovens and fireplaces at the *Dunnu* come in a range of shapes of sizes, but the typical oven is circular and about 60 to 70 cm in diameter. Such ovens are assumed to have been similar in shape and function to the tabun or tannur that have been traditionally in use in Western Asian village contexts until today (Tkáčová, 2013). Originally these were cylindrical to conical (tannur) or domed shaped (tabun) structures with a firing hole at the bottom and a hole at the top. What remains of them is generally only the lower side, which makes it hard to reconstruct their original shape or type. Nonetheless, of the ovens that have preserved well enough, none of them appears to have been dome shaped. Hence, we are dealing mostly with 'tannurs', in a range of sizes and shapes. Although baking bread is generally their main function, documented examples show that tannurs could in fact be used for cooking with a plate or pot on top of the opening, or for other oven prepared food types such as meat. However, since both fireplaces and ovens occur in the *Dunnu*, it is possible that the use of different types of installation reflects a distinction between cooking and bread baking.

Figure 182. Tannurs located in the alley against the back wall of the tower. Very little room was left for people to maneuver (photo by P. Akkermans).

At the *Dunnu* ovens occur both in clusters and as isolated cases. Most are free standing structures, but a few of them are built into the walls of the architecture. The latter phenomenon has also been observed in recent examples (Tkáčová, 2013). Also temporally, ovens tend to cluster, as old ones are demolished and replaced by new ones. Of these older phase ovens, often a few centimeters of the wall preserve, enabling us a view on the various generations of oven construction on one spot.

Figure 183. Oven integrated in the wall in space SW-6a (photo by P. Akkermans).

The largest and densest cluster is found in two to three spaces near the southwestern corner of the *Dunnu*, which has been dubbed "the bakers district" for this reason. Multiple of them are in small enclosures made of single brick walls, which were most likely uncovered. The bread baking took therefore place outside. Another cluster is located near the southwestern corner of the residence, where bins and ovens co-occur, and ovens vary in shape and size more than the baker's district. This may imply a different type of use, perhaps related to food cooking for the residence. This is also suggested by the vicinity of the small side entrance to the residence[63], near this cluster of bins and ovens. The space may have been unroofed, since both main walls belong to other structures (the residence and the fortification wall). However, some kind of partial roofing appears to be suggested by the additional architectural features of this space. Another interesting concentration of at least six fireplaces is found in a building in front of the main entrance of the tower. Contrary to the typical oven, these are rows of integrated fireplaces or stoves designed to hold large pots over a small fire. The oddly shaped plan of the walls, and rough, pebble covered floor surface may again imply an open-air space. Nonetheless, it could easily have been roofed, and it perhaps was. The

[63] The stratigraphic association of this doorway is uncertain. The excavation notes and reports suggest it was cut in a later phase, although no convincing evidence of this was documented.

curious cavity in the south wall could even imply some kind of integrated smoke duct. The arrangement suggests that cooking for large groups could have taken place here. It is interesting to note however, that this building is a relatively late addition to the *Dunnu.* Excavation never continued below its floors, so it is unclear what was replaced: the previous version of this “kitchen”, another building, or simply open space? Various smaller clusters that include much larger ovens of up to 1.90 in diameter, are found outside the fortification walls in the eastern and north-eastern *Dunnu*. It is uncertain what their size means, and whether it is indicative of a different function, or a larger production. Apart from the conspicuous clusters, there are many spaces that have just a single oven or hearth. In many cases, such spaces are highly likely roofed. Their isolated occurrence in closed spaces may imply small scale or private usage. It may be a tentative conclusion to link these to individuals or families that are resident of the *Dunnu*. If this type of reasoning is followed, then the clusters must be somehow related to larger scale and public usage, or in other words: cooking and bread baking for larger groups.

Figure 184. A row of three or four fireplaces integrated in the architecture in space NE-9c. These are simple stoves that could hold large pots above a fire. There is a cavity in the wall, plastered on the inside, which may be a kind of chimney, or simply point at an architectural modification (photo by P. Akkermans).

VI.8.3 Pottery kilns

Eight pottery kilns varying in size, belonging to levels 6 and 5, have been excavated at the *Dunnu*. An additional level 4 pottery kiln, one of the largest, was excavated right in front of the new gate, suggesting indeed the abandonment of the old functions of the *Dunnu* by this time. The technicalities of kiln construction and their pottery production have been studied in detail by Duistermaat (2001; 2007, 2014). These structures are generally partly subterranean constructions, but with a significant part above ground. Their above ground structure has in several cases been cut and levelled, and the remainder covered by a new floor. Kilns, as the most intensive type of fire feature found at the *Dunnu*, are probably outside features, therefore indicating an absence of a roof in the spaces they are located in.[64] Besides this basic link to architectural reconstruction, the kilns have a temporal dynamic and spatial context that makes brief consideration of this class of fixed features interesting.

Regarding the level 6 and 5 pottery kilns, they show a remarkable temporal pattern. The early kilns are exclusively found in the extramural *Dunnu*: one in the north[65], and three in the east. The occurrence of the latter three hint at the 'industrial' nature of this area. Two of them appear to have been demolished relatively early on, and covered by floors and other features. Thus, it is feasible that these functioned at the start of the *Dunnu*, and may have been involved in the production of ceramic building materials, i.e. baked tiles. The kilns that are located on the interior of the *Dunnu*, are all late additions. Hence, we see a movement of such features to the interior of the *Dunnu*. Careful contextual and stratigraphic considerations shows that they are associated to a phase of the *Dunnu* after significant architectural modification. They indicate a transition of the use of the interior of the *Dunnu*. Most significantly, the two kilns in the northwestern *Dunnu*, imply the abandonment of administration as they are founded in a layer that contains the remainder of the archive of Tammitte. The builders of this pottery workshop also cut an opening in the wall of the old bathroom space of this building that has tentatively been dubbed the office. Also the creation of a potter's workshop in the southeastern *Dunnu*, in an area and building that is associated with many discarded cuneiform tablets seems to suggest the same. Moreover, the kiln build behind the old gate appears to be founded in rubble deposits, implying the *Dunnu* architecture had already been significantly decayed or demolished here. The temporal-spatial dynamics of the kilns therefore suggest an upheaval of the *Dunnu's* original functioning at large.

VI.8.4 Fixed features as limitations to movement

As previously noted, fixed features have a dual role in our understanding of the architecture. They firstly point at a certain function of the space, and secondly form a physical obstruction to human movement and

[64] Theoretically, kilns can exist in covered spaces, as there are many such cases found across the world. However, due to the lack of precipitation during most months of the year, there is no good reason of building kilns in a roofed structure.
[65] The interpretation found in the reports that this kiln was located in a walled extension of the *Dunnu* (space NE-2), is not followed here.

visual line of sight. The barrier is less intrusive than walls, but depending on the size of the fixed feature, it cannot simply be stepped over. The presence of fixed features therefore has a significant influence on the way space can be used.

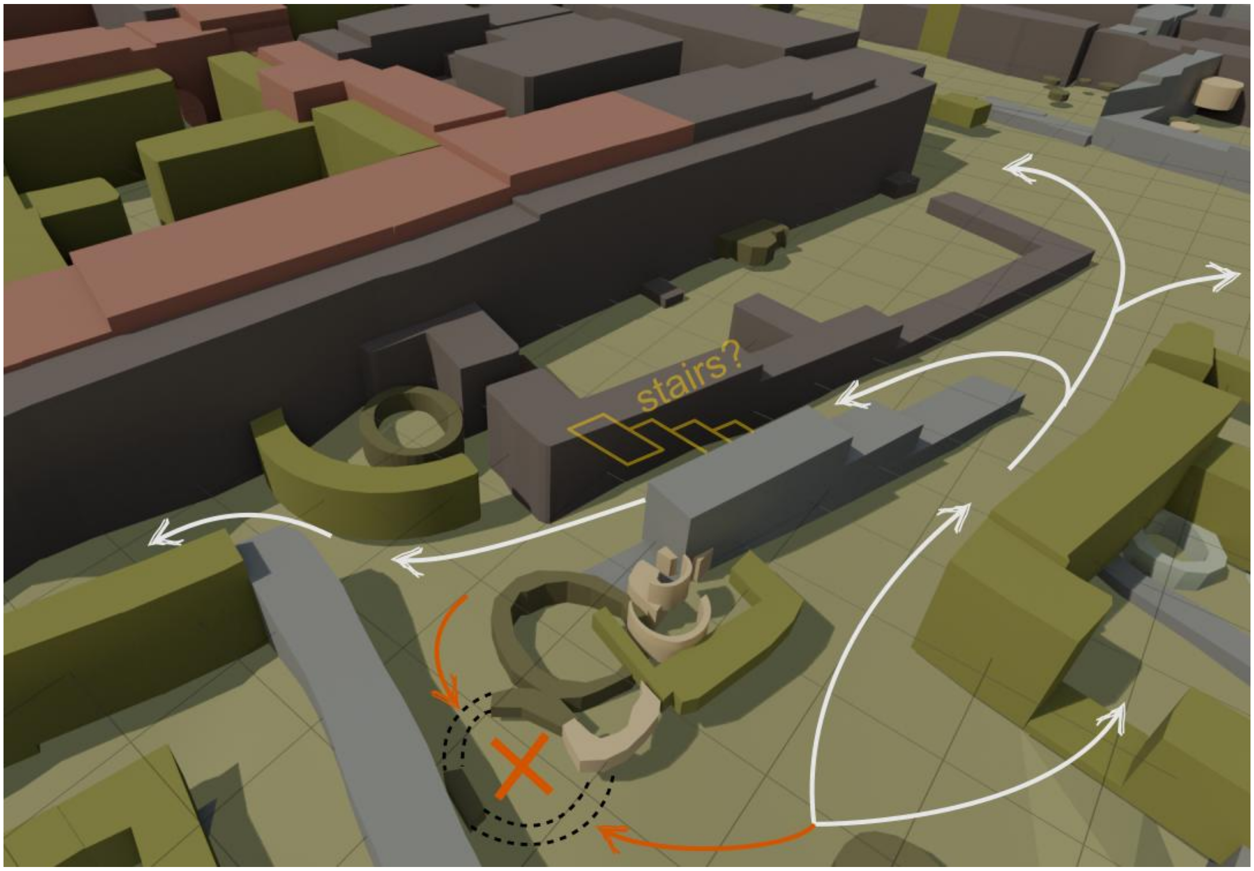


Figure 185. A series of fixed features, ovens and bins in space SE-7b in the south-eastern sector of the Dunnu.

The presence of fixed features influences movement in broadly two ways: by directing movement, or by blocking movement. A good example of direction of movement is the vestibule behind the new gate (figure 180). The bins are placed in such a way, that a visitor is automatically guided to the western side of the space, where the second gate is found giving access to the main court. Their setup along the line of entry, including those across the space on the right-hand side, makes one wonder whether their purpose was to serve a line of people or animals, awaiting entry to the main court. However, most concentrations of fixed features are located in between the lighter architecture in the south and east of the *Dunnu*. Here, fixed features block movement in such a way, that it influences our understanding of spatial organization of the *Dunnu*. In the south-eastern corner of the *Dunnu*, a group of bins and ovens of two different phases appears to block easy access to the southern *Dunnu* (figure 185). Instead, people are forced to detour, first passing the large eastern courtyard before taking the narrow passage in southern direction. This strongly controlled movement is probably significant, considering this is where people arrive just after exiting the postern gate structure. Why fixed features are used to play this role, rather than a regular courtyard wall seems puzzling. It must be noted however, that prior to the bins and ovens, a wall was located here. Perhaps the reason for taking it down later was due to the lack of space in this crowded area. Another serious blocking of access by fixed features is found in the bread oven dominated area in the south-western corner of the *Dunnu* (figure 186). Here, an oven is placed inside a passage, completely blocking (the only?) access to the areas further west. There are two conclusions possible: either the main access routes occurred on a higher level, i.e. the first floor, or there was no important spatial connection required between these areas. The latter has significant bearing on our understanding of the spatial functioning and intra-*Dunnu* spatial relations, and it further supports the hypothesis that the area to west (figure 181) was mainly associated with the residence.

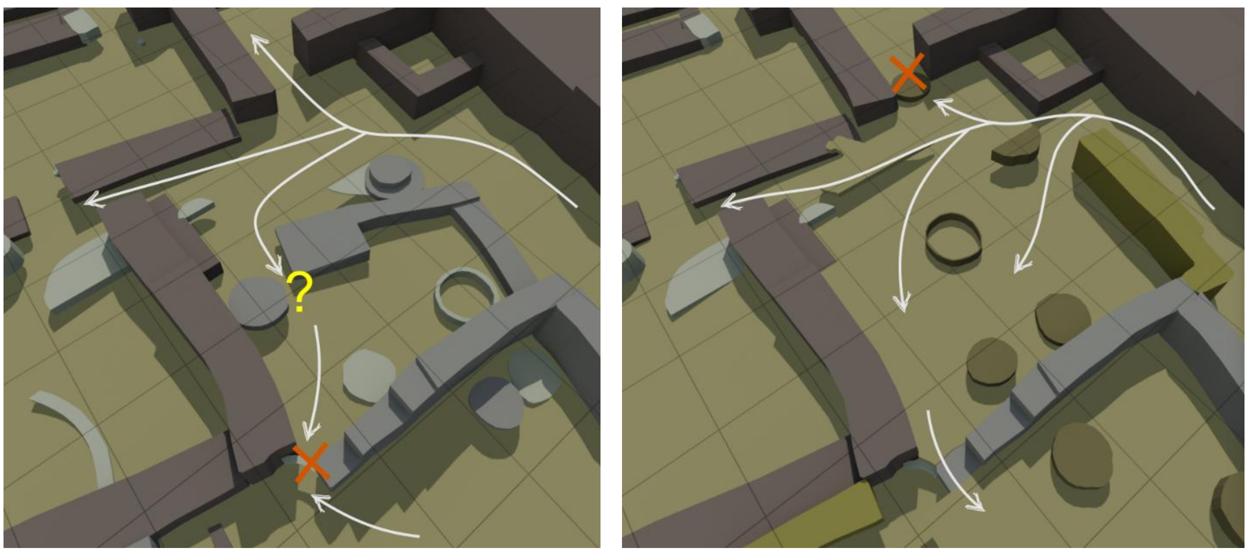


Figure 186. Two phases in the bread oven dominated area in the south-western corner of the Dunnu, with ovens possibly blocking routes.

In many cases, the presence of concentrations of fixed features does not completely block, but certainly limits access. For instance, in the already narrow alley structure in the south, many fixed features are places that limit the flow of people (figure 187). This is the case for all situations illustrated in this paragraph. Often, the resulting space for navigation is reduced to 40-60 cm. As these features are generally not higher than a meter, more freedom of movement was probably available for the upper body. Nonetheless, the spaces clearly indicate the low frequency of movement and just a single person at a time.

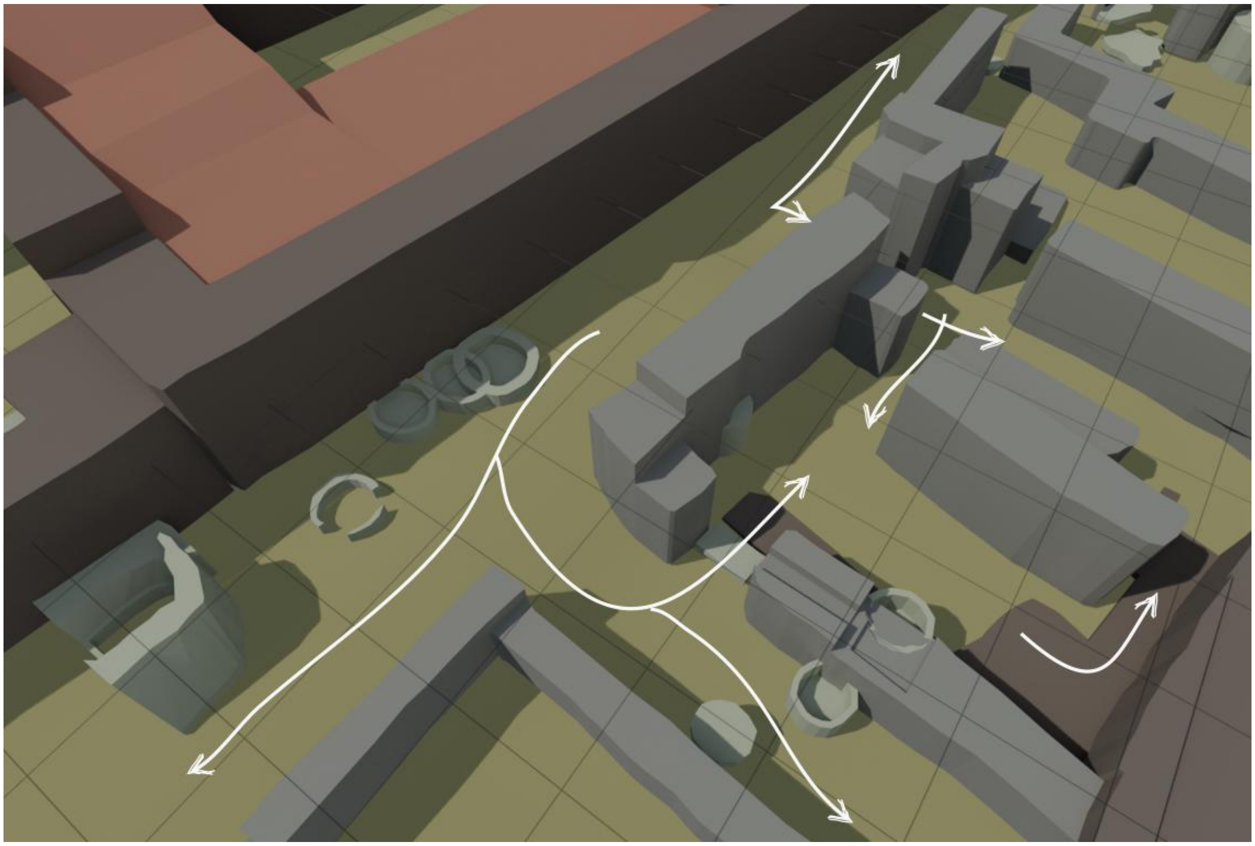


Figure 187. Occurrence of bins and ovens in the narrow alleys in the southern Dunnu. Although access is not blocked, it is certainly limited by the placement of these features. Grid size for scale = 1 m.

VI.9 Special architectural features

Several outliers or unique cases have been identified in the surviving architectural remains, that may point at specific functions.

VI.9.1 Piers

In the south-western corner of *Dunnu*, a series of short walls was constructed against the interior of the fortification wall. Their brick laying pattern (Figure 73) indicates these were intended as square piers, attached to the fortification wall with a narrow support wall. It is as yet unclear what they supported, but there are a limited number of options.

The first is that it supported a staircase to get up to the fortification wall. The general principle of stairs being constructed on top of a base of narrow walls or piers, creating spaces underneath the steps, is a common phenomenon in traditional architectural practices. In parallel to more recent traditional stairscases, such constructions may have used arches to connect the piers, or timbers, often halved tree trunks. Both techniques may also be combined. A wooden base structure for the lower steps may explain their absence from the archaeological data, as the steps would have disintegrated after the destruction or removal of the timbers. One observation that may support this interpretation is that the total length of approximately 10 meters matches the other staircases in the eastern *Dunnu*, that are also supposed to have given access to the fortification wall. However, when fitting the steps to the model, various conflicts arise that may speak against this interpretation. Looking at the stairs from the side (Figure 188), the steps may run from left to right, or from right to left. If running from left to right, the stairs would run over a relatively large oven structure, leaving not enough space left for a fully reconstructed oven. The only way a stairs would fit, and reach high enough, is to have the steps start a little before the first pier on the right, and let the steps run until the top of a wall of a building stuck in the corner.

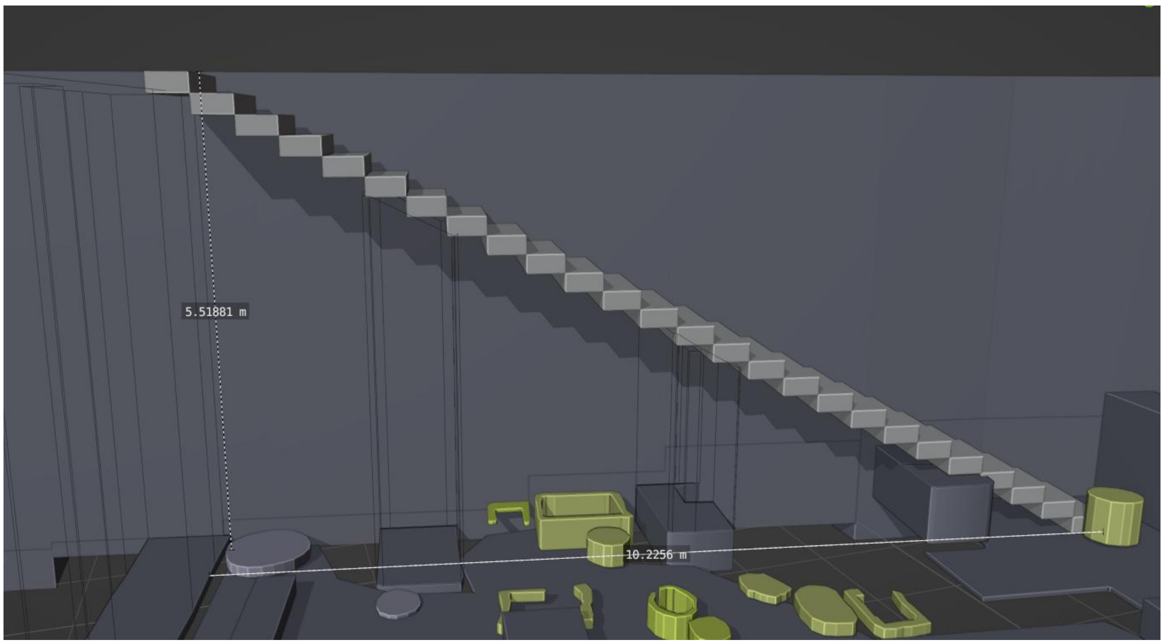


Figure 188. Hypothetical stairs supported by piers against the fortification wall in the south-western corner of the Dunnu. The spaces would have been bridged by timber beams, a manner of construction frequently seen in stairs construction.

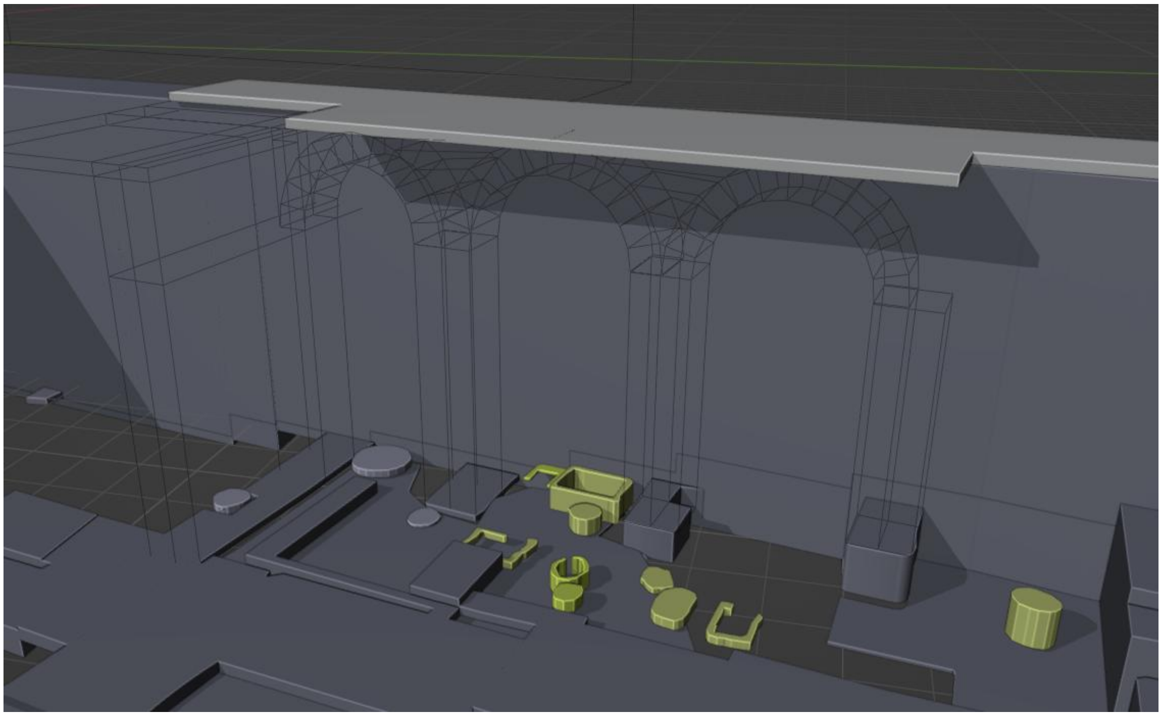


Figure 189. Alternative reconstruction option: extended surface supported by arched pier supported section..

Another option is that these piers supported a platform to create an extended surface area on top of the fortification wall. The extra space this created could have supported an additional roofed structure. Against the exterior of the fortification wall, excavation exposed more supporting walls, which may even imply that the surface area on top of the fortification wall extended in both directions. It is hard to say what exactly its use was, or even whether it had a defensive or other function. It would have created a large space with views on the west. Since it is difficult to access, and close to the residence, it may even have been an exclusive lookout area for the elite inhabitants of the residence. This would have had its parallel in the specially built loge type structures on top of the fortification wall, used in some defended farmsteads more recent regional traditions in western Asia and north Africa.

VI.9.2 Possible remains of a series of light partitions

In square H08, in the elongated space directly west of the residence, a series of seven holes in the interior face of the fortification wall were found (Figure 190). The holes are found 70 to 75 cm above ground level, and are unevenly spaced at 65 to 120 cm. Some are partially covered by plaster, implying a loss of use at some point. The latter supposes that these holes originally fulfilled an architectural function at some point, in which case they would have been slots that held a structural member made of a decayable material. They resemble putlog holes, universally seen in hand made and hand-maintained architecture, but for that they are too close to the ground. Besides, constructions with putlog holes have nowhere else been found in the *Dunnu*¸ which makes this isolated usage very implausible. The holes could have been used as slots for beams for a raised floor or platform construction. We should however note that no matching holes across the space were found, so it was certainly no construction that covered the entire width of the space. Their irregular spacing makes this interpretation less plausible, however. Another, more interesting, option would be that these slots held the horizontal members of a kind of partition walls (Figure 191). They thus created a series of partitioned spaces of variable size. A possible use for such structure are stables for various types of animals. Since the space connects directly to both the large central courtyard and a small entrance to side of the residence, a tentative interpretation is they are private stables belonging to the residence. The massive amount of burned organic material with a fibre structure, potentially straw, found here may be related to its use as stables. The burnt remains show a significant difference from the spaces inside the private court of the residence, which was filled mainly with burnt barley and wood. On the other hand, considering the probability of atypical usage in the final stages of the *Dunnu*, this burnt material may be unrelated to the original usage of this space.

Figure 190. Holes on the interior face of the forticiation wall in space NW1.

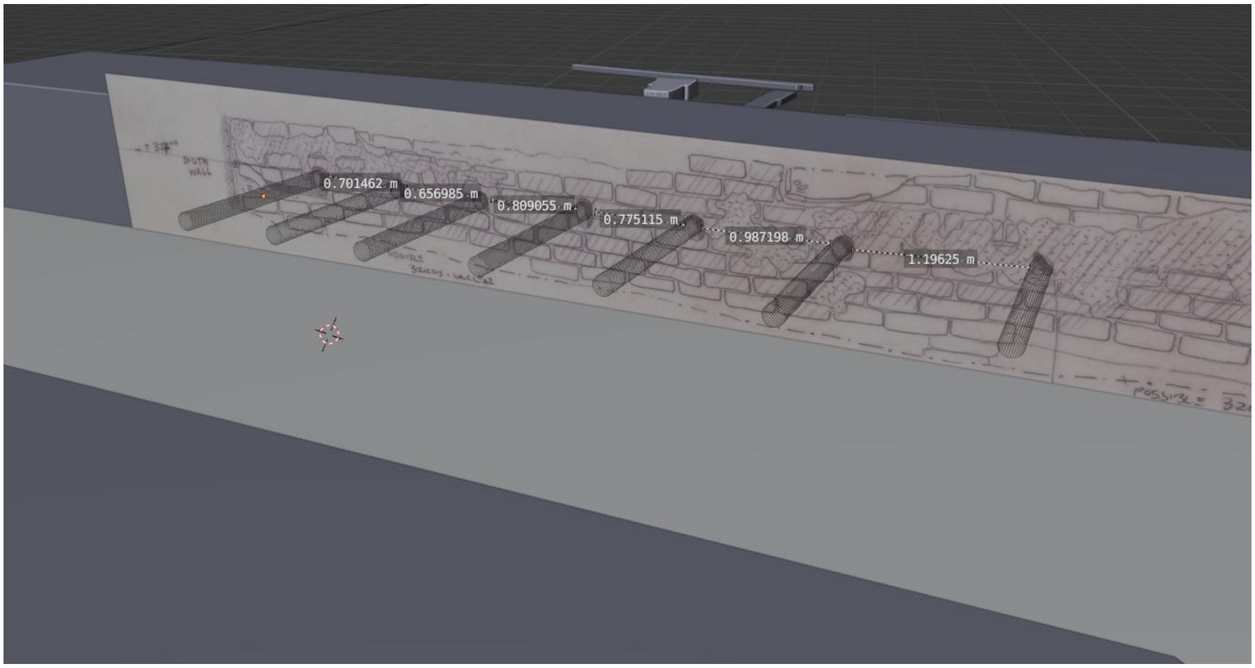


Figure 191. Drawing of the holes in 3D view with simple poles stuck into the holes.

VI.10 Roofing type

There is no surviving evidence for the type of roofing and the presence and shape of parapets. Type of roofing influences both the visual appearance of the architecture, and their functional performance. Flat roofs, saddle roofs, and domed roofs are all common in recent building traditions in Syria (Pütt, 2005; Mecca and Dipasquale, 2009), and are often mixed within the same settlement. Domes are considered an old practice, already depicted on Neo-Assyrian relief art. The dome constructed dwellings of Northern Syria are not found on multi-storey buildings and offer no possibility of using the rooftop for activities. Vaulted ceilings are however common in multi-storey buildings, but are predominantly used on ground level or for basements, not necessarily for roof construction. The saddle roofs found in the North Syrian tradition require one or more central posts, made of timber or mud brick, and are sometimes supported by a mud brick separation wall. Such elements may preserve archaeologically, but no convincing cases can be identified in the remains of the *Dunnu.* Like the dome, the saddle roof's downside is that the surface on top of the roof cannot be used for activities. In settlements with mixed roof construction, there is no correlation between roof type and building functions. All roof types are found on buildings used for dwelling, stables, kitchen, or stores (Mecca and Dipasquale, 2009, pp. 384–445).

Flat roofs, with a very slight slope for the purpose of draining, are the most common. They occur in all mud brick building traditions, in many different regions in North-Africa, the East Asia and Central Asia. Very broadly speaking, there are three types of roofs commonly used in stone- or loam-based architecture traditions: the box roof, the eaves roof and the parapet roof (see V.3.8). Both box roof and parapet roofs may have as downsides that they are less suitable for drainage control or roof top storage and activities. While box and eaves roofs may drain water over the entire length of a roof's edge, the parapet roof helps to precisely control the route and location of water expulsion. Moreover, the parapet roof prevents things and people to fall off. Especially in a densely built area, where space is limited and water flows may easily affect other buildings, the parapet roof would make a sensible choice.

VI.11 Fortification architecture

The *Dunnu* of Tell Sabi Abyad shows various characteristics typical of defensive architecture: a fosse, a ring wall and a heavy-walled building in the centre, in construction and placement not unlike a medieval 'donjon'. It has for these reasons been described as a fortress in previous publications (Akkermans, 1999, 2006). Defence as an architectural function comes with certain criteria for design. A fortification is designed to limit and control human movement both of peaceful users and attacking enemies. However, defence or security should be viewed as gradual phenomena. Settlements can thus be placed on a scale, from incorporating hardly any to incorporating high levels of defensive measures. This section is dedicated to understand better how such requirements influenced the design of the *Dunnu*, and to what degree it may be called 'fortified', or a 'fortress'. To answer this question, we first need to understand more about fortification architecture of the period, what it looked like and how it functioned. Moreover, if we find enough evidence to establish that the *Dunnu* was primarily a defensive structure, what other features could it have had that are part of defensive structures in general? This then informs possibility venues for a reconstruction.

VI.11.1 Ancient West Asian fortification

To contextualise and better understand the fortifications of the *Dunnu*, we will first make a brief excursion to look at fortification architecture in this period and region in general. It is uncertain whether Late Bronze Age fortification architecture or Assyrian fortification architecture is qualitatively different from earlier Bronze or Iron age fortification architecture in general. Construction technology evolved slowly over long periods of time. From a functional perspective, the development of fortification architecture is linked to the character of siege warfare of a certain period. Thus the last significant changes to fortification architecture occurred early in the Middle Bronze Age in conjunction with the introduction of the siege tower and the battering ram (Burke, 2008).[66] The architectural response to these were increasingly massive ramparts and

---

[66] Burke's study focusses on the Levant, but he frequently juxtaposes these developments with Mesopotamia and Egypt.

fosses[67] to impede approach to the fortification wall. Also typical are large rectangular towers and bastions placed in way that enfilading fire of slingers and archers could effectively defend the entire enceinte from enemies targeting the walls. Their size and shape have been explained with the need to be able to man the walls with as many people as possible, in order to counter large siege towers, also manned with plenty (Burke, 2008).[68] The last essential element of fortification architecture are the gates, which may be categorized according to the number piers supporting their structure, commonly six our four pier (Naumann, 1955, p. 301; Burke, 2008). Each set of piers supported a barrel vault, which in turn supported a timber frame and a loam roof deck. A completely preserved example is found in Tel Dan, Israel (Frances, 2013). Variation exists in the size of the gate rooms that are separated by the piers.

For a fortification wall its dimensions may be especially indicative of its defensive qualities. Archaeological evidence generally just reveals the width as the complete height is seldom preserved. Fortification wall widths vary immensely, from as little as 2 meters to over 10 meters. Of course, the wider a wall, the better its defensive capacity. However, wall dimensions of towns are dictated by a combination of defensive considerations and a degree of symbolism related to the status of a town and its ruler. Very wide walls, such as Terqa's Middle Bronze Age defenses (20 m wide) have often grown to these dimensions in consecutive construction phases (Burke, 2008, p. 359). However, Khorsabad's 14 meters wide fortification walls were built in a single phase of construction (Loud and Altman, 1938, p. 18). Clearly the walls of this newly built capital of the Assyrian empire had to convey a sense of grandeur fitting to the self-proclaimed rulers of the world. But the common range of fortification wall width is 2 to 6 meters. Heights can rarely be reconstructed for certain, except if there was some specific mention of it in an ancient document. The 13th century BC enclosure wall of Ramesses III's temple at Medinet Habu was constructed 6 meters wide at the base and made to taper to two meters at the top (Hölscher, 1941). This wall has a unique preservation of 14 meters, and its original height has been estimated just a meter higher. However, based on the archaeological evidence of the better-preserved Mesopotamian and Levantine walls, it seems that many walls were built straight up without a taper. Sargon II (late 8th century BC) mentions that the walls of cities he conquered in Mount Arzabia were 120 *tipku* or 12 m in height. The Akkadian conqueror Naram-Sin (21st century BC) writes down that the walls of the city of Armanum which he besieged were 10, 15 and 20 meters high. In depictions of towers occasionally windows appear, indicating different storeys. Some show as many as five

[67] The term 'fosse' is preferred here over moat, because of the common association of the latter with the water-filled features around mediaeval castles. The fosses of fortification architecture of the Western Asia were not filled with water but for occasions of high rainfall.
[68] Rectilinear towers give space to more people than rounded ones. The absence of large artillery aimed at destroying walls from a distance, typical of mediaeval siege warfare, made the structural vulnerability of rectilinear architecture less of an issue during the Bronze and Iron Ages.

rows of windows (most rows containing just one window), suggesting these towers had 5 storeys.[69] This would also amount to a height of 10 to 15 meters. However, for small fortifications that were probably not intended to stand sieges, such as a *dunnu*, we may expect the fortification wall to be lower than these town wall averages. A minimum height could logically be estimated at approximately 5 metres, the height at which is becomes hard to two people working together to climb over the wall (one standing on another's shoulder). This minimum height is confirmed by a quick review of heights of fortification walls worldwide. There is one source specifically stating the height of a certain smaller fort constructed during Sargon II's reign. Letter SAA 15 113 was sent from the city of Der near the frontier with Elam to king Sargon and reports that the author has demolished and bricked up the outer fortification wall of a fortress to 50 brick layers:

> Der [is well], the [garrison]s are fine, and the people are doing their [wor]k.
>
> As for me, I am working on the fort and constructing the outer wall. I have demolished the southern and eastern directions and bricked them up again, but have not yet finished (the work); I made both 50 layers high. I am now bricking up the n[ort]hern and western directions.
>
> The ki[ng], my [l]ord, should ask Balassu: he is familiar with the work

Taking averages of brick layers from the *Dunnu*, including the joints, this would make a wall 5,60 to 5,80 m high. The width of these walls were not reported.

Figure 192. Towers type 1: with shallow tower heads. Left: seal imprint, 1400 BC (earliest Mesopotamian depiction of a fortified city) (after Herzfeld, 1938, fig. 249). Middle: towers flanking a city gate on the White Obelisk (9th or 11th c. BC) (after Sollberger, 1974, Plate XLV). Right: three towers from cities represented on the bronze sheets of the Balawat gates. The right one is destroyed, suggested by the absence of battlements (after Schachner, 2007, figs. 43 & 45).

[69] These are primarily found in the depictions of Sargon II's conquests as found in his palace in Khorsabad (721-702 BC).

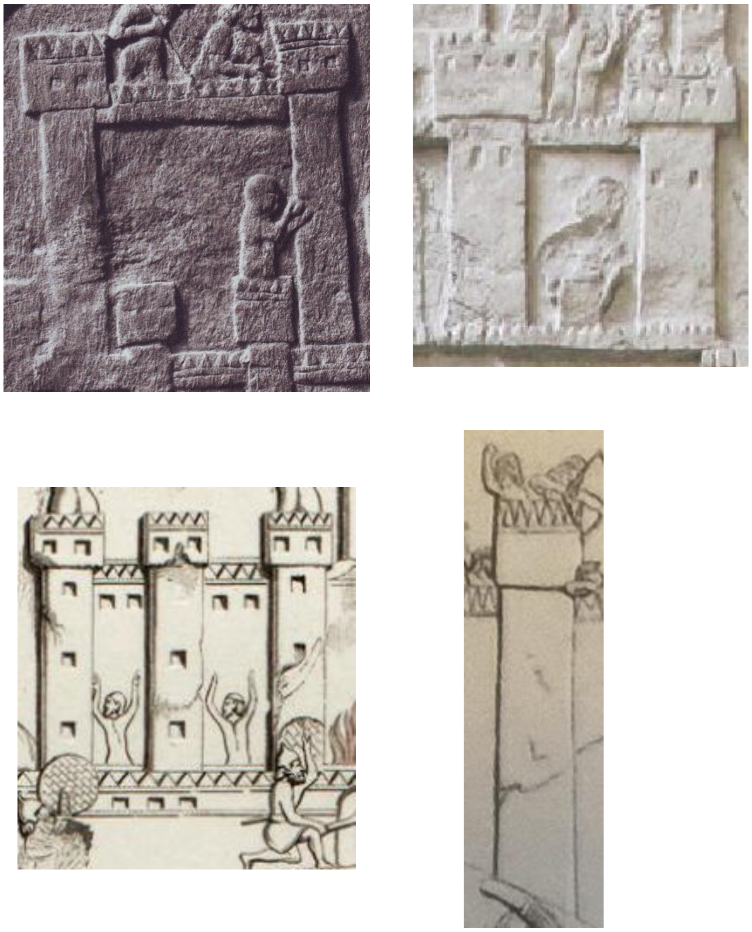


Figure 193. Towers type 2, depicted on the Assyrian bas-reliefs. There are many variations in height to width ratio and window configuration. Top left: Ashurnasirpal II, 865-860. Top right: Tiglath Pileser III, 730-727 BC. Bottom left: city in Urartu, Sargon II, 722-705 BC (Botta, 1850). Bottom right: High, windowless tower from a city besieged by Sennecharib, 700-681 BC.

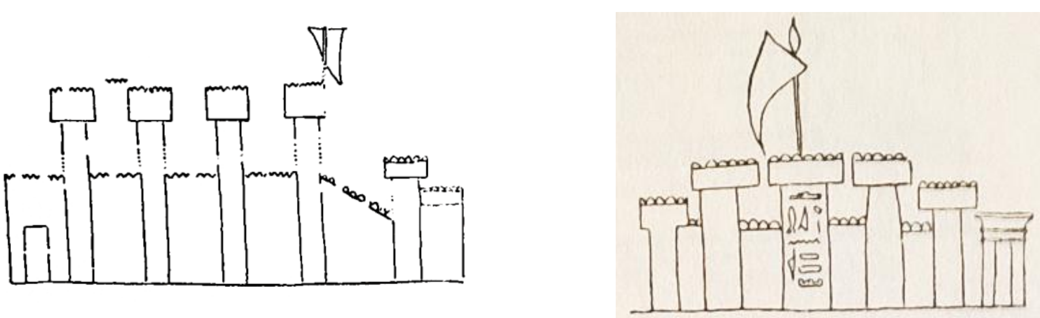


Figure 194. Two Egyptian representations of Kadesh. Left: from Luxor, around 1268 BC. Right: from Abu Simbel.(after Naumann, 1955, figs. 429 & 427)*. The representations seem to be each other's reverse, but the number of towers and location of gate matches.*

For the shape of the superstructure, we have to refer to ancient depictions, or more preserved fortifications of more recent times. Although the depictions lack much detail, and may not even be accurate representations of reality, they do give a general idea of how complete fortifications looked. Most prominent and useful are the bas-reliefs made to commemorate the conquests of the Neo-Assyrian kings (900-612 BCE). Although these are Iron Age in date, it is unlikely that fortification architecture had changed much since the Bronze Age, as siege technology had not seen significant changes from the Bronze to the Iron Age. On the Neo-Assyrian reliefs, we can see all the same tactics deployed – manual wall demolition, undermining, siege towers and battering rams – as were already listed for the Middle Bronze Age as essential elements. Also, most of the weapons carried by the offenders and defenders – the sling, the composite bow, the man-high curved defensive shield, smaller offensive shield, and spear and dagger – are essentially the same.[70] So there is some justification in using Neo-Assyrian representations of fortifications to develop an idea of Late Bronze Age fortifications. Moreover, depictions of Levantine and Syrian fortifications made in Egypt during the Late Bronze Age (Naumann, 1955, pp. 111–115), are in essence very similar to the Assyrian ones but for some minor details discussed below.

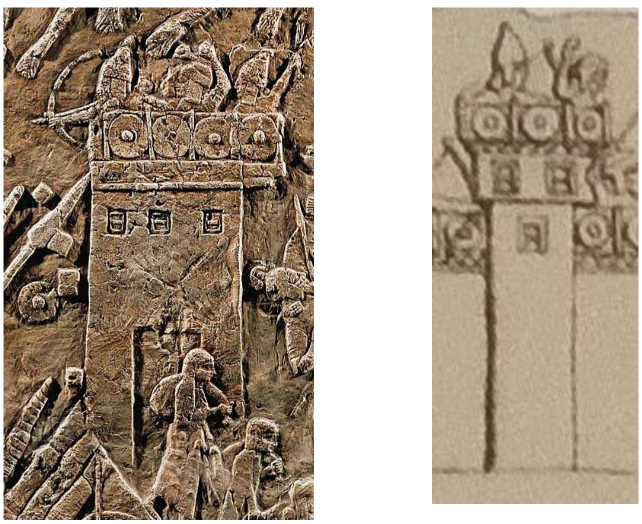


Figure 195. Left: a free standing tower on siege of Lachish with a platform. Note that the left side of the platform has already been destroyed by a siege machine. One of the shields and some bricks are shown falling. Right: one of the many towers in the city wall of Lachish.

[70] Neo-Assyrian reliefs show relatively long swords on the belts of most archers and charioteers, which may reflect the increased effectiveness of the sword with the introduction of iron.

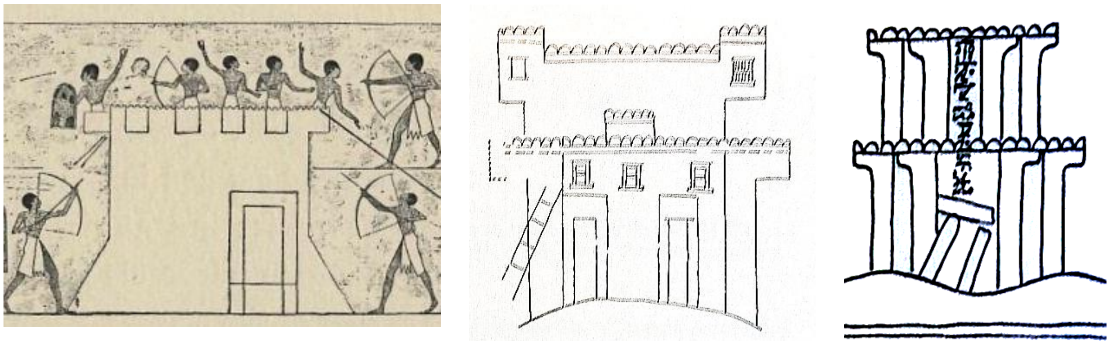


Figure 196. 'Tower' type 3: defensive balconies. Left: Middle Kingdom Egyptian depiction of a fortification under attack from the tomb of Amenemhet (20th century BC) (Maspero, 1903). Middle: city of Askalon, Karnak, Ramesses II (1279-1213) (after Naumann, 1955, fig. 423). Right: Syrian city of Geder, Seti I (1290-1279 BC) (after Naumann, 1955, fig. 417).

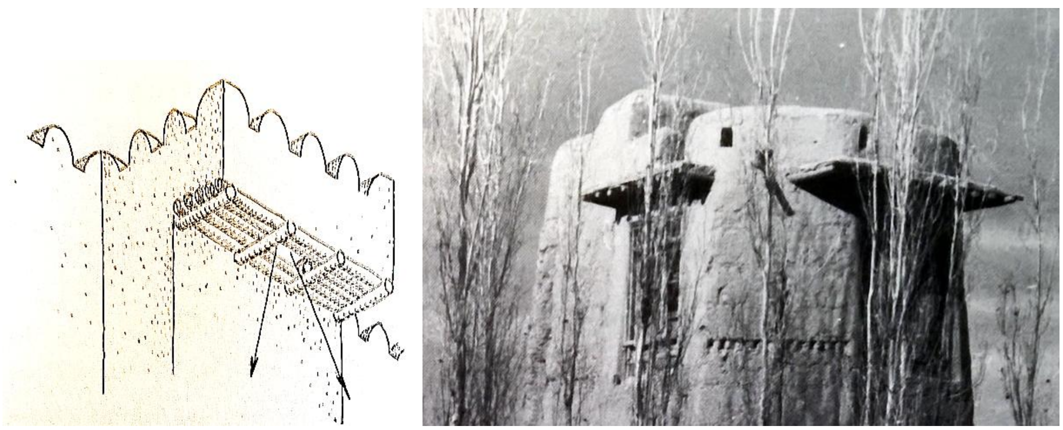


Figure 197. Left: Reconstruction of balcony by Rudolf Naumann (after Naumann, 1955, fig. 421). Right: similar cantilevered construction on a tower of an Afghan Qala (after Hallet and Samizay, 1980, p. 142).

The main features of the fortifications portrayed by the Assyrians are a high frequency of towers, mushroom shaped towers with a tower head that is wider than the base, almost always arched gates, and battlements either with triangular or stepped merlons. It seems likely that specific cities were represented, as was concluded by Schachner (2007, pp. 127–136), who argued that the differences between fortifications depicted on the Balawat gate[71] likely meant to indicate the unique features of certain cities, which is not just reflected by the number of towers and gates, but also in their geographical setting. The same case can be made for Egyptian Late Bronze Age depictions of fortifications, which represent particular fortifications in the Levant (Naumann, 1955, p. 112). In fact, what this all indicates is that construction techniques and defensive tactics were very similar across the entire Western Asia. This is not surprising since warfare was

[71] 9th century BC Assyrian Bronze plated gate incised with depictions of historical events. The Balawat gate is unique as it covers similar themes as the palatial bas-reliefs, namely conquest, but on a different medium.

a frequent type of culture contact, and the mobility of armies was quite high. The high frequency of towers is understandable from the defender's concern of being able to give enfilading fire effectively, and to be able to man the walls with as many people as possible.

Gates have generally and arched construction, which make most sense from the perspective of structural strength, also reflected by the few preserving examples such as those of tel Dan, Khorsabad or Babylon. However, in Egypt gates are always depicted with a flat lintel. As Egyptian architecture does in fact commonly feature massive gates with large stone lintels and columns, it is possible that the stylistic conventions, deeply embedded in cultural conceptions, influenced these Egyptian depictions of gates outside Egypt. In principle, gates with flat lintels in mud brick construction are possible, if the lintel is made of strong timbers and the weight of the superstructure limited. However, a large wooden doorframe like this, as is seen in some fortified architecture of Afghanistan in the 20th century (Hallet and Samizay, 1980, p. 124), may present a weakness in a siege against attackers with tools and fire.[72] However, for smaller fortifications, which are not meant to withstand large scale sieges, this may be less of an issue.

Compared to medieval and Roman fortifications, the large overhang of the tower head is a unique aspect of ancient Western Asian tower construction. This most likely represents a cantilevered construction that must have involved wood.[73] Functionally, it would have served to enlarge the surface area of the upper structure, which made it possible to man the towers with larger numbers. The cantilevered construction also adds slightly to the missile range and allows the defenders a better coverage of the wall base below. A feature seen in some Middle and Late Bronze age Egyptian depictions of fortifications must have served similar functions (figure 197) (Naumann, 1955, pp. 311–315). Here a cantilevered construction juts from the tower on one side, or simply from the fortification wall itself. Naumann's reconstruction adds a hatch or gap that can be used to target enemies at the base of the tower. This functions in the same way as machicolation in medieval fortifications. The towers on the Senecharibs relief of the siege of Lagish show a unique feature not seen elsewhere. Here the towers are topped by construction of poles and shields that

---

[72] The Afghan tradition of fortification architecture should be explained in the context of small scale clan warfare such as raids. Although safety and protection of assets was thus a concern, an important function of these fortifications was also to symbolize status. The incredible height of some these fortifications (up to 10 meters) seems to suggest this, as such heights are not absolutely required if the sole concern was protection against theft and clan violence. See Szabo & Barfield (1991).

[73] This might be the reason why it never occurs in Roman and Medieval fortifications, as the light timber-based construction of the tower head would be vulnerable to the artillery of these ages. In late medieval and renaissance fortifications a slight overhang, called machicolation, is occasionally build by offsetting large cut stones to make space for holes that allowed the defenders to target attackers directly at the base of the tower. An exaggerated but non-functional form of this is often found in the medievally inspired romantic architecture of the 18th and 19th centuries.

were likely constructed for the defense of the city during this siege. These were measures needed in desperate times and were most likely meant to increase the height and surface area of the towers even more.

In the ancient depiction of towers there is a notable difference between those with a relatively wide and shallow tower head, and those with a higher profile.[74] Those with the wide and flat profile are earlier, as seen on a seal imprint dating to 1400 BC, the white obelisk (11th century BC), the Balawat gate (9th century BC), some Egyptian depictions dating to the 13 century BC and finally also on Ashurnasirpal II's palace reliefs in Nimrud (865-860 BC). The significance of this is hard to assess but it is quite likely we are simply observing the evolution of stylistic conventions for depicting towers rather than a change in fortification architecture. Towers of all times may or may not be depicted with windows. Windows are found in its base structure as well as in the protruding tower head (however, they do not fit in very low profiled depictions as seen on the Balawat gate). This indicates there were rooms inside, served by staircases and fitted with timber framed floors and ceilings. Usually, the windows are limited to the tower head and a floor directly below. However, in some cases the tower structure below had multiple levels with a single window.

VI.11.2 Fortification architecture of the *Dunnu*

To answer the question of the degree to which the *Dunnu's* fortification architecture functional, we may start by listing all the defensive properties:

- The *Dunnu* stands on the summit of an elevation, the tell. Its southern and western sides skirt the steep slopes of the tell.
- It has a fosse 3.80-3.90 m deep, 5-5.5 m wide at the top 1.70-1.90 m at the bottom.
- There was one place to cross, which was probably also fortified with a gate structure of some kind. Another crossing was added later.
- It had a single fortification wall 1.40 to 2 meters wide. Although with several additions it grew on certain places 2.80 to 3 meters wide. The minimum height of this wall, based on infill volumes of the best-preserved area, is around 5 meters. Staircase reconstructions suggest that it might have been as much as 6.5 meters high.
- It had one large main gate at any single point in time and a postern gate. Gate construction is of a simple double pier type, unlike that of most town fortifications. However, additional access control was gained by means of a second wall and gate behind the first.

---

[74] Also noted by Porada (Porada, 1967) and Micale (2005, p. 137).

- There are several protruding elements on the fortification wall that could indicate a tower construction. Interestingly, only one of the four corners such an element is present.
- There is a single massive building in the centre with walls 2.30-3 meters wide.

VI.11.3 Location

The *Dunnu* was built on the summit of an existing tell. This offers clear strategic advantages. Apart from a good view of the surroundings, steep slopes leading up to a fortification help to slow down enemy advances in the same way ramparts do for some town fortifications. The *dunnu's* southern and western sides border the steeper slopes, while the northern and eastern sides stand on more gently sloping ground. That means that all gates face gentle slopes. Purely from the point of view of defensibility, gates would be best placed near a steep slope, with an access way running parallel to the fortification wall. Since this is not the case, it is likely that the gates were placed with accessibility rather than defensibility in mind. Aside from easier access, it places the gates near the flatter areas better suited for various extramural activities. It is no coincidence that most evidence for extramural domestic, industrial activities is found north and east of the *Dunnu*. Placing the gates on these sides will certainly have optimised communication between the inner and outer *Dunnu*.

VI.11.4 Fosse[75]

Sections through the fosse have been made on eight locations. In three of them the bottom was reached. The fosse seems to have been dug quite uniformly to a depth of 3.80-3.90 m. From the top down the slope of its sides gradually increases, at one section almost reaching 90 degrees. Its profile is something between a U and a V shape. The cross-section is often not perfectly symmetrical, generally with the internal side dug out smoother and straighter, and the exterior side rougher and bumpier. Along some stretches mud brick walls were constructed against the interior side. At the two places where the bottom of these walls was reached it shows that these walls were built some time after the digging of the fosse since they stand on about 40 cm of sediments deposited on the bottom of the fosse. Considering that the fosse is a perfect sediment trap, and rapid infill can be expected, the walls were probably built just a few years after the digging of the fosse. The construction of these walls indicate that the fosse was at that time still in use, and regarded a valuable asset of the fortification.

At some point maintenance of the fosse was given up and it gradually silted up. This process would reflect a decreasing importance of defensibility. Of the two best drawn sections, the total number of identified

[75] In the excavation documentation this feature is always referred to as 'moat'. Following Burke's comments on the terminology for fortification architecture (see above), I am using the term 'fosse'.

sediment layers is 30 to 35, indicating that the rate of the infill process was approximately the same. This would imply a largely natural process of sedimentation caused by erosion of the sides, and eolian deposition. The content is often variously described as loamy and hard, or powdery. Although without microscopic or chemical analysis it is impossible to confirm the formational origin of deposits, it is plausible that the harder loamy deposits are compacted degraded mud brick material while the powdery ones include eolian deposits and ash. The excavators mention that the fosse was used as a thrash dump, and although that is likely, the density of pottery and bones is not extraordinarily high. Also, if it was used intensively as a dump, the infill process would not have been as uniform as it appears to be.

The three complete sections show a patterning in the thickness of layers, indicative of a changing infill rate. The first two to five layers are relatively thick indicating deposition of a large volume in a short amount of time. These deposits contain compacted loam and occasional brick fragments. It is thus likely these are indicative of a high dynamic erosive moment during which part of the surrounding architecture, and fosse wall decayed rapidly. The thickness of the following deposits steeply declines, indicating a slower sedimentation rate. It is possible that for a brief time, maintenance continued. However, it is also possible that erosion had stabilized by now by natural means. After a few thin ones, average deposit thickness increases again. At some point, when the fosse had not yet been filled up completely, mud brick structures are being built inside. This moment signals the definitive end of the fosse as defensive element. The fosse is now a shallow ditch less than a meter deep.

VI.11.5 Crossings

There are two places where the fosse could be crossed, and there is probably a chronological relation between the two. Both are found near the north-western corner of the fosse. The first crossing runs west to east across the western side of the fosse, the second north to south across the northern side.

The first, most likely earlier, crossing was probably fortified, as is suggested by the thick mud brick structures along it. Its position offers more tactical advantages then the later crossing. It is placed at an angle in respect to the direction the main gate faces. The route to the main gate is longer, forcing people to walk past a longer stretch of the fortification wall, thus increasing the level of potential control. If this crossing was still in use at the time that the new gate was used, there would be no direct view to the main gate, but anyone traversing would have his view blocked by the corner of the *Dunnu*. A person posting on the wall in this corner would have a very good view on the crossing. On the other hand, it is possible that precisely because the new gate and the contemporaneous modifications offered a less efficient entry for traffic, that it was decided that a new crossing nearer to the gate would be more practical. Unfortunately, we have no reliable stratigraphic link between the new crossing and other architectural modifications of the *Dunnu*.

The second crossing has not been interpreted as such in earlier publications on the *Dunnu*. However, the pattern of infill diverges so strongly from the rest of the fosse that another explanation is hard to find. About 13 meters east from the north-western corner, the infill pattern indicates intentional dumping of large amounts of mud brick debris. Moreover, a thick retaining wall was found that kept this dump in place. The direction of the tilt of these layers indicates that most of it was dumped from the retaining wall. The distinct layering, and variation in the content could indicate that various sources for the dump material were used and perhaps that it was a task that was spread out over several days. The possible explanation for this new crossing is that it was nearer to the new main gate. If this was the motivation it seems to indicate a shift in priority from a defensible design to an accessible design. In relation to the infill chronology of the fosse, this occurred most likely[76] after the second phase of rapid decay.

VI.11.6 Fortification wall

During its largest extent the fortification wall has a perimeter of 235 meters running in an approximate square with sides of 50 to 63 m. The exact perimeter of the older fortification wall is uncertain. To the northern side of the *Dunnu* a large new wall replaces the older fortications, extending the fortified area northwards and effectively blocking the earlier main gate. There are good indications the western stretch is also a later addition: it abuts the southern fortification wall, it is aligned slightly different, and is constructed wider. The other new stretches of fortification wall in the north are also constructed wider than the old fortifications. If the western stretch was a later addition indeed, it leaves us with the problem of where the older western fortification wall originally ran, as this one has not been found.

[76] The exact relative stratigraphic position of the bottom of the retaining wall is impossible to make out based on the documentation.

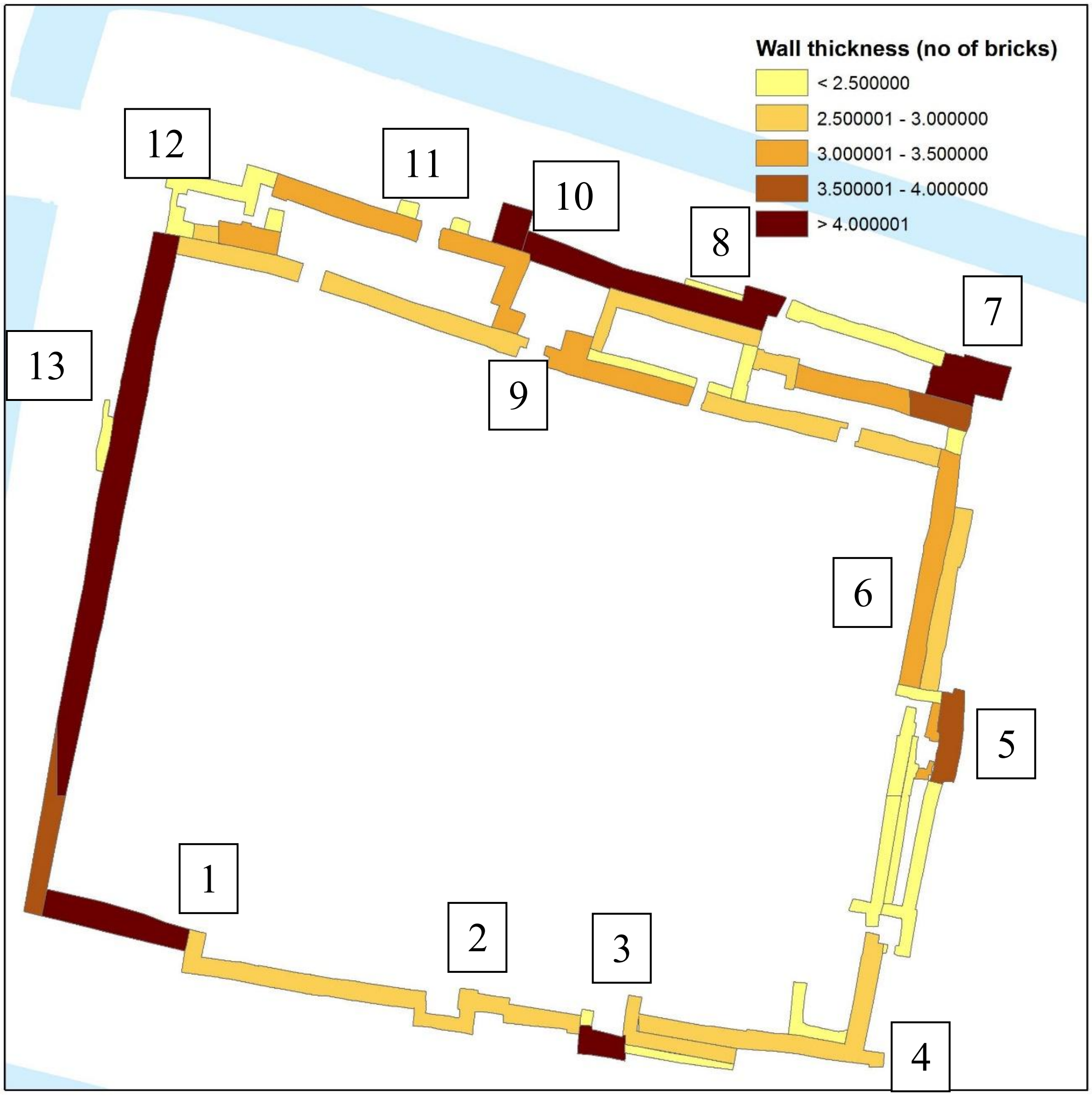


Figure 198. Fortification wall, coloured according to wall thickness in bricks. Numbers indicate special features referred to in the text.

A good option is provided by the corner that the older part of the southern fortification wall makes, about 12 meters from where the later southwestern corner would be (1 on Figure 198). If the hypothesised wall continues in its direction north and is connected to the old gate, we have a perimeter which shows a familiar characteristic (Figure 199). Namely, the proportional placement of the gate in the northern fortification wall is the same as the later gate (Figure 200). In both old and new situation, the gate is found at approximately 1/3rd of the total length of the northern side of the *Dunnu*. This reconstruction also has the consequence that the protruding elements in the southern fortification wall now have regular placement (2 and 3 on Figure 198). The distance between the outer corners of the protruding elements and the corners of the fortification wall is now a little longer than 17 meters in both directions. The scheme effectively breaks up the southern fortification wall in equal thirds, which may be indicative of some design choice. Of course, these facts could be a coincidence, but it could also be the application of some architectural model. Unfortunately, we do not know anything about theoretical principles of Assyrian or Ancient Western Asian fortification architecture to confirm such a proportional rule. However, from a general and practical perspective, the placement of the protruding elements in the south is sensible. If these are indeed representing a defensive element of fortification architecture, part of their function would be to gain a good view and fire coverage from the walls. If this is the case, a placement in the middle between two corners is the most logical. The question remains why nothing has been found of the conjectured older western fortification wall that is suggested to run underneath the later residence. If it ever existed, the only answer can be that it was demolished to the last brick. The reason for the thorough demolition might also be guessed at: the area was being prepared for the construction of the residence, which needed to be built on level ground. In this context it might be insightful to reflect on a report to Sargon II concerning the progress made in the construction of a fort, cited earlier (IV.2.2).

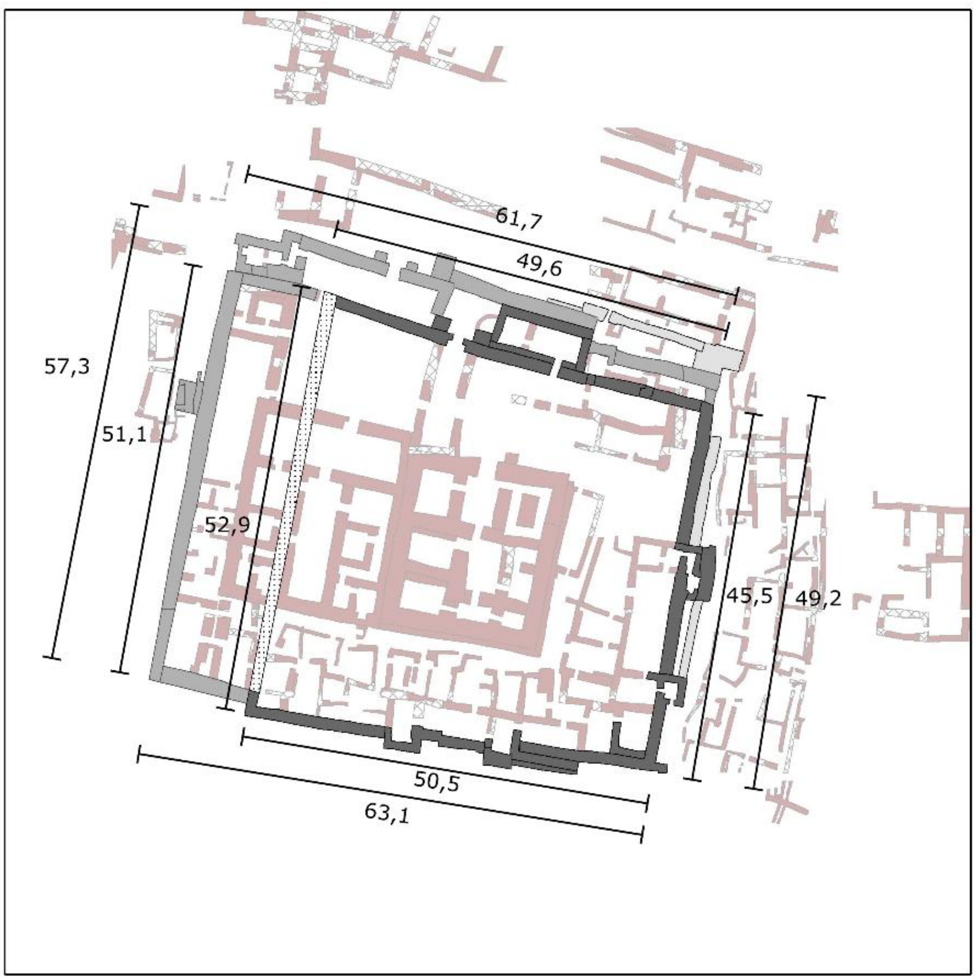


Figure 199. Dimensions of the fortifications, indicating a possibly smaller square, earlier phase.

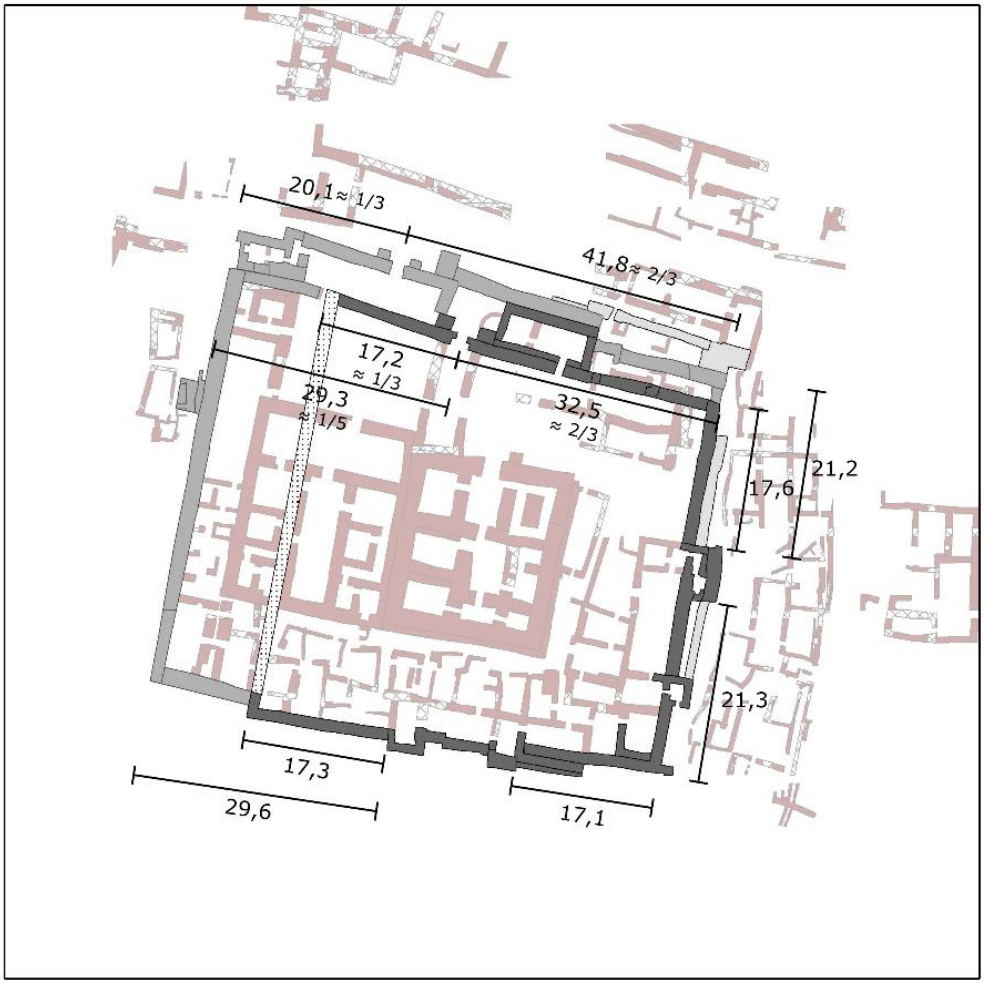


Figure 200. Dimensions of the fortification, indicating regularities with regards to placement of main gate (old and new) and other defensive features.

The widths of the fortification wall of the *Dunnu* vary from 1 to 2 meters. Or 2.5 to 4.5 brick width, which is a better reflection of the ancient builder's structural intentions and concept of wall width. Most of what can be considered the older fortification wall was 3 or 3.5 brick width. The newer parts were generally constructed thicker, 3.5 to 4 brick width. This might indicate an increased focus on security and defence. It might also be related to the increased importance of the settlement, additionally reflected by the conception of the residence.[77] At certain points brick width is exceedingly large but this is often the result of multiple walls set against each other, and not necessarily reflecting increased defensive measures. In the centre north the new wall is constructed against an earlier building that already stood against the fortification wall. In

[77] See previous chapter for the argumentation of seeing the construction of the residence in conjunction with the new fortification works, rather than earlier as was put forward by the excavators.

the northeast a wall is placed against the fortification wall, probably as a reinforcing abutment. This wall is stratigraphically much later, and might have functioned to structurally stabilize the fortification wall. But its real function is hard to infer since no evidence that the fortification wall was subsiding was found. Possibly the structural problem occurred at some higher elevation in the wall, and has thus not preserved. A similar wall is found on the south-eastern side of the southern fortification wall. However, in this case there is no observable stratigraphic difference between the fortification wall and its abutment. It might thus have been constructed soon after or simultaneously with the fortification wall. It could be that structural problems occurred very soon after construction. There is no apparent defensive advantage to constructing an extra thick wall over such a limited stretch, apart from increasing the surface area on top of the wall. But if that would have been a consideration it is unclear why this was necessary at this particular place.

In the north-western corner the fortification wall is only 2.5 bricks wide. This case suggests that defensive considerations were secondary, as such a wall is relatively easy to breach. The fortification wall makes two corners over a short distance here, and the small rooms of a bathroom are integrated with it. The corners and the presence of small rooms increase the structural strength of the corner. Moreover, a thick block of mudbrick is found on the other side of the lavatory rooms. If the small rooms had multiple floors, the floor construction would firmly anchor the relatively thin fortification wall to the rest of the structure. Hence, additional structural reinforcement, otherwise ensured by a certain exterior wall width, was not necessary here. Elsewhere, the slenderness (or width to height ration) of a freestanding fortification wall requires a certain minimum to be sufficiently stable. These facts combined would suggest that the primary reason for the wall to be of a specific thickness was to ensure a certain degree of stability.[78]

VI.11.7 The gates and access arrangement

The *Dunnu* had at any point in time one main gate (9 and 11 on Figure 198) and one postern gate (4 on Figure 198). The very shallowly preserved remains of another gate structure, in front of the older crossing over the fosse, were also excavated indicating an additional level of control. The main gate, as has been discussed earlier, has two phases: and old (9 on Figure 198) and a new one (11 on Figure 198). Most likely this was related to the large modification that added the residence to the *Dunnu*. As has been discussed in the previous chapter, this idea diverges from the standard interpretation made by the excavators that posit

[78] There are other locations in the *Dunnu* where the fortification wall is supported by interior architecture. That the wall width was not adjusted here might be because these interior buildings did not reach to the height of the wall. This limits the amount of support that its floors can give. And a 2.5 width fortification wall, results in a very narrow walkway on the battlements. If 40 cm is given to the width of the row of merlons, just 60 cm passage is left. This makes it inconvenient for two people to pass each other. And this even excludes some space that might have been taken up by a fence or barrier on the inner side of the fortification wall.

the construction of the residence contemporaneous with the old gate. Moreover, in the previously published plans some additional openings are left in the north wall in its earliest phase, suggesting that next to the main gate, there were additional points of entry through the fortification wall. This I consider unlikely, as will be argued below.

The construction of the old and new main gates is similar but there are also differences. Both have a straight passage through the fortification wall, and are flanked on the exterior by large piers. The size of these piers differs. The older gate has piers of 2.05 m by 1.70 m while the more recent gate’s piers are much smaller: 1.40 m by 1.10 m. On the other hand, the width of the passage is smaller at the old gate (1.36 m) than at the new gate (1.55 m). This is because the old gate has two smaller additional piers on the interior that limit the width of the passage. These also served as a secure element for the gate door to close against. A threshold simply constructed by means of a slight ramp cut off in a straight angle at the height of the door, similarly, ensured a tight and firm closing of the gate door at the bottom. Such features are not found at the new gate, which could otherwise certainly be closed off by means of a double door. The pivot holes were supported by unworked rocks, typical of the unassuming manner of construction of the *Dunnu*, are still present.

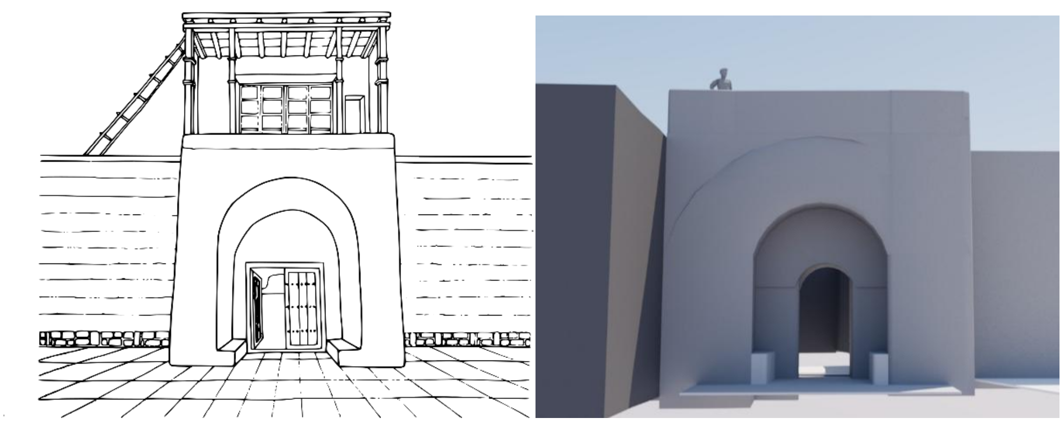


Figure 201. Left: Arched gateway of a fortified farm or Qala, in Logan, Afghanistan. Note the benches on the inside of the gate. Right: the old gate of the Dunnu reconstructed based on the Afghan model.

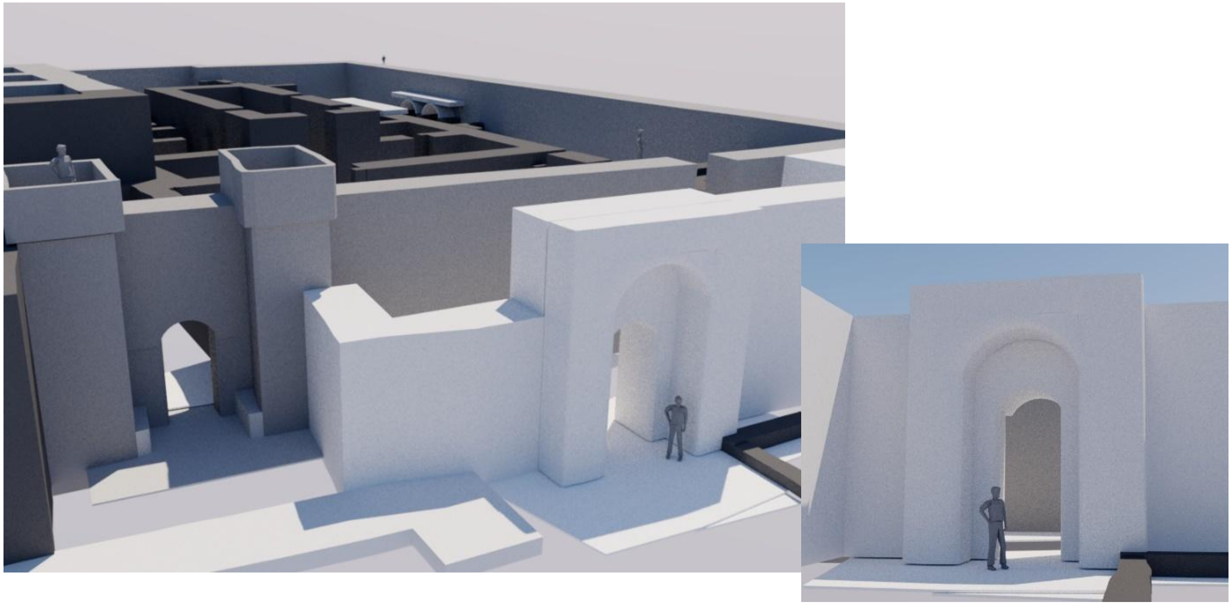


Figure 202. Left: the old and new gates side by side, with an alternative option for the old gate. The flanking towers are based on ancient iconography of city gates. Right: reconstructed new gate as seen from the northwest.

The difference in size of the large piers that flank both gates incites some thought with regard to their function. In general, such piers are very common in ancient fortification architecture worldwide. Piers increase the rigidity of the wall at a point where a gap, a structural weakness, is present. But perhaps more importantly, these piers visually accentuate a gateway, enlarging its perceived dimensions and thus instilling the architecture with some sense of monumentality. But it is not entirely certain how to reconstruct their superstructure, as there are at least three options. Either they supported simple straight piers, or they supported an arch, or they supported small towers. If they are straight, their function is purely structural, as buttresses to a wall. Their visual effect is not as strong as when they would support an arch, which is probably the most common use of such piers. With the kind of inset structure thus created, an arch enveloping another arch, the result is visually more striking. If the aim is to accentuate the monumentality of the entryway, such a structure seems to work better than plain buttresses. However, there is another interpretation possible. In Western Asian fortification architecture of cities, a gate is commonly flanked by towers. The piers of the *Dunnu* are relatively small and obviously do not support a true tower structure with interior rooms and staircases. But it is possible that they had a corbelling superstructure that extended the surface area of the tower (see VI.11.1). It is thus possible that it mimicked the larger city fortifications, only at a smaller scale. The defensive use of such towers at the *Dunnu* would be somewhat limited perhaps, since by now it has become clear that any besieging army would have no problems demolishing any part of the relatively low and thin wall in a matter of hours. Still, by adding good vantage points, these towers could also have aided access control. It is possible that, considering the difference in size between the piers of the earlier and later gate, only the earlier gate was equipped with such towers. A last option should also be considered, namely that both gate and piers supported a simple flat timber-based lintel. Since the fortification wall was relatively low, a couple of strong beams must have been able to carry these loads.

The construction of the postern gate, in the south-eastern corner of the *Dunnu* is different. It has a small gatehouse that is added to the exterior of the fortification wall. The exact widths of the passages are hard to ascertain because of the bad preservation, but it seems to have been very narrow: around 60 cm.

In plan, the gates are unlike those of town gates. They were nevertheless part of a well thought out access control system. For instance, to get from a location outside the fosse to the large courtyard in front of the residence a person had to change direction three times. As noted above, it seems to have been intentional that from the crossing, a person was led along a long part of the fortification wall. Once inside, behind the gate a long room was entered that needed to be crossed lengthwise to get to yet another gate that offered access to the paved court (although it is uncertain this one could be closed). The length of the route and the multiple 90-degree direction changes seem to be intended to optimize access control, and to block direct views into the next area. At the postern gate the same principle was applied. In the earlier phase of the *Dunnu*, there were three spaces that needed to be traversed, each with doorways facing a 90-degree angle in relation to the next, to get inside the *Dunnu*. The third room was an elongated room with a doorway at the opposite end of the room, similar to what is found behind the main gate. In the later phase, the access structure is diverted, and it was not necessary anymore to cross the full length of this room to reach the next passage on the other side. Instead, a new doorway was made nearer to where a visitor would enter the space. But behind this new doorway also a new building was erected, so now a visitor would first need to cross one of the spaces of this new building before he or she entered open *Dunnu* space. In other words, it seems that access control was made even stricter.

The access arrangement of the old gate is slightly more difficult to understand, and it depends on whether one follows the hypothesis put forward in this thesis, or the one that is suggested by the excavators of the *Dunnu*. In the first case, there would be no residence and great court built yet, and the spatial focus of the *Dunnu* would have been the central tower. The space behind the old gate is elongated as well, looking at a dead end, with two opposing doorways to the sides. It requires one 90 degree turn to face one of these doors. If it functioned contemporaneously with the great court and residence however, it leads to inefficient control of vision and movement. Access to the great court from the north-western corner has some benefits. The first is that it directs the visitors view to the main status building of the complex, the residence. At the same time, for practical matters, the administrative section is very near. The building that has been identified as ‘the office’ (which is very likely a correct identification, considering its layout and concentration of administrative tablets), can be found at short distance on the right. This is both convenient, and further controls access. It is possible that some might just have had business with the administrator, but were not supposed to stay longer or cross the court to enter the residence. If people entered through the old gate to get to the office, they would need to cross the entire courtyard. Entering from this side, the visitor's eye would not first be directed to the residence but to the wall where the administrative building is found. Moreover, in this situation, the administrator would not be able to check everybody who enters. The only practical solution for the administrator would be to move to a location nearer to the old gate for his daily tasks, while keeping his administration in the office. But why was the office then built at an impractical location in the first place?

It seems therefore that the new gate, the office and the residence are spatially related. They have complementary spatial functions. A direct entry to the great court from the extramural zone prior to the construction of the new gate, as is suggested by the published plans of the *Dunnu*, is unlikely as well. It means that access becomes distributed and control lessened. Of course, this all assumes that the *Dunnu* authorities always optimised access control and movement. It also makes an assumption about how administration best functions spatially. It is still possible that this is not valid for the earlier phase of the *Dunnu*. Nevertheless, the assumptions derive from observation of the final architectural layout of the later *Dunnu*, which is most complete and best preserved. It is in any case certain that during the later phase both the main gate and the postern gate, and the buildings surrounding them, show high levels of access control optimization.

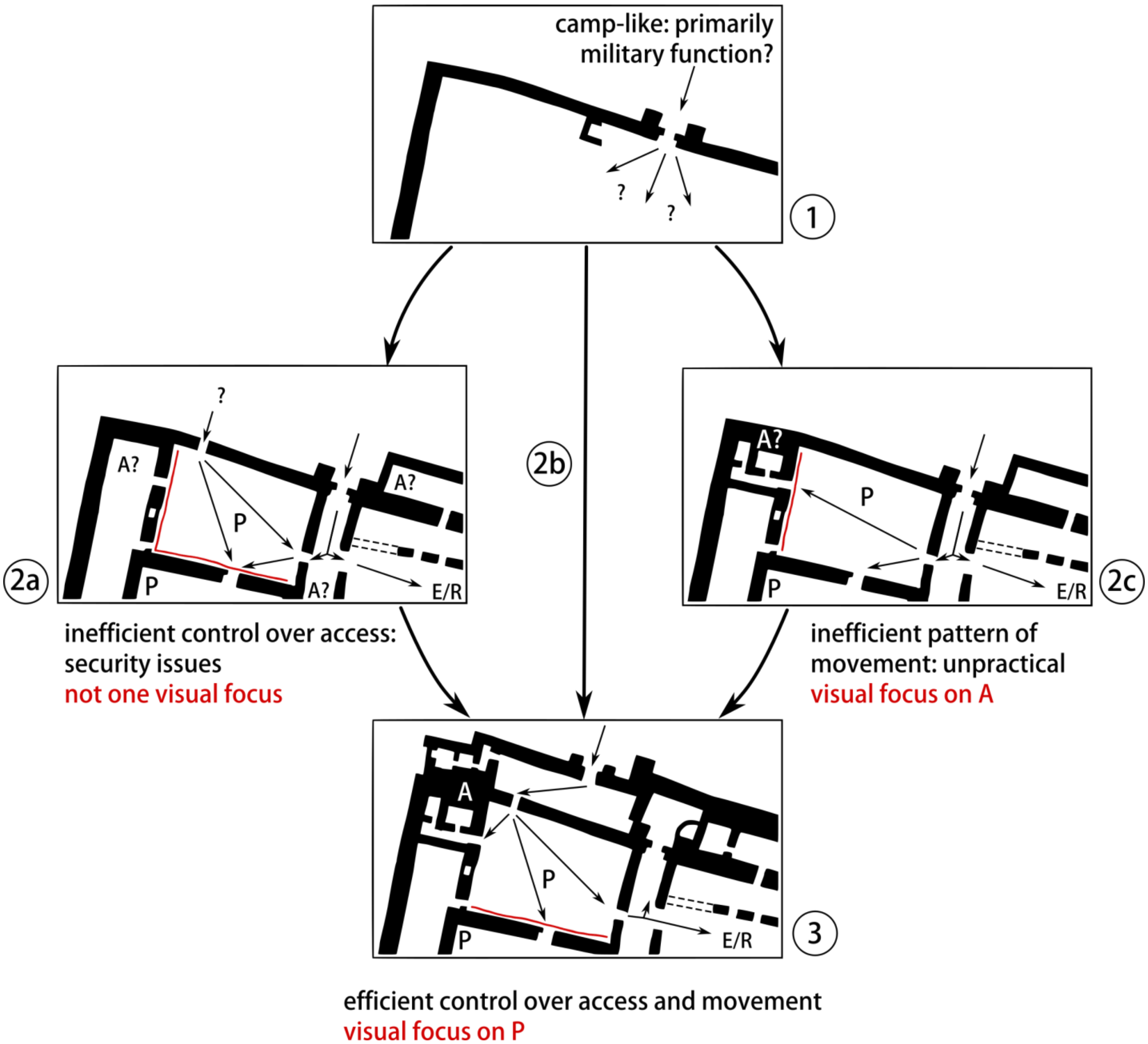


Figure 203. Model showing alternative pathways of architectural plan development, and their effect on movement, access and visual focus. Meaning of the letters: A =location building for administration; P = architecture representing & communicating Power; E/R = Economic/Residential area. It seems that both alternatives (2a and 2c) are either inefficient or unpractical with respect to control over access and movement. A direct development (2b) from situation 1 to 3 is more sensible from this point of view.

VI.11.8 Protruding elements and potential locations for towers

The fortification wall has several protruding architectural elements that are likely to be part of the defensive architecture (Figure 198). Each of them is slightly different and we can thus not speak of an archetypical fortification with towers of the same type at regular distances. It is moreover possible that not all towers were constructed on a projecting base. Like the fortifications known from the iconographic sources, they might have been fitted with a projecting superstructure.

At the southern fortification wall two distinctive projections can be observed (2 and 3 on Figure 198). They are part of a larger building that is integrated with the fortifications, an entire section that was built at once and simultaneously with the fortification wall. As noted above, the centre-point between these projections is exactly half-way the conjectured older perimeter of the fortification wall. Thus, the projections enable view and fire coverage of an equal length of wall. Even if the hypothesis is not correct, the corner that the fortification wall makes at the point of the conjectured wall, blocks views on the wall beyond it in any case. Hence, here another viewpoint would be needed, that might in fact be located exactly on this corner. Here a very small room with thick walls could have supported a super structure as high as the fortification wall itself. The view on top would then control the last 13 m stretch of fortification wall before it makes a corner to turn north. It would however be more useful to have such a vantage point exactly on the south-western corner, as this enables views in both directions. There is no evidence for any heavily reinforced structure here, but this corner has been eroded completely. Even if it was a simple corner, it could still have borne a lightweight timber based cantilevered construction.

The western fortification wall was the longest stretch of wall without change of direction or architectural elaboration (13 on Figure 198). However, the remains of a large mud brick block have been found about 30 meters from the south-western corner. It is not well-preserved nor described in detail, but appears to have been bonded with the fortification wall. Its wall base is 40 cm higher than the base level of the fortification wall, suggesting it was added later. Its dimensions are uncertain but seem to have been 4 to 5 meters long, and projecting 3 meters from the wall. It is possible that this was the base of a tower on the western fortification wall. It is not placed in the middle of the western fortification wall, which might indicate that another tower was located somewhere more south, where erosion has removed much of the remains of the fortification wall.

About 15 m north of the potential block we find the north-western corner (12 on Figure 198). This piece of architecture has been discussed earlier, in the context of the fortification wall construction. It was argued that the fortification wall was so thin here because it was not structurally necessary due to several reinforcing structural elements: the jig-saw shape of the fortification wall, and internal support of walls and floors firmly bound in a thick mud brick wall across the interior spaces. Since this points at the possibility of a higher building with floors inside, a corner tower would be a possibility. Just like all other tower-like structures of the *Dunnu*, it might not have been much higher than the fortification wall and could consist of a cantilevered superstructure to make space for a few people. Access to this tower is unconfirmed, but if direct access was possible, it may have been from the roof of the small building directly south. This roof could have been reached by means of a ladder. Since no more structural way of entering this tower can be ascertained (apart from the walkway on top of the wall), this would certainly indicate a none-frequent use of this tower or just by a few people that had access.

Moving further eastwards along the wall we find another massive block of mud brick (10 on Figure 198) just beyond the new gate at a place where the fortification wall has an offset. It is preserved to a considerable height, but its sides are heavily eroded, therefore its precise dimensions are uncertain. Its reconstructed dimensions are 2.30 m long, projecting 1.47 m from the wall. The orientation of the mud bricks inside this block makes an unusual curve, which could mean it has shifted or that it is another type of construction altogether. It is nevertheless part of the fortification wall since it is bonded to it. If the block supported a tower, it was strategically placed to defend the new gate, and to have an excellent view on the crossing and the path leading up to the gate. It moreover blocks views and hinders passage to the route along fortification beyond the gate. It had thus a very strong control over traffic coming to the gate, and physically forced people to turn right and move through the gate and nowhere else.

17 meters further east another massive block is found against the fortification wall (8 on Figure 198). It is approximately 3 meters long and projects about a meter northwards. It is stratigraphically confirmed that this block was a later addition to the fortifications. Nevertheless, the upper courses of mud brick are clearly bonded with the fortification wall, possibly indicating the entire rebuilding of this section of wall. It might suggest the presence of a tower here, but there are no apparent tactical advantages of having a protruding tower here, apart from the general defensive advantage of being able to man the wall with more soldiers in case of an attack. It might be a large buttress, but structurally this corner seems to be well reinforced already. The section does not show that the base of the fortification wall was unstable as it is still as level as it was once laid. However, some other structural instability might be indicated by the tilting of the corner of the interior architecture that was part of the fortification wall. But it is not clear whether this is of ancient date or the result of gradual post depositional soil movement.

The north-eastern corner has three phases (7 on Figure 198). A simple tower superstructure might have been present during the first two, during which the potential tower did not project. Small rooms present at ground level in these phases might indicate a taller structure that reinforced the corners structurally and made a solid base for any kind of superstructure. During the last of the three phases a real corner tower seems to be indicated by a projecting massive mud brick block. This block measured 5.60 m by 3.20 m. It does seem to protrude only on the eastern side, although two separate blocks of mud brick found on the northern side might be the remains of the projection of the tower in this direction. The preservation of the walls is extremely shallow here, so it is likely we do not have the circumference of the entire block. If we take the liberty to connect all the fragments, the tower might have been as large as 8.50 by 5 m, projecting 2 m on the western side, and 1.50 m on the northern side. During the middle phase, when the large tower had not been built, there is good evidence that there was a staircase present that lead up to the corner. However, by the time the tower is constructed, it is fairly certain that the entrance of this staircase had been converted into a bathroom. There is a faint possibility that a staircase had also existed in the small room of the north-western corner. If so, this would have to be a revolving staircase on a timber base, so nothing remains of it. Otherwise access to this tower would be by the walkway on the wall. The final possibility is that, being a relatively late addition to the *Dunnu*, this block was a large buttress. If this was the case, this block, the new stretch of fortification wall and the block at the other end of this wall were in fact part of one massive structural reinforcement of the north-western corner.

Turning south again, in the centre of the eastern fortification wall, yet another massive block of mud brick is found (6 on Figure 198). This time we can be more certain it represents the base of a large tower because it is structurally and spatially integrated with the fortification wall and the architecture behind. It does not appear to have come as an after-thought, but was part of the original design, as can be seen in the way the brick lines of the fortification wall are set back to enable access to the ground floor of this tower. It is 6.50 m long and projects about 3 m. It is possible that timber based revolving stairs were present in the small interior room, however here were also found the remains of a baked tile pavement which is otherwise only used in bathrooms and representative courtyards. The sequence of two small rooms is also typical of bathrooms. If there ever was a bathroom, it fell out of use when a real staircase was constructed on the exterior of the fortification wall and these rooms became the entrance to the staircase. However, the staircase did not lead to the tower, but to the southwestern corner. It is likely that direct access to this tower was again via the roof of the appending architecture on the interior, using ladders. Otherwise, it would of course be accessible via the walkway on top of the wall, like all other protruding elements.

The south-eastern corner is not that well-preserved and harder to understand structurally (4 on Figure 198). A relatively small block of mud brick projecting from its eastern side seems to mirror the northeastern corner, but less heavily constructed. Similarly, it could have been a structural reinforcement. We might conjecture a light cantilevered superstructure like elsewhere.

VI.11.9 Central building or tower

The last aspect of the fortification architecture to be dealt with separately is the massively dimensioned central building. In the documentation of the excavation dating to the early 1990s this building is referred to as ‘the fort’, and some years later as ‘the tower’, reflecting the undeniable associations with fortification architecture. More recently, in search of a more neutral terminology, we looked at the single property that is certain and opted for ‘central building’ (Klinkenberg and Lanjouw, 2015). Although this choice reflected our uncertainty as to high this building actually was, the term ‘tower’, might apply flexibly on various types of building even if in the modern strict sense, they are not very high. In the ancient sources the term does not specifically apply to buildings of a certain height, but more often refers in a general sense to 'stronghold', which might thus also indicate a strategic siting on difficult terrain.

The location of this building in the centre of the *Dunnu* may reflect the application of concentric lines of defence. The first is the fosse, the second the fortification wall, and third a building with massive walls. Its position and relative wall strength are in fact not unlike a donjon in medieval castle architecture. In other words, a time-tested principle of defence.

However, the question remains: what was the reason for the immense width of these walls? The reason that fortification walls of cities are generally so wide, is that each bricklayer makes it harder for an enemy to cut his way through. It has already been ascertained that the *Dunnu* was not meant to withstand sieges, and thus it seems unlikely that this was the reason for the width of the walls of the central building. Another reason could be to express monumentality. However, the way the building was constructed – slightly irregular, bricks of different sizes and loam mixes – and modified, indicates a very pragmatic approach. In addition, the way it appears to have been used suggests a mostly multifunctional utilitarian use. Another reason for thick walls is that it was a very high building, requiring heavy walls to support a massive load. Walls this wide easily support a 30 m high building (see VI.5.2). However, this seems disproportionally high for a small Late Bronze Age settlement. The last possibility that should be considered is that the walls are wide because they were required to carry much extra weight apart from that of the building itself. The only type of building that has to perform in this way are storehouses. This is an interpretation advanced in an earlier article (Klinkenberg and Lanjouw, 2015).

Reconstruction of the walls of the best-preserved room, room 1, based on the volume of room fill does not allow for a building higher than 4.30 m. (Klinkenberg and Lanjouw, 2015). The reconstruction of the large staircase that this building had suggests that the first floor was on 3.13 m from the base of the wall. Comparing this to the wall height reconstruction based on room fill, this seems to suggest that at least another floor must be added. It also suggests that a significant volume (material worth for approximately 2 meters construction material) has eroded. Since even level 1 strata seem to run up against the top of the wall of the central building, it is evident that this building was visible for much longer than the other architecture of the *Dunnu*. Even other high and relatively well-preserved architecture, such as the residence and the northern fortification wall are by this time buried and built over. It thus seems logical to assume that this is the highest building on the site, which means it is quite certain to have at least two floors. However, with two floors it is just on par with the fortification wall, while that wall was already buried and overbuilt at an earlier stage. So one way to explain the fact that the central building stood exposed longer, is that it had more architectural mass than the fortification wall (which was otherwise just as thick). It is thus possible that rather than two, the central building had three floors. Three floors, each as high as the first would give a building of nearly 9.5 m high.

The difference between 2 or 3 floors is significant when considering the views from the roof on the surrounding settlement and the tell beyond the walls. Views further away are always possible. The quality of the views also depends on the height fortification wall, so we must also adjust that variable to see the effect. Standing on a building three floors high, looking over a fortification wall 5 meters high, allows for a reasonable viewshed across the summit of the tell. The buildings just across the fosse are visible in this case. This view is severely limited if the fortification wall is set on a height of 6.30 m, which is the maximum height of the fortification wall based on the staircase reconstructions. A two-floor reconstruction leads to very limited views, even with a 5-meter-high fortification wall. The 6.30 m high wall simply blocks all views on the tell. I also tested what adding a fourth floor would do. As may be expected, this leads to a supreme command over the entire tell, and even allows for views directly to the foot of the tell at its eastern and southern sides. Hence, a building at least 13 m high results in the best strategic advantages if views on the direct surrounding would be considered important. Of course, we do not know whether this was considered an important criterium for the builders of the *Dunnu*. Good views on the tell and the surrounding settlement are possible from the fortification wall as well. The advantage of being able to see the same things from the top of the central building, is that an individual would need to walk shorter distances to view another part of the tell. Rather than taking the tour of the walkway over the wall, he could just cross the roof of the building.

VI.12 Spatial configuration

VI.12.1 Access

In paragraph VI.4.1, access analysis was already used to identify integrated spatial structures that could be interpreted as buildings. In VI.11.6 access arrangements were discussed again, but in the context of the fortification architecture. In the following, we will turn our attention to additional global and local access patterns and the most significant changes to it, resulting from architectural modifications. This is a summary of a more in-depth analysis of access patterns and associated methodological discussions to be published in the future.

The main global features of access in the *Dunnu*, are influenced by the presence of the fosse and fortification wall, and the limited points of entry. These have been discussed already as part as the defensive features of the *Dunnu*. These features form physical obstacles, and limited points of access, which can be viewed as the result of actions to limit movement for security reasons. Also, already pointed out in the discussion of the *Dunnu* as defensive system, is the highly controlled access arrangement behind both the new main gate, and the postern gate. Control was enforced by having people move through a series of spaces, with doorways positioned in such way that they are explicitly not aligned.

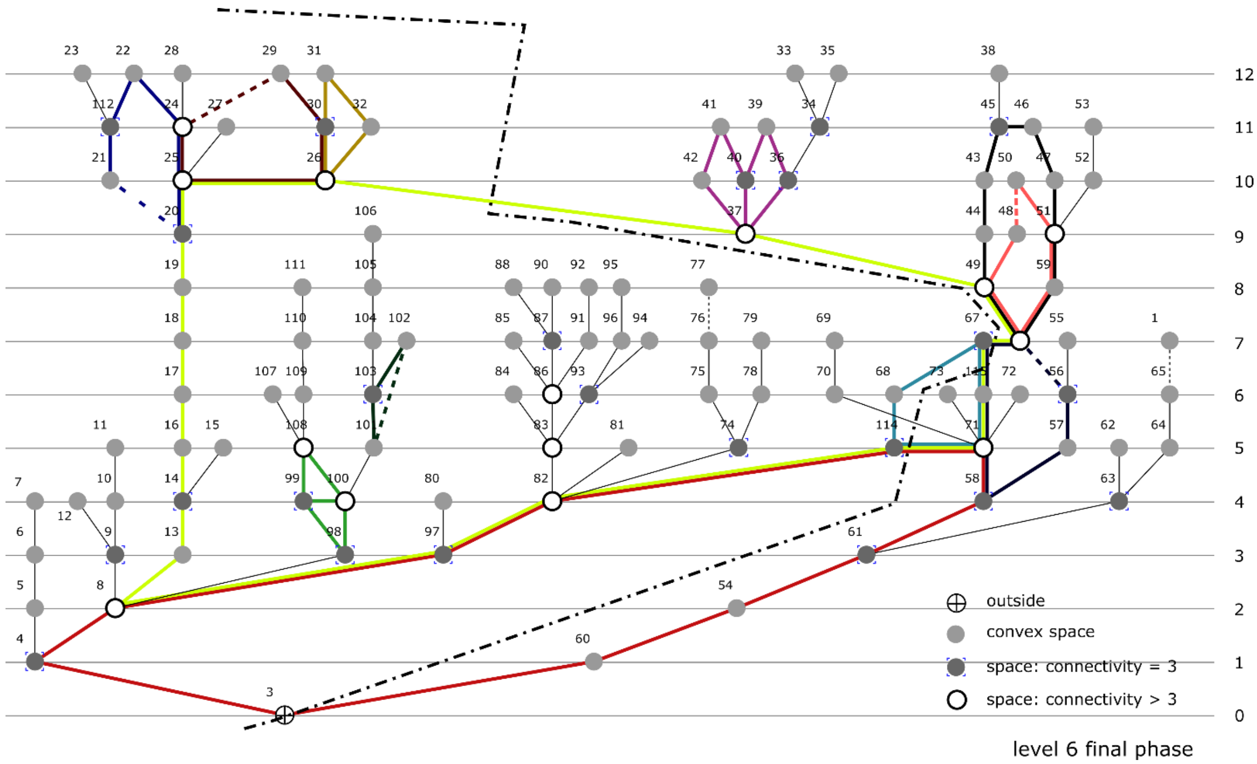


Figure 204. Access graph/ Justified Plan Graph, final phase level 6, starting on the outside. The axis on the right displays the depth of each node as measured from the carrier, here the outside. The coloured lines represent all possible circulatory movements. The hashed lines indicate doorways which are not certain due to inconclusive evidence or doorways which are blocked at some point. The greater the distance between the hashes, the less certain the connection. The dash-dotted line indicates the access domains of the two gates: to the left of it spaces are closer to the main gate, the right, spaces are closer to the postern gate.

Figure 205. Circulatory access patterns projected on an early level 6/5 plan of the Dunnu. It is however questionable whether complete tours (yellow line) were possible considering the multiple doorways that had to be passed through.

Another important feature can be found by looking at how all intramural spaces and buildings are connected. The entire spatial organization at large may be described as buildings connected by a ring-like structure, consisting of open courtyards and narrow alley-like areas (figure 204 and figure 205). More detailed investigation does however challenge the idea that the complete ring could be navigated freely. Certain passages are blocked by a fixed feature (see VI.8.4), or simply by the possibility of a closed doorway (see V.5.6). There are two main locations with doorways that make it easy to disable the possibility of going the full circle (yellow line on figure 204 and figure 205). First is the gate between the large court in the west, and the old gate passage. This gate could certainly be closed, as a posthole for the gate pivot near the corner indicates. The other passage would be through a small building attached to the west of the residence (residence spaces 5a and b). This building is basically the gatekeeper for access to the southern *Dunnu*. Although no pivot holes or stones were found, it is unlikely that a small independent building like this had no doors. It is also possible that access was already controlled at the point of exiting the main court to the west into space NW-1. Notwithstanding doubt about the exact location for access control, it is clear that from the new main gate, passing to the main court, further access to the remainder of the *Dunnu* was controlled, and possibly inaccessible for most.

What this conclusion highlights, is that the area of the new gate, the vestibule and small bathroom attached to it, the group of spaces in a building called the office, the residence and connected spaces, and the large space west of the residence, form a spatial unit. They are closed off from the rest, thus creating a dichotomy between the two sides of the *Dunnu*. One side more focused on representation and administration, the other more focused on domestic activity and production. However, this is only the case if one assumes that doors were semi-permanently locked. If one purely looks at spatial configuration, a different division can be made, based on the number of steps from either of the two gates: the new gate, or the postern gate (figure 204, dash-dotted line). If this is followed instead, a large part of the *Dunnu* in the north, and the tower would also belong to the main gate. In the case of the tower, its relative closeness to the main gate – although less close than during the old gate phase – would fit well with the idea of this building as the primary location of bulk storage.

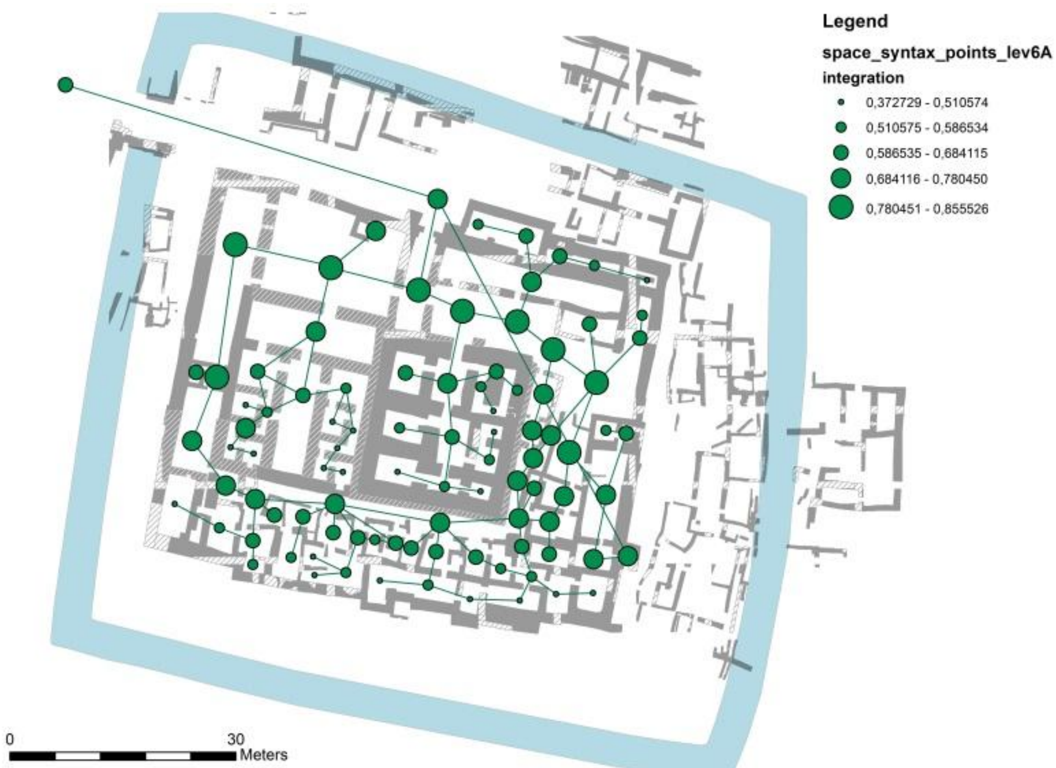


Figure 206. Integration, early phase Dunnu.

Figure 207. Integration, later phase Dunnu.

Certain groups of spaces are closely related due to their interconnectivity. As has been discussed, these may functionally constitute different buildings. The *Dunnu* shows variation in the different access patterns across these spatial groups, some configured in a tree-like structure, while others are arranged on a line. There are also those arrangements that form smaller rings of connected spaces. Each of these will be briefly discussed.

As a result of the spatial configuration, the more steps a space is removed from the core ring, the more isolated it is, or more formally: the less integrated. Spatial integration is a figure based on the total number of steps required the reach all other spaces (figure 206 and figure 207). Especially deep line like arrangements, such as visible in the sequence of spaces in the residence, result in higher isolation of the spaces at the back. Although the tower is arranged in a more tree like fashion, also the rooms at the back of this building are significantly isolated. The same is true for any spaces in buildings attached to the fortification wall, as one has to pass through the lighter architecture in front of these buildings in order to access them. Good examples are especially those areas identified as bathrooms. The toilets structures are always the end points of linear configurations. These spaces are not arranged in a straight line, but directional changes are common, using a corridor system with 90 degrees turns. The best examples are those in the residence. All such isolated spaces could point at increased concerns about privacy or security.

Changes of direction, or unaligned doorways give additional strength to this notion. Privacy and security is however not the only possible explanation. It may be useful in some cases to consider the possibility that low integration may just point at a lower importance in the day-to-day use of the *Dunnu*. For instance in the case of some spaces in the heavier buildings next to the fortification wall, their isolation may be the unintended effect of the global spatial design of the *Dunnu*. Also, the corners of a walled fortified structure, are easily located at the end of linear sequences of spaces. Last, if we assume that full circulation was possible in the *Dunnu*, it has significant effects on the integration of spaces, primarily those in the south-western corner (compare figure 206 and figure 207).

As indicated, some spaces branch out to other spaces, resulting in tree-like arrangements. The stereotypical example is the tower, with its three central spaces that form the trunk, branching out to subsidiary spaces. In all other "buildings", just one space branches out in two or three directions on just one occasion, followed by a linear sequence of spaces. An example is the residence. The branch generally occurs close to the entrance, which means that people entered a building, and were, directly or after one more space, given the option to choose from two or three directions. Further or additional branching down the line is rare, and occurs again in the residence, and also at the later *Dunnu* southeast 'house'. In both cases, this is due to a corridor structure, and the branches may lead to 'private quarters' of some sort, a bedroom perhaps.

The *Dunnu* contains a number of circles (figure 131, figure 132 and figure 133). These are spaces connected to each other because they are located on a ring. Buildings with multiple entrances cause such a pattern. These ring-like arrangements would point at close local spatial integration of the associated spaces. As a result of their spatial relatedness the hypothesis rises whether they also functioned as an important unit. Again, the question is whether such cycles were passable by most people. Some doors could have been semi-permanently locked. Nonetheless, the groupings of such spaces in the south and in the east appears to indicate some spatial divisions that may be related to functional groups.

VI.12.2 The effect of architectural modifications

As discussed, the *Dunnu* saw some modifications that have significant effect on the access patterns. One of the main cases is of course the movement of the main gate location. However, as there is considerable uncertainty about the spatial layout of the early phase *Dunnu*, it is hard to understand how the structure functioned at the time of the old gate. If the theory of Akkermans is right, that the old gate functioned for a time in conjunction with the residence and related spaces, the construction of the new gate shifted the point of gravity in the access pattern westwards. This would have made the eastern *Dunnu* less accessible, and more isolated from the main gate. Also the tower would have been less easily reachable. However, whether crossing the large courtyard as an extra step should be considered significant, is perhaps questionable. Perhaps more than the number of steps, it was rather the presence of two additional interior gates that was significant, as they allowed for a better controllable passage to the main entrance of the tower. As has been stated in the discussion of defensive properties of the *Dunnu*, a situation with the old gate functioning contemporaneously with the paved court and residence raises some additional security and practical concerns (figure 203). Because of the inefficient access situation with the old gate in relation to the paved main court, the question rises whether it is possible that the old gate originally functioned in a different spatial configuration.

In the western wing, space NW-2, some relatively minor modifications take place that have a big effect on the spatial structure of the *Dunnu*. Two walls are constructed in space NW-1, subdividing this large space in three smaller ones. Residence space 6a and b are created in the south, a bathroom building with a less elaborate toilet and a cesspit to the northern exterior. The wall that was constructed to create this new small building permanently blocks the possibility of making a full ring navigation in the *Dunnu*. Perhaps this underlines what we already suspected: that it had never been really possible, or intended to be used in such a way. The bathroom, residence space 6a and b, are connected to the main room of the left apartment with a small doorway. Although in the excavation documentation this is always considered a late doorway, i.e. that it had been cut, it is possible that it had always been there to give access to the western wing. If, as has been tentatively suggested in this study, the residence's food preparation area and the stables were located here, a side access would be very practical, and therefore that it had been part of the building's original design.

The other new wall created in this area makes a spatial division a little more north. This wall is associated with a new floor, and most likely also with the cutting of a new opening in the wall on the other side. This is the south wall of the building known as "the office" (NW-3), and reuses its bathroom spaces. Also, access between the small corridor and the former bathroom spaces is blocked, splitting a formerly unified building in two. New floors are constructed here, raising all floors – interior and exterior – to the same level. Functionally, it is turned into a potter's workshop with two kilns. Even though it is impossible to proof that all these changes occur simultaneously and with a single aim, to make space for this workshop, the complete upheaval of the access system in conjunction with abandonment of previous use of space appears to suggest it did.

On the plans published by Akkermans and Wiggermann (2015), the west wing was in an early phase completely empty. No office building was yet constructed, and just a number of doorways were present in the western wall of the paved court. Although this clearly affects the spatial configuration of this area, the empty space with several doorways is functionally ambiguous, and appears to suggest that some information is missing here. It is possible that these doorways were created later. In this dissertation, another interpretation of the stratigraphic and architectural data is proposed, in which the apparent phasing of walls is the result of the specific order of construction within a single constructional event (i.e. construction on the fortification wall started before construction of interior buildings, see IV.4.4).

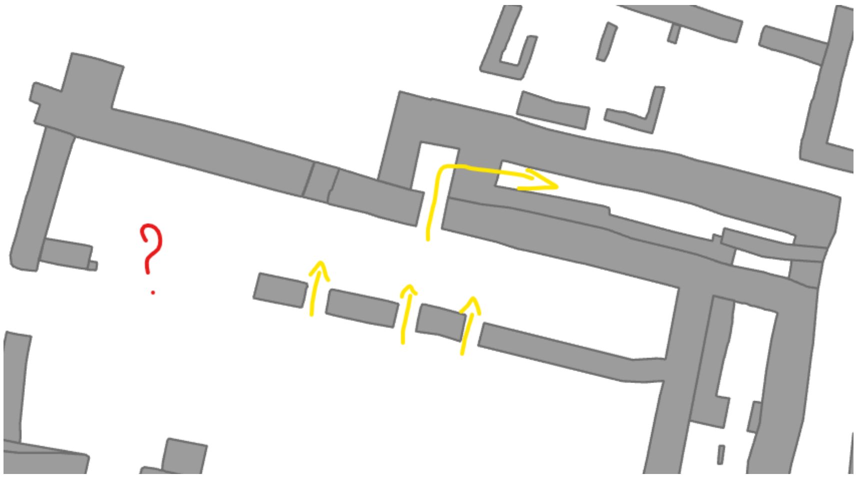


Figure 208. Access situation NW-sector, early phase. The elongated room was probably a staircase.

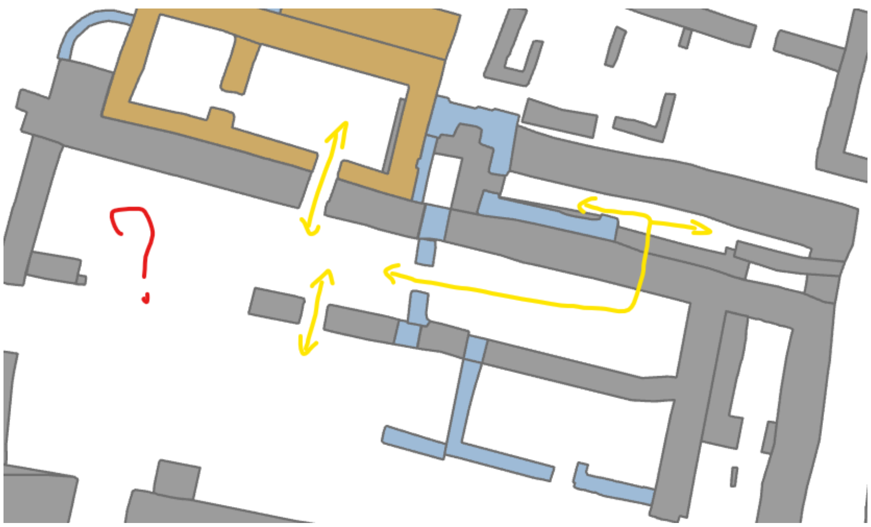


Figure 209. Access situation NW-sector, after various modifications. The elongated staircase rooms was turned into a bathroom.

The access configuration in the north-eastern sector also changes due to modification (figure 208, figure 209), but its exact nature is elusive due to incomplete archaeological data. For instance, there appears to have originally been one very long space, NE-3, although whether it was really lacking spatial divisions remains uncertain. Evidence shows doorways at multiple points, of which several were blocked later on. The most eastern one for instance, was blocked as a new building was added to its exterior. Similarly, a northern doorway is blocked as a bathroom is created behind it. This bathroom is now accessible through a new doorway, cut in the old phase fortification wall. Only now a spatial unit appears to be in existence, that can be properly defined by its access pattern. Although archaeological information on floor types and new functions (the bathroom) implies a significant repurposing, the role and functioning of this general area remains unclear. On the eastern side of this space (NE-3c), information is even more unclear because a very speculative wall is put here in a yet unexcavated baulk area. Very little archaeological information was retrieved, as the earliest *Dunnu* phases were never excavated here.

Figure 210. Modifications in south-eastern sector had significant effect on access configuration and distances.

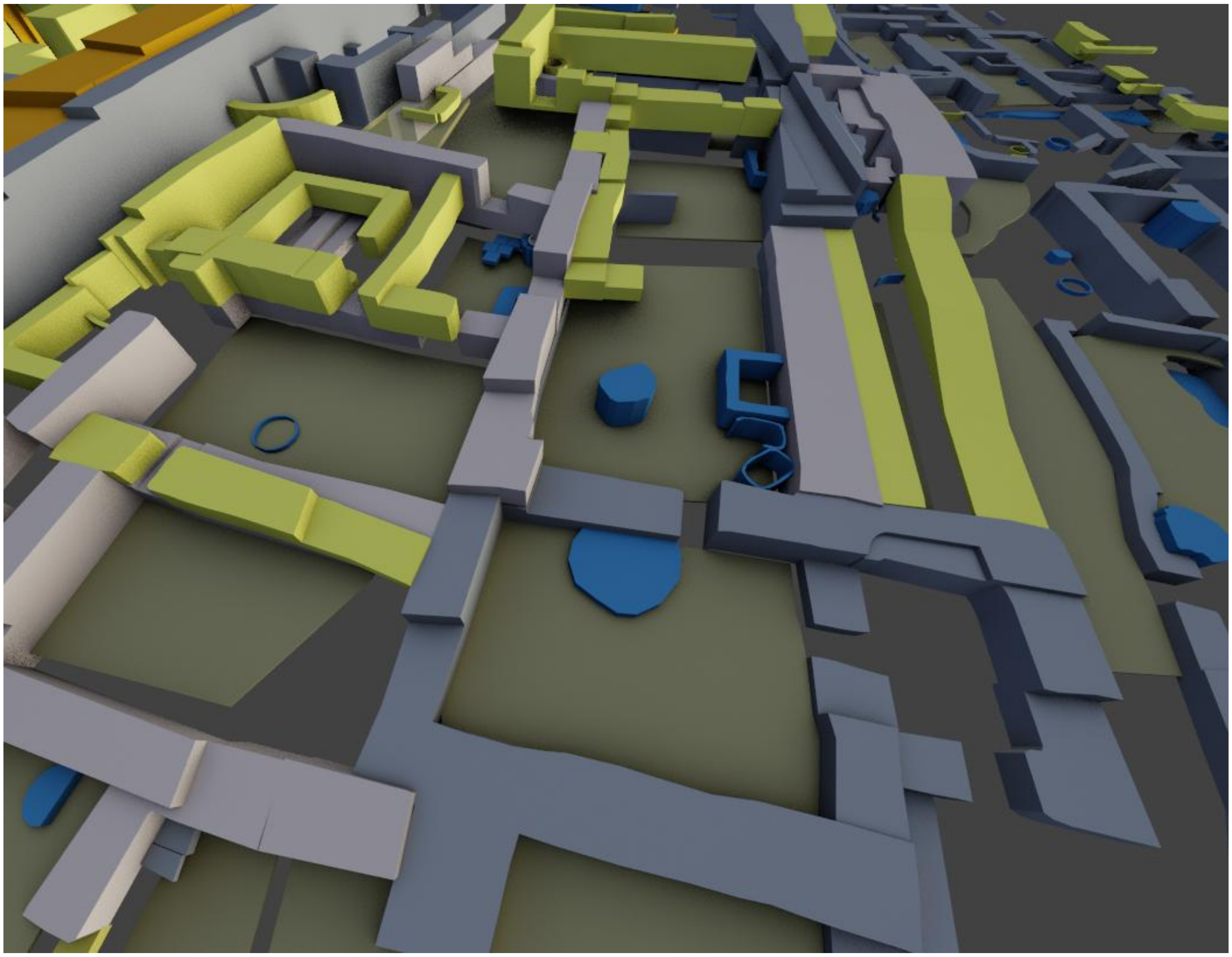


Figure 211. 3D view of the modifications in the south-eastern sector. Only the first phase floors are visualised in order to have a full view on the stratigraphic order of the architecture.

Another significant modification took place in the south-western sector, near the postern gate (figure 210). Again, the early phase archaeological remains may not be entirely complete due to demolition activities, but some important elements of the modification can be derived reliably. As has been discussed in the section on defensive properties, entry from the postern gate towards the inner *Dunnu* involves several directional changes. The lack of long straight lines limited both movement and views into the *Dunnu*. With the modifications implemented, access became even more limited and controlled. Although the doorway leading from the large, elongated space into the *Dunnu* is moved closer to the postern gate, a new very small courtyard was formed through which all traffic is forces to pass. This courtyard is structurally and temporally part of a newly constructed building. Due to the presence of a bathroom attached to a corridor structure, and a small, secluded room, this may have been a living space of some sort. Besides, a concentration of tablets forming part of the archive of the scribe Belu-eriš, assistant to the steward, found here, implies administrative functions. It in effect mirrors the small "office" building near the new main gate, that also may have combined administrative functions with a domestic function in the sense that it was fitted with a bath- and bedroom for the senior scribe or the steward. The fact that the small new courtyard gives complete control over people going in and out the *Dunnu*, strongly supports the hypothesis that the building had an important function in access control and administration. It is possible that in the early phase, these functions were fulfilled by a small building north of the large, elongated space (SE-2d/SE-2e). This is supported by two additional observations that underline its similarity with the later phase building. First, it is close to original location of the old passage towards the inner *Dunnu*. It was thus moved to line up better with the new building. Second, a bathroom may also have been connected to this space, located in the tower like projection of the fortification wall.[79]

The tower has seen significant modifications as well, especially from the early to the middle phase (figure 212). However, like elsewhere, the early phase access pattern is riddled with uncertainties. If we rely on the hypotheses of the excavator, at the back of the building, access to room 7 and 9 was completely different than in the later, while room 8 was of less significance in terms of access. The early phase building had a stronger focus on room 5 as the main distributor of access. The spatial role of this room, together with structural and functional aspects discussed elsewhere in this study, could indicate this room functioned as courtyard. The modification from the middle phase to the final phase primarily had the effect of reducing space inside the rooms and influencing visibility. As the effect of these modifications on spatial configuration is very limited, the purpose of them was probably structural. As has been argued elsewhere, these newly constructed reinforcements may indicate the construction of a new floor level on top of the building.

---

[79] Although no toilet was found here like elsewhere, a small baked tile pavement was found that is otherwise only seen in bathrooms.

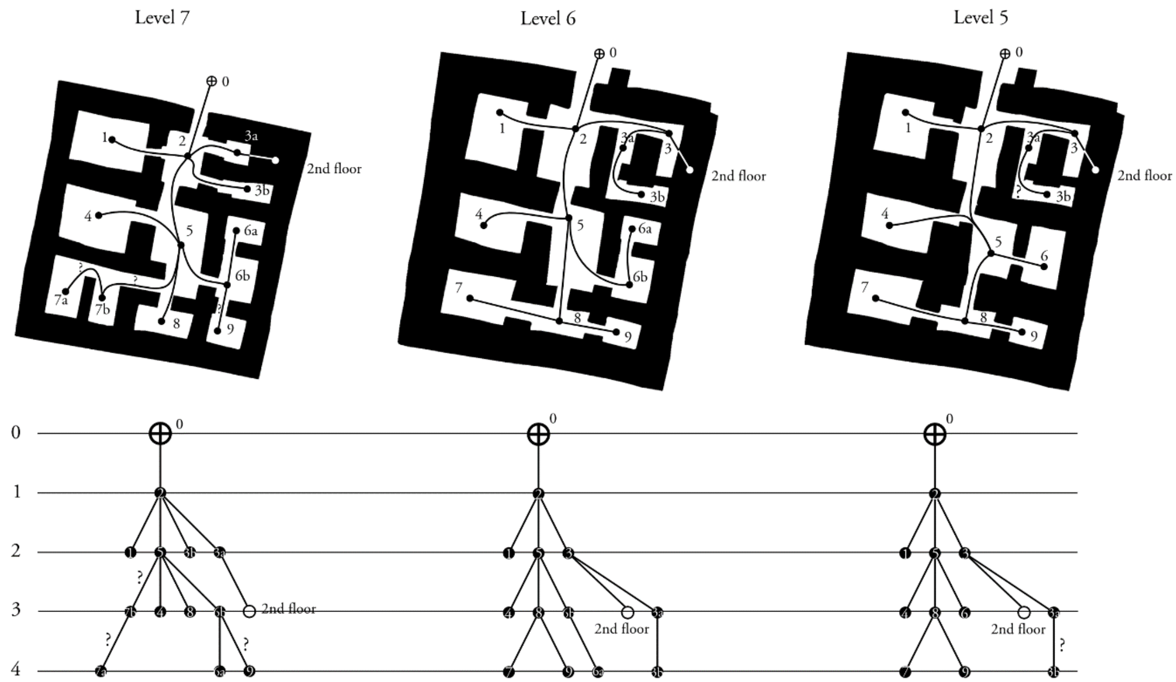


Figure 212. Spatial modifications of the tower.

VI.13 Conclusion

In this chapter different aspects of the architecture were analysed: building phases, roofed and unroofed areas, constructional height, ventilation and light, drainage, presence of fixed features, fortification principles and spatial configuration. The study of these elements reveals the choices and logic of the builders. These choices indicate that the *Dunnu* was carefully planned, with certain functional needs in mind. This is manifested in the variations in building heights, the placement of open spaces, and the access arrangements to enter and move through the *Dunnu*. Occasionally, small ad-hoc adaptations were necessary, sometimes to counter the effects of water flow or rising surfaces. However, as already argued in the chapter on deposits, construction phases generally appear to have been planned and relate to changes in the (spatial) functioning of the *Dunnu*.

VII. Synthesis

The research question aimed to address the dynamics between the architectural effect of top-down decisions from an imperial state's perspective, and those decisions made in the course of day-to-day life. To what degree therefore, can we speak about a purposeful design? And how well was it executed? And what do the modifications of the architecture and the spatial configuration say about changing purposes or functions? The study focussed then on four topics to tackle these questions. First, the historical and geographic contexts were discussed in order to set the scene, and understand how and why a *dunnu* here in the form it had took shape in this historical and geographic context. Second, in order to optimise archaeological interpretation and understand the biases and potential of the archaeological record, the nature of the archaeology of the *Dunnu* was discussed. This primarily focussed on formational processes of archaeological deposits to identify aspects of human behaviour such as various construction and demolition activities, and to distinguish those from the effects of natural decay. Third, we focussed on the activities of the builders by discussing construction materials and methods used to build the *Dunnu*. Finally, by reconstructing parts of the architecture of the *Dunnu*, these elements were interpreted from a functional perspective. This included several subtopics such as structural properties, architectural functioning, such as water and waste disposal, ventilation and light, access and circulation of people, and defensive properties. A further step towards understanding the functions of the spaces of the *Dunnu* was made by looking at fixed features. These are immoveable objects such as ovens, fireplaces, bins, and kilns. In this discussion and concluding chapter, the relationship between the architecture and the evidence for various activities is dealt with deeper by linking up with the conclusions of the study of activities in the *Dunnu* by Victor Klinkenberg (Klinkenberg, 2016). After that, the information and insights are synthesized into a model of architectural functioning of the *Dunnu*. In the final paragraph, a conclusion to this study is drawn.

VII.1 History & geography

We can assume that geography, the natural properties of the landscape, and historical events play an important role in shaping not only the general conditions, but also influence the physical properties of the settlement. In addition to these, technology and the cultural background of the people involved with the construction of the *Dunnu*, will have influenced architectural forms, design and spatial organisation.

In chapter II, the general historical and geographic context were discussed. It was shown that the *Dunnu* was built under specific political and military conditions of the early conquests of the Middle Assyrian empire. The *Dunnu* was one of several such *dunnu's*, a type of fortified settlement, built in newly conquered territory in the west, at the expense of the Middle Bronze Age Mitanni kingdom. As the Assyrian state had for the first time expanded this far, it needed to solve the question of consolidating territorial control. Most likely, the *Dunnu* played a significant role in this early imperial phase. The *dunnu's* were probably built on places of strategic significance: on crossroads of important land and water routes, or near important natural resources such as fertile fields. Another element in the choice for *dunnu's* may have been the lack of an local settled populations, that characterised some of the conquered areas. Traditionally, cities with their walls and naturally located on strategic locations, were the main means of territorial protection and influence. Stuck in the desert-steppe land between the Euphrates and the Balikh, inhabited by nomadic populations, the Assyrian leaders needed a tool for control. This did not just mean political and military control, but also control over agricultural production. The newly conquered areas with its military and forcibly relocated population needed to be fed, and long-distance transport of food over rivers was only possible to a limited degree. Hence, the idea of a *dunnu*, as a fortified centre of a farming estate was implemented. In addition to these historical circumstances, the socio-political structure of the Assyrian kingdom also favoured the use of *dunnu's* for its imperial aims. It has been emphasised by some authors (Brown, 2013), that the Middle Assyrian state was formed by a number of families, lead by powerful individuals that enjoyed significant amounts of political and military freedom. The *dunnu's* are supposed to have been the private possession of such families to be used for the raising of funds for their exploits, or the tasks given to them in exchange for political or military power. Hence, we see the agricultural produce of the *Dunnu* of tell Sabi Abyad being used to supply the military or chariot groups, responsible for the security of the highways.

That they instated *dunnu's* for this end did not just make sense within the geographical context of areas of low urbanisation, but also culturally. Fortified farmsteads, as economic and political bases for important families, already existed for a longer time. Although they seem to be concentrated in certain areas, or periods, the concept persists and can even be seen to survive into more recent times. Nonetheless, they did not play any role of significance in the political structure of the Neo-Assyrian state. Most likely, this is related to higher centralisation of political power to the king in Assur, with a reduced influence of other elite families (Brown, 2013). If this hypothesis turns out to be correct, the *Dunnu* of tell Sabi Abyad played an important role in the demise of these families, and the *Dunnu* as a tool of imperial power. This *Dunnu* was from its inception the possession of the grand vizier of the Assyrian king, who bore the title of king of Hanigalbat. This title and status of kingship finds it origin in the former power that controlled this territory, the Mitanni kingdom. In the course of events, the Assyrian political leadership chose to keep this political unit and status more or less intact and consider it a client kingdom. The Assyrian family that got to be in charge of Hanigalbat, originally headed by a man named Aššur-Idin, therefore became a potential competitor to the central power in Aššur. Aššur-Idin grandson Ninurta-apil-Ekur ultimately conspired against the king and successfully usurped him. After this, there never was a separate 'king of Hanigalbat' anymore, also because it is quite likely that the Assyrians lost much of their control in the upheavals of the 11th century BCE, known as the late Bronze Age collapse. The *Dunnu* was abandoned, and the concept of a *dunnu* as a tool for imperial control did not survive.

Dunnu's were multi-functional settlements and may in some case be compared to small towns. Similar to towns, they played a military strategic role, had political and judicial functions, and had an important economic function as centres of production. Although information is scanty, it is likely that not all *dunnu's* had the same combinations of functions, political or judicial importance or administrative status. It is therefore unlikely that they all looked the same. The little archaeological information we have on other *dunnu's*, summarised in the next paragraph, appears to confirm this. The physical form of a *dunnu*, would have been determined by the type of structures required to fulfil its functions. It is expected that they all had system of fortifications, as this is implied by the signifier '*dunnu*'. But the buildings that belong to a *dunnu,* its spatial organisation and the degree of fortification are most likely highly individualised. The concept of a *dunnu* may have been applied flexibly to adjust to local political, military, social and economic requirements.

VII.2 Building culture & technology

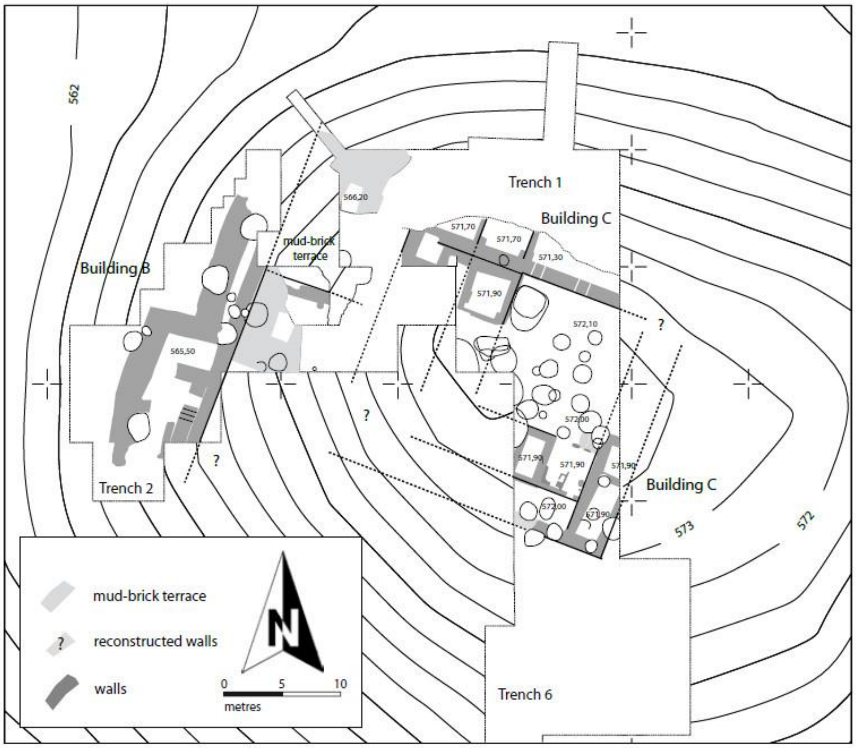
A *dunnu* was as much a social and political phenomenon, as it was a physical phenomenon. The builders were part of cultural traditions that used particular architectural forms and building techniques. Looking at the *Dunnu* from a purely building technological perspective, there is very little that can be considered unique. The mud brick technology as displayed had been around for most of the Bronze Age and continued into the Iron Age. Interesting variations have been observed within the *Dunnu* in terms of wall bonding methods, arch construction, and mud brick material and sizes. The interpretation of these variations is still open: do they relate to the cultural background of the various groups of builders, to the social status of different building types, or to structural requirements of different building forms? A wider comparative study of such details in terms of building technology was left outside this study, but should be executed to assess the possible significance of variations. It is telling that the available treatises on ancient mud brick construction technology, document and discuss the larger developmental stages of building technology, but do not regard subtle technological variations in a comparative perspective. This may partly be attributed that most archaeological excavations do not systematically record these aspects. If they do, it is to study spatial and temporal developments on the same site, not for a superregional comparative study. There is certainly room for new research avenues here.

A more fruitful comparison is possible on the level of building typology and morphology. Although this was not the prime focus of this dissertation, some interesting parallels may be pointed out. Since it is justified to consider *Dimtu* (early/Mitanni) and *dunnu* (later/Middle Assyrian) as different names for approximately the same phenomenon, we may look at both for direct comparison. Various researchers have identified *dunnu's* or *Dimtu's* in the physical remains found in excavations at Tell al-Fakhar (Khalesi, 1977; Kolinski, 2002), Giricano (Bartl, 2012), Nemrik (Reiche, 2014), Tell Qabr Abu al-'Atiq (Montero Fenollós *et al.*, 2011; Luis, Fenollós and Caramelo, 2012; Montero Fenollós, 2015), Tell Hariri, and Gre Amer.[80] Of these, only Giricano has unequivocally been identified as *Dunnu-sha-Uzibi* based on references in cuneiform sources (Schachner, 2004). The others are all possible candidates based on various criteria such the small size of the settlement, presence of fortification, evidence for administration, nearby presence of fertile land for cultivation, or their strategic location. A problem with most of these excavated settlements, except for Tell al Fakhar, is that excavations have not uncovered the complete settlement, or even a complete building. This makes comparison very difficult. However, comparing the incomplete plans with each other, the main conclusion is that there is considerable variation in layout and size. This is in line with the idea that *dunnu's* are used as customizable settlement units, easily adapted to local conditions and circumstances. We should therefore not focus too much on searching for a standardised type of fortified settlement.

There is however one interesting similarity with the only other confirmed *dunnu* and the one at Tell Sabi Abyad, at Giricano/*Dunnu-sha-Uzibi.* At that site the Late Bronze Age levels are poorly known, but the earlier Middle Bronze Age remains – of which we do not know whether it was also a farmstead type settlement similar to a *Dunnu* – there was a central building, or possibly a cluster of multiple buildings with open space encircling it (figure 216), and beyond that space a fortification wall. This arrangement resembles that of the *Dunnu* of tell Sabi Abyad. This spatial arrangement cannot be identified in any of the other excavated *dunnu's* or *dimtu's*. For instance, the supposed *dimtu* at Tell al-Fakhar, is a conglomerate of associated buildings without a spatial separation between the core and a fortification system. The heavy walls function both as exterior walls for the buildings, as fortification walls. This architectural form, dating to the Mitanni period, was therefore very different from the one used at tell Sabi Abyad. Another possible similarity between Giricano and Tell Sabi Abyad, although admittedly tentative, is the elongated rectangular projection from the fortification, connected to a narrow, elongated space. It is alike a similar structure in the eastern fortification wall at Tell Sabi Abyad, where the long narrow space may be identified as stairwell. These observations may indicate there was between the builders of Tell Sabi Abyad and

[80] See also the discussion of the issue of identifying *dunnu's* in Düring (2015, pp. 53–54).

Giricano. For all other excavations of potential *dunnu* structures, the piecemeal fragments of heavy mud brick structures are too generic to draw any conclusions about cultural associations.



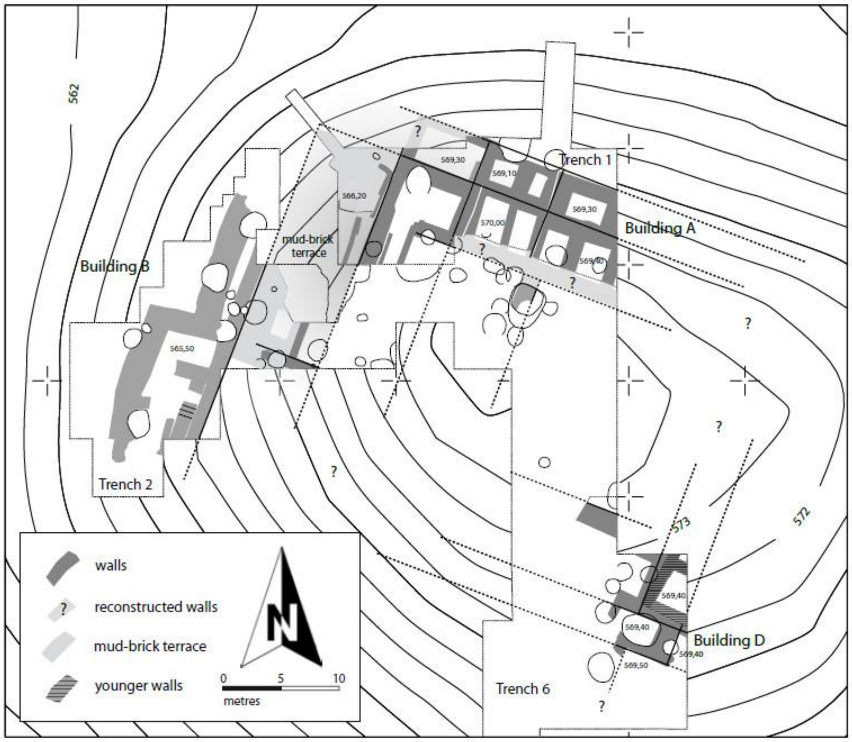


Figure 213. Two phases of the archaeological site at Giricano or Dunnu-sha-Uzibi (after Bartl, 2012).

Specific buildings of the *Dunnu* may be linked to other Middle Assyrian, or Late Bronze Age, examples. For instance, the Middle Assyrian building P at Dur-Katlimmu (Kühne, 1983) has some superficial similarities with the tower of the *Dunnu*. Both are heavy walled structures with small arched doorways (figure 214). Although it may be tempting for some to see these as evidence of cultural links, these architectural features are again too universal to justify this. Mud brick arches and thick walls had been around for a long time, and are used to this day in similarly heavy structures, especially on basement level or ground floors. Reiche (2014, p. 52) also draws a parallel between the heavy walled Mitanni structures at Nemrik, Northern Iraq, and the tower of the *Dunnu*. However, apart from its heavy (but still lighter) walls and the occurrence of (possibly) nine small rooms, there is little real resemblance in access pattern and construction.

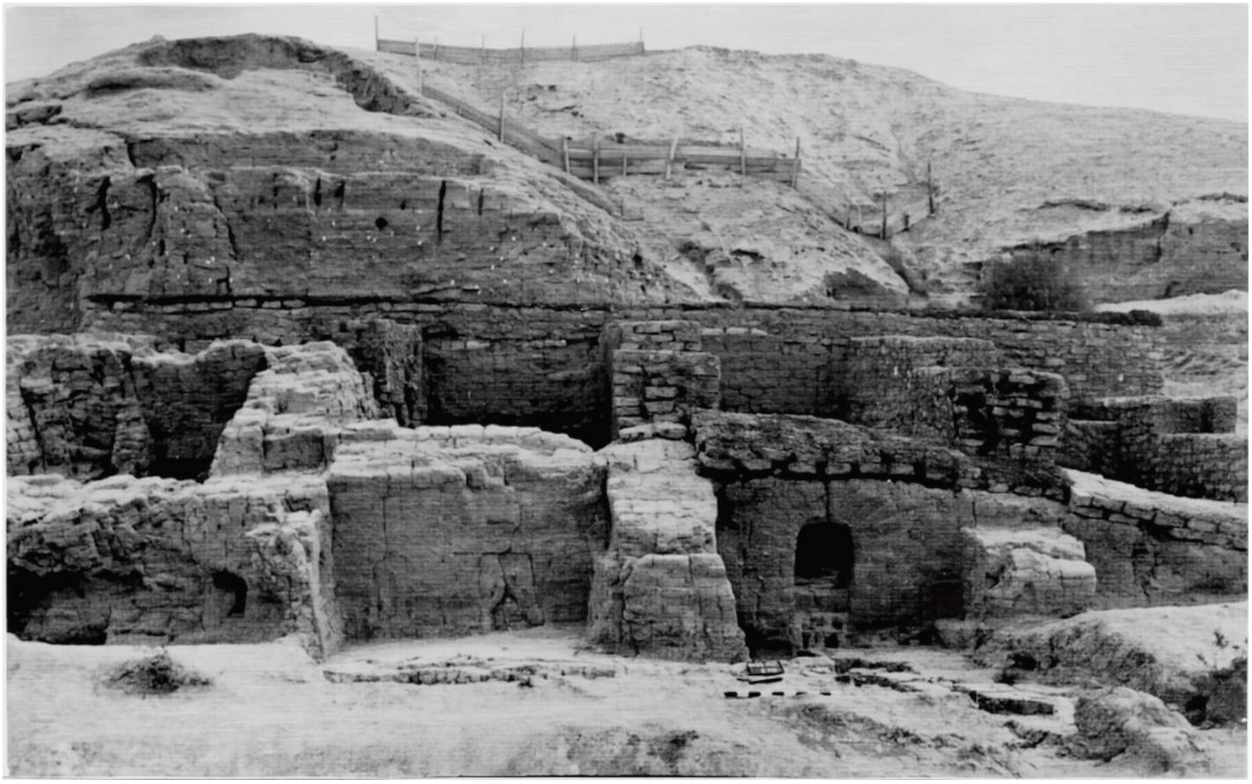


Figure 214. Middle Assyrian building P at the slopes of tell Sheikh Hammed, with the completely preserved arched doorway (after Kühne, 1983, fig. 2).

A spatial structure that does show remarkable similarities to a specifically Late Bronze Age phenomenon is a sequence of rooms that may be interpreted as “apartments”. In the *Dunnu*, several examples are found of one or two rooms connected by a corridor system and a bathroom consisting of one or two spaces. The most striking examples are found in the residence, but at least two, and probably four smaller examples are found as well. These are very similar to houses found at Middle Assyrian Tell Fekheriye (figure 215) (McEwan, 1958; Bonatz, 2014). Although the number of rooms varies, the main characteristic feature of these, is a corridor system connecting the rooms, and with a bathroom always at the end of the corridor. A parallel may also be drawn to the so called ‘reception suite’ phenomenon that has been identified as a characteristic element of the North Syrian palatial architecture tradition with origins going back to the Middle Bronze Age (Matthiae, 1990). The example most resembling the residence of the *Dunnu* is found at Arslan Tash, as it also has two apartments of three rooms connected to the same main room (figure 216). However, although all these reception suites sport a similar sequence of, usually three, rooms with the last being a bathroom, they are lacking the quintessential corridor, which results in a significant alteration of the access pattern.

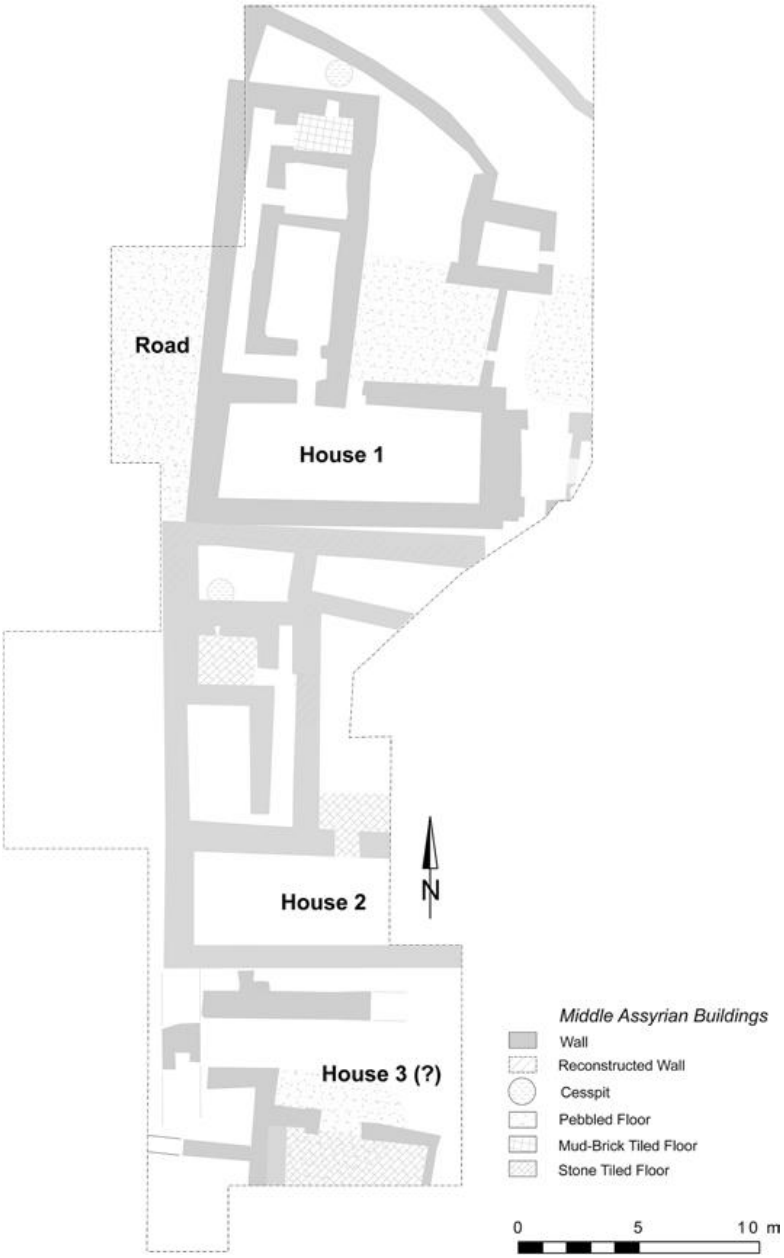


Figure 215. Middle Assyrian houses at Tell Fekheriye (after Bonatz, 2014, fig. 3).

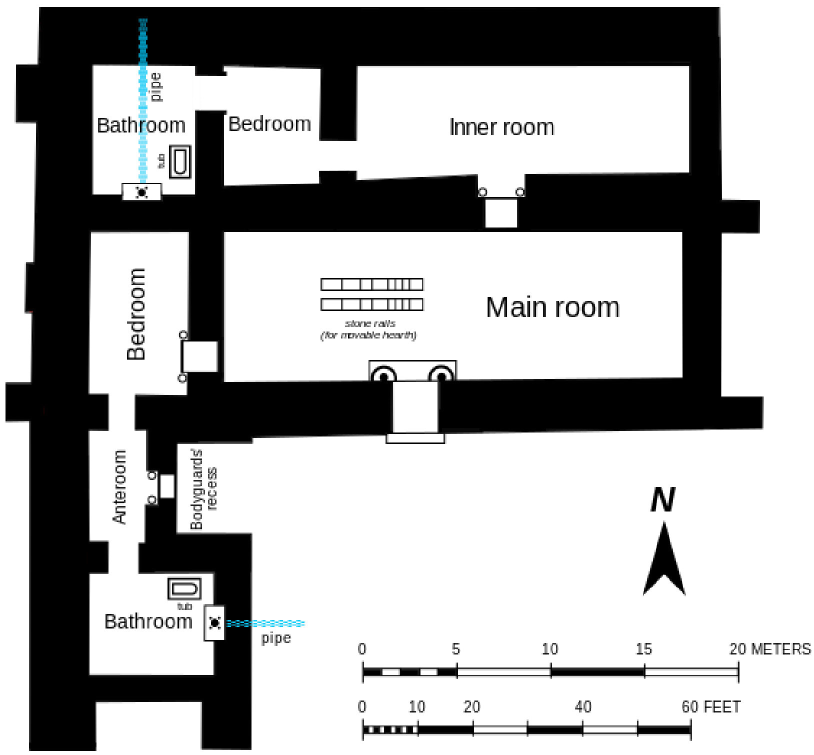


Figure 216. Arslan Tash (image by Bjankuloski/Wikipedia).

In the previous the residence was looked at in isolation, but if the entire architectural context is considered, additional parallels may be drawn. The organisation of space with a residential section and other subsidiary spaces, and a gate room around a courtyard resembles the spatial principle of a house with an enclosed court (Miglus, 1999, pp. 7, 23). This is a type that occurs frequently in a time much earlier than the *Dunnu*, the old Babylonian period, in southern and middle Mesopotamia, on urban sites like Larsa, Nippur, Tell ed-Der and Ur. Again, since the courtyard as spatial organising principle is such a common phenomenon in much of the history of Western Asia, the historic cultural significance of these parallels may be questioned. However, in the case of a courtyard house from the Isin-Larsa period at Bakr Awa, the alignment of gate room, courtyard and residence on the same axis has a generic resemblance to what seen at the *Dunnu* (figure 217) (Miglus *et al.*, 2013), although there is no direct relation between the two. This is remarkable since in most instances of courtyard houses, the main gate and vestibule are not arranged on the same axis as the residential section of the house. Nonetheless, this could very well have been part of the "natural" variation seen within this type of houses with enclosed courtyards. Moreover, ultimately there are more differences than similarities between an example as Bakr Awa and the courtyard/residence combination at the *Dunnu*.

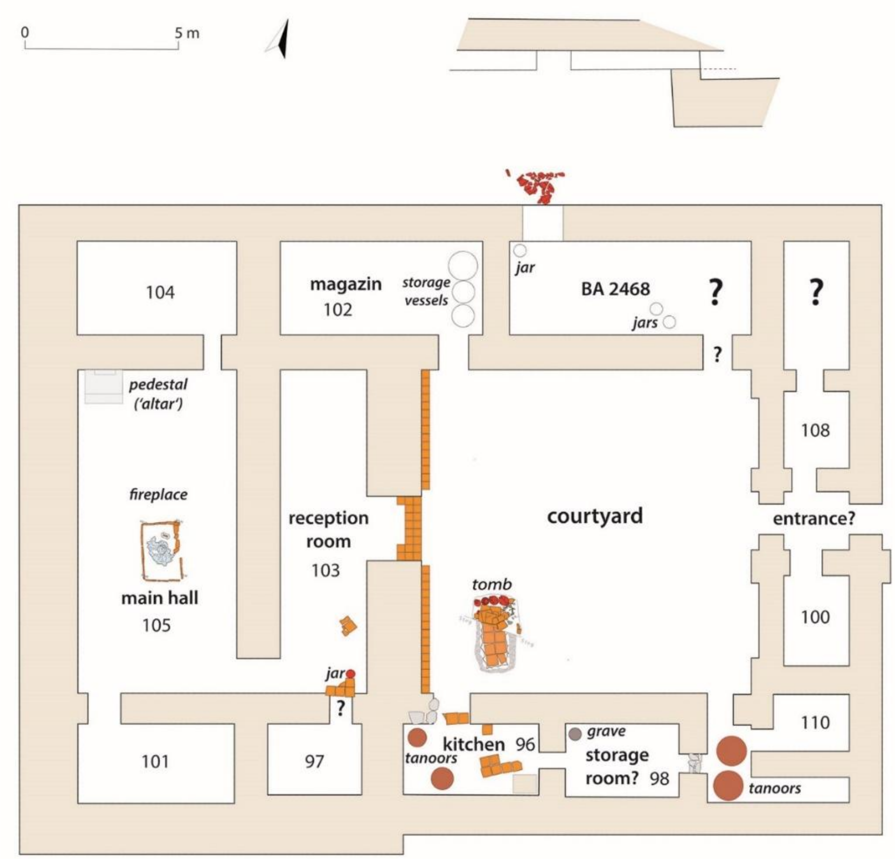


Figure 217. Bakr Awa, Middle Bronze Age residence (after Bürger and Miglus, 2014).

VII.3 Archaeological site dynamics

Now we will turn to the archaeology of the *Dunnu* of Tell Sabi Abyad. In chapter IV of this dissertation, the formation of deposits was discussed with the triple aim of understanding how human building and demolition activity contributed to deposition, of reconstructing what has been lost due to post-formational processes, and of understanding the dynamics of architectural modification over time. The applied methodology involved systemisation of depository processes in 'deposit sequence graphs', in essence generalised section drawings with a unified symbology. All analyses are based on traditional section drawings and deposit descriptions made in the field by the excavating archaeologists. The absence of modern micromorphology methods to analyse and determine the character of deposits, is a limitation of this study. For example, ash deposits can be hard to differentiate visually from eolic deposits of fine grained soil without microscopic study (Friesem, Karkanas, *et al.*, 2014). In the same vein, collapsed roof deposits require detailed, although not necessarily microscopic, stratigraphic observation and an awareness that of the fact that such deposits are perhaps more often preserved than has been accounted for previously in archaeological research (Friesem, Tsartsidou, *et al.*, 2014). Another important methodological note is that these dynamics cannot be understood without a model of mud brick construction practices and building modification practices. It may be argued that all building activity is the creation of a type of cultural deposit. The topic of site dynamics has therefore much natural overlap with the discussion on building methods and reconstruction of architecture.

Seven different general patterns of deposit sequences were classified using the recorded stratigraphic data, both section drawings and deposit forms. A rough classification can be made differentiating rubble deposits, and gradual accumulation/decay deposits. Rubble deposits, further classified according to the density of mud brick debris, are either caused by demolition, destruction, or natural collapse. It has been shown that deposits caused by intentional demolition activity can be differentiated from deposits caused by decay and collapse. The gradual decay deposits have been classified based on the thickness and irregularity of the layers. The thicker the individual layers, the faster the rate of infill is. This rate of infill can be linked to natural sedimentation from decaying loam plaster and wind deposited materials, and to various activities such as the construction and demolition of installations, thrash disposal, and cleaning regime. The close stacking of a sequence of thin floor levels is also regarded as gradual infill deposit in this model. In fact, it is very hard to draw a difference between ‘floor levels’ and compacted sedimentation. We will return to this issue below.

The first important aspect to emphasize, is that most deposition in the *Dunnu* occurred in a phase that the *Dunnu* did not function anymore as the *Dunnu* we know from the Assyrian cuneiform sources. Roughly defined, there is a distinction between phase of use with evidence for various modifications, followed partially by abandonment and partially by reuse of a different nature. The effect of this sequence is that most evidence for deposits is concentrated in the so called ‘post-*Dunnu*’ use phase. This is due to a combination of factors. On the one side the rapid architectural degradation, possibly induced by active destruction followed by accelerated natural decay. On the other side, reuse was of a character that caused additional deposits to form. The typical case is the large, paved court in the north-western sector, probably the heart of the administrative, political and judicial *Dunnu*. It starts to fill up only after a phase with evidence for burning and scavenging. It did not fill up due to abandonment and building collapse however, but by a concentration of human activities that included construction and demolition of smaller walls and installations. Additionally, rapid infill may have been caused by absence of building maintenance of the former *Dunnu* buildings and fortifications. As a logical consequence, there is hardly any depository evidence of the actual use of the large court during the main phase, as it was kept clean during this entire period. In other spaces, a rubble deposits are found directly on top of floors, in some cases also followed by a phase of gradual deposition, indicating the fact that these formerly covered spaces are now open, and deposits are allowed to accumulate. The effect is that several spaces, both open (the paved courts) and roofed basically have a single floor phase during the entire existence of the Assyrian *Dunnu* without accumulation of deposits. Any later floors or 'walking levels' present in such buildings must often be viewed as a complete change of character of use, associated with the discontinuation of the *Dunnu* as it was. The presence of kilns inside the fortifications is a symptom of this development. The places where just one confirmed floor or surface level has been found is however limited to various spaces and buildings in the western *Dunnu*: the residence, and office. But also in various buildings in the south.

However, not everywhere is there an absence of deposition during the main use phase of the *Dunnu*. In several spaces, some gradual deposition is allowed to occur. These are found in the south, amongst others in spaces related to the bread baking and food preparation zones. The gradual, but modest rise in surfaces here is probably related to sediment accumulation, and the decay or demolition of fixed features. Faster rates of deposition are found just outside these spaces, in the narrow passage, or "alleyway" that encircled the large central buildings. These probably collected a lot of erosion products from the roofs and walls of these large buildings, hence accumulating faster than other exterior spaces. It has been observed that this space did not collect rubble deposits, but did fill up notably faster higher in its later stages, indicating a gradual transition into the post-*Dunnu* phase. It is unfortunate that the large open courtyard like space in the north-eastern *Dunnu* has not been sufficiently excavated, as it would be interesting to compare its rate and type of infill to the alleyway. The limited information that can be gleaned from the soundings seems to indicate a similar process, confirming its status as courtyard with domestic status and use.

The other spaces with evidence for deposition prior to the partial abandonment and reuse phase, all have rubble deposits. These spaces are found across sections of the south-eastern *Dunnu,* the north-eastern *Dunnu*, and in the tower. In all such cases, it involves a rubble deposit, followed by building activity, modifying the prior architectural layout or structure. These rubble deposits can therefore be linked to demolition and levelling activity prior to new construction activity. This construction activity can in turn be linked to functional or structural change or improvements to the architecture. In the case of the tower, the effect of the modification was the enlargement of the building, including the staircase. The structural and functional reasons for this, are most logically the raising of the floors, or even the addition of new floors. In the case of the modifications in the south-eastern corner, it is interesting to note that the rubble deposits cause a levelling of an area that was formerly terraced. Although this may be considered a convenience for users of the area, this does not explain the spatial redesign that also occurs. Looking at the changes in accessibility and new architectural features, it seems that higher levels of security are created with better control over access into the *Dunnu*. In addition, a staircase was constructed that required secure entry. In the north-eastern corner of the *Dunnu*, the demolition deposits are the effect of taking down building in favour of expansion of the fortifications. Also, most buildings in the eastern extra-mural *Dunnu* contain rubble deposits, and the area is entirely levelled. Again, this implies intentional demolition, although it is uncertain in favour of what, as the layers above that have been preserved badly. It is however interesting that the reduction of these buildings took place before the modifications of the *Dunnu* in the south-eastern and north-eastern corners. In other words, the entire area was repurposed still during the main phase of the *Dunnu*.

As noted in the introductory paragraph of this section, sequences of thin layers within a gradual deposit may be hard to interpret. In the excavation documentation, such thin layer stacks are usually understood to be a sequence of 'floors'. However, looked closely, their character varies widely, and there is not always good material evidence for usage of these surfaces. In in some cases it is not apparent whether these layers are constructed floor renewals, or natural rising of the floor level due to various kinds of sedimentation discussed previously. In some cases, these may be particular for the ruined state of architecture, and related to variable degrees of exposure of interior spaces and the presence of cavities in partly collapsed architecture. It should be emphasized that in most cases of real constructed floors in interior spaces, floor renewals causing a stacking of floor levels, are absent nearly everywhere. Although cyclical floor renewal on interior spaces may have taken place, the stratigraphic documentation does not allow us to tell. This observation makes the exceptions to the rule interesting, and in demand of an explanation. Most notable are the floor level stacking in rooms 2, 3 and 5 of the tower in its earliest phase. Even more notable is the fact that this stacking is halted after a large-scale renovation has taken place. This information put together, has developed into the new hypothesis that these spaces may have been open spaces originally, and that the new interior walls were constructed with the aim of supporting newly built roofs. In theory, interior spaces could also see natural rising of the floor level, if they saw much 'dirty use', involving refuse disposal, the building of loam installations or other types of interaction with the exterior that brings in new sediments. Concrete examples may be stables, interior food preparations areas, or other production activities. However, this situation is less plausible given that most ethnoarchaeological studies indicate, that such activities are nearly always found in outside areas.

VII.4 The construction of the *Dunnu*

The study of construction materials and techniques at the *Dunnu* aimed to understand how the *Dunnu* developed its physical form by cultural knowledge, embodied technological practice and responses to functional and structural challenges and requirements, and within the material limitations offered by resources and technology. A study of construction would not be complete without a proposal for a reconstruction. In this, the perspective of J-C. Margueron (1999a) was followed, who highlights the rational nature of builders of the past, meaning that no structures were built without relation to functional and structural requirements. His view is a response to the debate about 'non-sensical' large dimensions of walls of ancient Mesopotamian architecture (Heinrich and Seidl, 1968). Margueron reasons that even in the case of over-sized structures with a high symbolic meaning embedded in them, they still had to adhere to a structural logic. And this logic can be 'read', in part, from the building plan. This regards such aspects as the thickness of walls, the type of bonding, the width and length of spaces, the presence or absence of buttresses, etc. The reconstruction, as a method, forces one to think about the structural and functional interpretations that the excavated remains imply.

This topic was studied in three ways: by investigating mud brick construction practices cross-culturally, by analysing the archaeological evidence documented during the excavation of the *Dunnu*, and by assessing the possibilities of the natural and cultural resources in the Balikh valley in the Late Bronze Age. As has been noted above (VII.2), the study of mud brick building practices is somewhat hampered by the fact that research has focussed on the larger developmental outlines, but the particularities of regional, local and perhaps site to site variations of practices have not been investigated in overview studies. We will start by discussing the main characteristics of building methods and materials.

The *Dunnu* was built on top of an eroding Neolithic tell. Digging activities prior to construction have meddled with these layers. Most prominently the fosse, a three meters deep defensive trench was dug into the tell. From a pragmatic perspective, the dug-up material from the fosse must have been used for initial construction. The use of the neolithic tell as mud brick construction material is also implied by the presence of neolithic sherds in Bronze Age mud bricks, but this phenomenon has never been quantified. Preliminary calculations show that the volume of earth thus excavated was enough for the construction of the fortifications[81], and some additional buildings, but not for the entire *Dunnu.*

The hypothesis has been put forward by the excavators that the tower, or the building preceding the tower, was a Mitanni period construction, and this is also confirmed by the ceramic analysis (Duistermaat, 2008). The oldest walls of this building appear to be indeed stratigraphically earlier than the fortifications. However, in the absence of physical, uninterrupted stratigraphic links between the tower and the fortification wall, even this remains uncertain. Theoretically, the early version of the tower could have been accompanied by an early version of the fortifications. Nonetheless, considering the evidence, the hypothesis forwarded by the excavators appears to be the most plausible. This means the Assyrians did not come to a

[81] The volume of earth in the fosse has been estimated to be 4030 m^3. While the total volume of the fortifications are 2550 m^3.

completely empty site, and among their first building activities alongside the erection of the fortification wall with the old gate, may have been the renovation and modification of the building that preceded the tower.

Early building activity, prior to construction, also certainly involved shallow terracing. This must have involved levelling both by addition and removal of soil. The terraced nature of construction is especially clear from the buildings on the south side, where the tell slopes more steeply. Terraces do not appear to have been created for entire buildings, but to accommodate specific walls. This results in a pattern with walls of the same building with different base levels. In some cases, for especially long walls, a stepped construction that followed the local topography, was applied. This is evident in the tower, the residence, and the fortifications. The best documented example of both stepped construction and of wall terracing are found in the well-studied walls of the residence. But the method is implicit in the base levels of walls everywhere else. It should be noted that notwithstanding various references to foundation trenches found in the excavation documentation, 'trench foundations' were not applied at the *Dunnu*. As has been discussed in this dissertation, the absence of foundation trenches is a common feature of mud brick architecture, now and in the past. The generally large dimensions of the width of mud brick walls are related to this, giving them the required stability. The absence of trenches also meant that in the *Dunnu*, the earliest floor levels of spaces are close to the base or foundation levels of the walls. In some cases however, floors appear to be slightly higher than foundation level. This is not due to trench digging, but more likely caused by the dumping of a layer of soil in between the walls of a newly constructed building. The main purpose of this practice was most likely to create a level floor. This artificial raising of floor levels above the natural level of the tell surface, is again most clearly present in the residence, reflecting the additional attention and care given to the construction of this building. In general, the foundation methods thus applied are pragmatic and cost effective. This is expected in a context where construction has to advance quickly, and human labour is the main force driving construction.

Later construction activity, modifying already standing Late Bronze Age *dunnu* architecture, made use of this architecture in the same way that has been documented for many excavated conglomerated built environments across the ages. As has been discussed in the context of site dynamics, evidence from the study of deposits showed that buildings were demolished, probably levelled, and new constructions erected on top of them. This resulted typically in 40-50 cm mud brick building debris within the older walls. This intentionally backfilled space formed the solid foundation for new constructions. In one instance of a complete architectural revision in the south-eastern corner of the *Dunnu*, this method was used to level an entire area that previously had a terraced nature. Thus, more rubble was simply deposited in the deeper founded spaces. These are indications of a well-planned building activity that considered both the new functional requirements as practical use of the area. It was in other words, an improvement.

The main element of construction are the mud brick walls. Variability of wall construction was studied by mapping and assessing the following material properties: wall thickness, mud brick size, mud brick colour, and bonding methods. Regarding mud brick size and mud brick colour, these have not been consistently documented during excavation, but are interesting sources of information for mud brick building practices, and therefore deserves more attention. The patterning of brick colour and consistency appears in most cases quite random, indicating that this may reflect coincidental differences due to differences in loam sources used for bricks in different sections of walls. On the other hand, in other cases we can see a remarkable more significant differentiation. For instance, the difference in mud brick material and sizes between the residence and the tower. The tower has a larger range of sizes, and has bricks of a different colour and consistency. These materials differences further reinforce our idea that the tower is of a different construction date than the residence. Differences of loam materials used for the bricks also indicate that a different loam source was used. In this respect the most remarkable difference that was easy to observe during excavation, is the contrast between brown and red soil bricks. The residence and the walls of the large, paved court contain layers of bricks of these colours, indicating that a choice was made to create a hybrid wall consisting of two kinds of bricks. Although this has not been confirmed by petrological analysis, the most likely cause is that bricks made from a 'fresh' loam source were used in combination with bricks made from reused tell soil. As this pattern was not observed anywhere else, it emphasizes the special care the residence and associated court received in construction. The application of two types of mud bricks of different quality are known from anecdotal ethnographic sources and from references in ancient texts. Archaeologists of mud brick sites however find a much larger range of mud bricks colours and consistencies (Homsher, 2012). The location of loam sources plays an important role here, with some coincidental patterning as a result. However, selection of good versus bad quality must have taken place on many sites in the past. To better understand the builder's rationale and the causes of coincidental patterning, further and especially systematic comparative study is required.

It was argued in this dissertation that wall thickness is likely associated to building height, and therefore is a source of information for the reconstruction of the architecture. More factors play a role however such as wall slenderness (i.e. long walls without lateral support, high walls without intermediate floors), and functional requirements with regards to potential loads or security. The aim is wall stability in all cases, and increased wall thickness, brings more stability. As higher buildings, or higher walls are potentially less stable, they require thicker walls. Excluding the special case of fortification architecture, it is highly likely that differences in wall width of most 'regular' utilitarian buildings, reflect the number of floors they had.

On the other hand, a special case can be made for the residence, which most likely had a single floor, but high ceilings, which creates more potential instability, hence requiring thicker walls. We may assume that the storeys of the tower were not as high, but that the thickness of its walls reflects the building's considerable height. In addition, it may also be a indication of its function as main storage building, requiring heavily supported upper floors. However, we should not exclude a possible defensive role, or its potential use as prison as functional aspects that determined the thickness of its walls. The former discussion is all based on relative differences of mud brick wall thicknesses. If the absolute thickness is considered, all walls are probably oversized. Building heights that reflect the carrying capacity of the mud bricks, would result in a tower that could be safely 30 meters high, a fortification wall 16 to 20 meters high, and regular buildings with two mud brick wide walls would be 8 meters high.

VII.5 The functioning of the *Dunnu*

In this dissertation, the functioning of the *Dunnu* architecture has been approached from several angles: the access pattern and spatial configuration, defensive qualities, architectural facilitation of domestic and practical usage, and material evidence for the use of spaces. An attempt was also made to chronologically map changes to the functioning of the *Dunnu*, although not all categories of evidence were exhaustively dealt with in this manner.

VII.5.1 Access patterns & spatial configuration

One of the main characteristics of the *Dunnu* results from its concentrical spatial organisation, with several rings each constituting a larger access zones. These zones are spatially demarcated by a fortification wall, a fosse and an inner ring of open spaces. The outer zone is not demarcated by a physical obstacle as far as we know, although we may consider the slopes of the tell a physical demarcation and barrier as well. This zone was not built up uninterruptedly, although the available data is limited both due to preservation issues (erosion), and the limited coverage of excavation. However, it seems plausible that at least the southern area was left vacant as the tell slopes here most steeply and is therefore a slightly less favourable area for construction. Also, the western side seems to have been left largely unbuilt. In the eastern area on the other one large building was excavated. The area north of the fosse appears to have been most built up, since the archaeological evidence shows various elongated structures in this area. This pattern suggests that the flatter areas of the tell were probably chosen for construction, and that the *Dunnu* fortifications were deliberately placed a little off-centre on the hill, skirting the steeper slopes in the south and west. This serves the dual aim of defensibility of these directions and leaving more flat space in the north and east for construction or other social and economic activities.

The area in between the fosse and the fortification wall, called ‘extramural area’ in this dissertation, was also not built up everywhere, and again the focus lies on the eastern and northern sides. This was probably influenced by the same considerations as construction activity in the outer zone. The amount of space that was created between the fortifications and the fosse is also larger in the north and east, than in the south and west. Nonetheless, some excavated structures in the west, indicate that the narrower space here was not left unbuilt. Access to this zone was already much more highly limited due to physical barrier that the fosse created, with only one point where it could be crossed. We should however consider the possibility that also a crossing existed on the eastern side, as there are still some large unexcavated areas, and a crossing would make sense in view of the *Dunnu'*s connectivity with the surroundings, and presence of a very gentle slope here. But even if there was an additional crossing, access to this zone would be much more limited than to the outer zone.

The concentrical organisation is also retained in the intramural area, with a ring of buildings against the interior of the fortification wall, a ring of open spaces, and the inner core of the *Dunnu*, constituted by the two largest buildings: the residence and the tower. The exception to this pattern is the western side: the space between the fortification wall and residence is so narrow that this sequence of a building followed by open space could not be maintained here. The exception is probably caused by the insertion of a large architectural system that takes up all space and required a different approach to spatial organisation: the combined structures of the residence, gateway, large courtyard and related smaller spaces.

The concentrical organisation of the settlement, and the physical barriers that support it, must be viewed as a deliberate design that reflects some ideas of how the *Dunnu* was supposed to function. It implies the existence of graduated access zones, with fewer people being able to continue as one moves towards the core of the *Dunnu.* The first notable effect is that this makes the residence and tower the natural foci of the settlement, which must have had some implications on their status. This is corroborated by the size of these buildings, and other exceptional architectural characteristics. Second, their location in the centre makes them the least accessible and best secured elements. This implies that their function was considered paramount. Although no direct evidence exists to confirm this interpretation of these buildings, this is implied by contextual information. The cuneiform sources found on location clearly suggest the existence of a residential building, and in general its links to the main political figure in the area. Parallel to palaces of the time, the building functioned both as the place where the viceroy resided, and as a symbolic representation of the political power. The cuneiform tablets moreover reveal the importance of the agricultural production and storage. The vital importance of both buildings, economically and symbolically, justifies such a central and well secured location for these buildings.

A desire to control access is not only apparent from the concentrical organisation of space, but also from the specific designs of the access areas that controlled both movement and views. The early moat crossing is oriented along the axis of the northern fortification wall, which constrained people to move along this wall and limited their view on the main gate. It is possible that the other, likely later, crossing changed the situation, as it is placed parallel to the gate entry axis. However, the badly preserved structures on both sides of the moat near this crossing, may be tentatively interpreted as some kind of access and visibility controlling architecture. The spatial structures behind both gates reveal further access controlling measures. Both the main (new) gate and the postern gate have a system of strategically placed secondary and tertiary gates and spaces that controlled the direction of movement and limited views. It is interesting to note that this is also the case with the postern gate, implying there was by no means easy movement between the "potter's district" outside the walls and the inner *Dunnu*. The inner core and extramural areas were therefore strictly separated and did not have much functional overlap. The existence of different gates probably reflects a functional spatial segmentation of the inner *Dunnu*. The large main gate in the north gave access to the main administrative, political, and judicial *Dunnu*. It was probably also the gate through which all the agricultural revenue entered the *Dunnu,* was administrated, and moved to storage. The postern gate on the other hand, mostly served the *Dunnu* staff. Goods and people that entered through this gate must have been used to supply them, or their food procurement and preparation activities.

The accessibility of the intramural *Dunnu* is dictated by the presence of the two gates. As has been shown in this dissertation, both gates have their exclusive service zones. This is evident from the access pattern, and the probability of strong access control between the two halves of the *Dunnu*. Although the concentrical design, and theoretical possibility of a full circular movement would imply integration of the two halves, this was most likely not the case. Access between those parts was controlled through two points of passage, most likely closable doors or gates. This structure allowed for physical separation of functions of the *Dunnu* and ensured that visitors and staff did not need to interact unnecessarily.

The access situation was however not always the same, as the main gate was relocated at some point in time. This offers some interpretational challenges. The old main gate, although more heavily reinforced, seems to have a less optimised access control. It was oriented towards the tower, and gave direct access to it. People were not channelled past a large court with an administrative building and an additional gate, such as in the later situation. It is therefore possible that the old gate was a remnant of an earlier situation, in which the *Dunnu* may have been built for a different purpose. Considering the more heavily reinforced construction, this could have been more military or defensive. By adding the residence and administrative court, and the important functions that come with it, space needed to be organised differently for optimal functioning. As a result, the requirement for a new gate was also created. Although the existence of a different spatial design of the *Dunnu* in an earlier phase is implied by the existence of the old gate, the archaeological evidence is inconclusive. Although various tantalising clues in architectural plan and structure could be observed, indicating possible earlier versions of the plan, the early *Dunnu* cannot be reconstructed reliably.

Apart from a significant global access pattern, spatial subdivisions can be identified within the *Dunnu*. It has been shown in this dissertation that such spatial subdivisions overlap to large degree with structural subdivisions of the architecture, but not completely. Some structural subdivisions ("buildings") are integrated in larger local access structures. This suggests the presence of spatial subgroups consisting of multiple "buildings", at other times a single building. Clear examples of the latter are the residence and the tower. In these cases, the access pattern and structural entity completely overlap. But many structures are integrated in groups, which strings multiple inside and outside spaces together as functional groups. However, the identification of such groups is somewhat limited by uncertainties regarding the presence of doors. Nonetheless, the patterns are clear enough, and in combination with additional material evidence for activities and architectural features and character some suggestions can be made regarding their function and use.

VII.5.2 Material evidence for activities

The artefactual evidence for activities has been discussed in detail by Victor Klinkenberg in his dissertation (2016), and is used in this section to reflect on the architectural evidence. It is important to note that Klinkenberg focusses on the intramural distribution of artefacts of the latest *Dunnu* level only. References to distributions or finds elsewhere in the *Dunnu* or stratigraphy are based on my own observations, or previously published excavation reports by Akkermans.

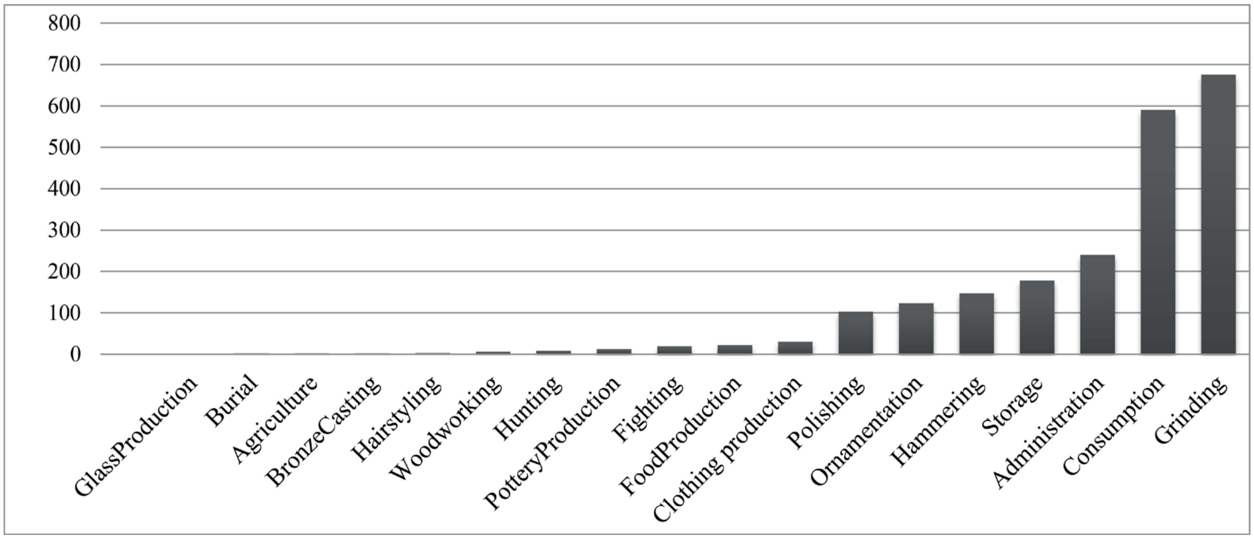


Figure 218. Statistical distribution of level 5 artefacts. Note that for some spaces, level 5 and 6 surfaces are continuously used (after Klinkenberg, 2016).

Klinkenberg defines various activity types, grouping them in larger categories such as subsistence, production processes, etc. Objects are classified according to shape, material and known interpretations and assigned one of these activity types. He then plots individual items on the plan of the *Dunnu.* This gives us both an indication of statistical distribution of artefacts related to certain activities, and their spatial distribution. Regarding statistics, the overwhelming majority of objects are related either to grinding (mortars, pestles, grinding slabs) and consumption (drinking cups, bowls). Storage (large vessels and constructed bins) and administration (tablets) follow, with some significant objects related to manufacture (polishing, ornamentation, and hammering) as well. We may expect that three factors explain the numerical distribution of evidence for various types of activities. These are for a large part low value item, less likely to be brought after abandonment or recovered. In addition, the picture is probably strongly biased due to high survivability of stone and ceramic artefacts, in relation to perishable evidence of activities (fabric, plants, wood). Finally, the actual numerical incidence of certain activities must have caused the pattern as well. For instance, the fact that spindle whorls and loom weights appear in such extremely low numbers, probably reflects the absence of a significant (domestic) yarn and fabric industry. It is clear that much is missing when we compare the results with the activities attested in the cuneiform tablets (discussed below). These for example allude to chariot manufacture and a leather or hide processing industry. No clear evidence has been found of these in the artefactual record.

Main category	Subcategory	Typical objects	Spatial distribution in level 5
Subsistence	Agriculture	Hoes, sickles	One hoe, one sickle in north-western corner
	Hunting	Sling missiles	Four items in south-western area
	Animal husbandry	Cuneiform tablets, faunal material	
Food preparation	Grinding and hammering	Grinding slabs, mortars, pestles	Concentrations in southern *Dunnu* outside of main buildings. Northern *Dunnu* sparser distribution.
	Baking and cooking	Ovens (*tannur)*, fireplaces, cooking pots	Clear concentrations of ovens and fireplaces in certain areas. Spatial focus on the southern *dunnu.*
	Beer brewing	Brewing vessels and strainers	Three confined areas in the north, east and south-east of *dunnu.*
Production processes	Pottery	Kilns, wasters, tool	Three "workshops": East, north and west. *Note:* these reflect *Dunnu* in a state after a functional shift of the architecture. The earlier workshops are all located outside the *Dunnu*
	Metal work	Bronze lumps and molds	Scattered with two possible small concentrations in south-east and south-west. No clear evidence of a workshop.
	Clothing	Loom weights, needles, spindle whorls	Very sparse. Two locations with more than one loom weight (4 and 8) on the same spot may indicate presence of loom.
	Stone working	Unfinished beads, flint and bronze cutting tools	Two locations. Workshop in extramural building west (level 6?). Tools and beads set in box in "kitchen", level 5.
	Wood working	Chisels, axes, adzes	Five objects in total.
Administration		Cuneiform tablets	Six marked clusters, five inside the fortifications, one east of the fortifications. Clusters are part of archives of various individuals: the steward, baker Paya, and a scribe.
War and peace		Arrow heads, spear heads, daggers, mace heads	Few scattered items, large areas without distribution. General predominance of northern half of *Dunnu.*
Storage		Jars, jar stoppers, pot stands	Various marked concentrations, suggesting the use of these rooms or areas for storage. Markedly not in large courtyards, gate areas and in residence.
		Bins	Strong predominance in southern half, and in main gate area. Gate presence differs from other storage objects. Not in large courtyards, residence and structures north-east.

Domestic life	Sleeping and living	Architectural type: formal apartments with private room and bathroom	Discussed in this thesis. Many other areas without clear specific function are identified by Klinkenberg as potential sleeping and living areas.
	Eating and drinking	Goblets, straws, jugs, bowls	Wide distribution, with exception of open spaces and some structures in north-east. High density at pottery workshops does not indicate use for consumption.
	Personal care	Combs, razors, tweezers	Just four items.
	Adornment	Beads, bracelets, pendants, rings	Scattered distribution, some small concentrations. Many spaces excluded. Absence in residence, large open areas. Relatively high incidence in tower.
Burial		Cremation and inhumation graves	Scattered distribution of a few burials. Level 5 only 3. Most date to earlier level 6. Underneath floors.

Table 10. Summary of artefactual evidence for activities in the Dunnu, as classified and identified by Klinkenberg (2015). *For the distribution maps, the reader should refer to Klinkenberg's work.*

When we turn to the spatial distribution of these activities, there are some patterns that appear, but also these may be strongly influenced by various other factors. One important one results from the fact that Klinkenberg focusses on the 'level 5' distribution of artefacts. Since this level both attests of the *Dunnu* in its latest phase, as well as its shift towards a different function, its final abandonment and its re-use, this is a mixed layer which may be hard to disentangle. Typical of this late phase are the presence of pottery workshops with kilns inside the fortified area of the *Dunnu*, in buildings that were clearly not build for this purpose. Other examples are the presence of mortars and pestles, and large amounts of barley inside the residence. Moreover, in the course of abandonment, the location of objects may have been meddled with, as is evidenced of various stockpiles of building materials, and scatters of cuneiform tablets. In other words, the spatial distributions of moveable artefacts in this level cannot be completely trusted. It is different for fixed artefacts such as ovens, cesspits and bins, although they may also have been constructed during the late use phase as well.

When confronting the mapped activities with architectural characteristics and configuration, the picture is diverse in terms of clarity. It is clear for instance that certain focused 'industrial' or productive activities related to baking, cooking and pottery production are associated with more irregular, open and lighter types of wall construction. These are explicitly not located in the heavier walled architecture build against the interior of the fortifications. How the latter architecture is used, remains somewhat unclear. It would be logical, for their ground floors at least, to be somehow included in the chain of activities related to food production in adjacent areas or spaces. This is indeed indicated by various of such places with high concentrations of objects related to grinding (grinding slabs, pestles) or storage (large vessels). On the other hand, both of the latter categories of objects are also found throughout the *Dunnu* within the lighter walled architecture. Should we therefore assume more of a continuum of usage of spaces, independent of architectural characteristics? Different locations of storage vessels, or grinding tools can also be explained by their place in the production chain: the difference between a spatial position practical for direct usage, or longer term storage. In that scenario, the usage of the ground floors of the heavier, darker, spatially less integrated architecture for longer term storage seems sensible. It is moreover interesting that most grinding tools have been found in what we expect to be interior spaces. This may suggest grinding activities primarily took place inside. We do however not know for certain whether their find location means they were stored here, or used here. Some of these are found in the fills of rooms, indicating they may have been originally located on the second floor or roof. Looking at architectural characteristics, such items are found in all kinds of buildings, except in the large open spaces and certain baking and cooking areas. This means that there is no propensity of grinding activities or tools storage to favour a type of building. Its presence or absence appears to be more related to its spatial position in relation to other activities. On the other hand, there are spaces where we would definitely not expect grinding tools to be present, such as in the residence. Its architectural features strongly point in the direction of an elite home. The grinding tools found there must therefore be seen as part of the post-*Dunnu* use phase. This pattern is typical for the level 5 phase, which is characterised by (at least) two use phases on the same floors, effectively creating a mixed pattern that is very hard to untangle.

Figure 219. Distribution of grinding tools in level 5 (after Klinkenberg, 2016, fig. 4.7).

There are other remarkable locations of artefacts, which could be functionally related to the architecture. For example, on three locations in the *Dunnu*, small clusters of items possibly associated with beer brewing (large vessels with a hole in the bottom and small strainers) have been found (Klinkenberg, 2016, p. 192). Two of these are found inside the heavier walled architecture next to the fortifications. This would suggest that part of the beer brewing process took place in these dark and less spatially integrated rooms, which makes sense for processes such as germination or fermentation. These processes require the brew to be left alone, and perform better under relatively “cool” circumstances of between 20 and 30 degrees Celsius. Outside temperatures in summer will often have topped this, especially in the sun. The large vessels with holes in the bottom probably are, analogue to the brewing experiments at tell Bazi, as “germination vats” (Duistermaat, 2007, p. 234; Zarnkow *et al.*, 2008, p. 73). Germination is at the very start at beer brewing, while fermentation, which would have taken place in regular large vessels, is one of the final stages of the process. Parts of the process that may require heating liquid (mashing) or heat drying would have certainly taken place elsewhere. The area of the northern brewing object concentration has easy access to the "kitchen" with stoves that can contain large vessels that would be an excellent location for mashing.[82] However, cold mashing techniques have been suggested to have been in use as well, based on archaeological evidence and experiment at tell Bazi (Zarnkow *et al.*, 2006, 2008). "Cold" mashing makes use of the soaring summer temperatures for stimulating the required enzyme activity. This, however, will only produce a beer very low in alcohol (1-2 %).

In general, there is no academic consensus about the beer brewing process in ancient Mesopotamia, and the interpretation of artefactual and textual evidence is wrought with difficulty (Zarnkow *et al.*, 2006; Damerow, 2012; Sallaberger, 2012; Paulette, 2024). Another aspect to consider is that breweries often functioned as taverns at the same time (Berger, 2012, chap. The fermenting vat inside a tavern in Mesopotamia.). This would turn the dark and cool germination and fermentation areas into more lively social spaces. The texts found at the *Dunnu* related to brewing hint at the presence of a "house of the brewer", which usually was both brewery and tavern (Wiggermann, 2010, p. 33). Moreover, the treaty between the *Dunnu* and the Suteans (T04-37) specifically stipulates that Suteans are not allowed to consume their beer at the brewery inside the *Dunnu*, but back at their tents, implying that others could drink their beer on location (Akkermans and Wiggermann, 2015, p. 119). The distribution pattern of objects possibly related to beer consumption (goblets, straws, filters, jugs) shows they appear in many places throughout the *Dunnu* (Klinkenberg, 2016, p. 215). Many such objects are however small, and the pattern could easily have been influenced by abandonment and post-abandonment processes. Klinkenberg (2016, pp. 192, 215) tentatively places the brewery and tavern in two adjacent but unconnected spaces north of the old gate. The location of a tavern in the space in front of old gate would spatially make sense, since it is at a dead end, somewhat away from the main circulation route. As this space was probably not roofed, but surrounded by high walls, it would have been an outside tavern with good lighting. If the brewery would have been located in the adjacent building, the tavern may have a had an outside and inside area. But this interpretation remains hypothetical.

The cuneiform tablet concentrations, indicative of administrative activities, also have a distinct spatial distribution (Figure 220). The presence of two administrative archives near the two gates, the main gate and the postern gate, in small buildings with a similar layout and is hardly likely coincidence. Both buildings have a movement controlling location in the plan of the *Dunnu*. People had to pass through or along the front entrance of these buildings. Moreover, as the contents of these archives point at daily administration of incoming goods and people, it appears that we are dealing with strategically located "offices". Although

[82] The heating of the mix of barley and water to stimulate enzymes that produce starch sugars. These are then converted by microorganisms into alcohol or lactic acids. This is the fermentation stage.

the offices have different structural properties in terms of plan and wall thickness, they have the same combination of spaces, a small room, a corridor and a bathroom, implying its use as apartment. Thus, the spatial type and function are not necessarily indicated by physical properties of the architecture itself.

Figure 220. Distribution of cuneiform tablets.

The ad-hoc correlations between certain activities and physical architectural properties could be improved by a sounder statistical approach. Nonetheless, the pattern is roughly clear in the sense that different forms of structures could have been used for the same type of activities. The patterning in object distributions, insofar they reflect activities, is probably more related to their spatial interrelations and general spatial organization of the settlement. The question then remains what the reason is behind the different shapes and sizes of various structures inside the *Dunnu*. The probable answer is that these were no primarily related to the uses of the building, but more to structural function and pragmatic spatial planning. This conclusion supports the hypothesis offered elsewhere that the main reason for differences in wall thickness is structural, i.e. building height. With regards to the second part of the conclusion, the different shapes and orientations of the architecture probably reflects the limited space available for building. A good example are the different apartments found in the *Dunnu*. They are clearly recognizable by the presence of bathrooms, connected to another room or set of rooms through a corridor. All are roughly based on the same spatial concept, but the physical properties of the architecture such as wall thickness, space dimensions and plan design, differ significantly. This most likely is to be explained by the factors mentioned above: structural architectural considerations (presence of second floor, height of ceilings) and pragmatic design within spatial limitations. One other factor must however be added, when it comes to explaining differences in size. Since there are no practical or structural reason for a variation in size of similar spatial structures, size is probably an expression of the social status of the users.

VII.5.3 Architectural facilitation of domestic and practical usage

Based on a preliminary analysis (VI.6), it seems that the *Dunnu* reveals quite some patterning that may be associated with a design that had to optimize day-to-day human activities. For instance, the entire settlement was structured in such way that most buildings had access to light and air by alternating open and roofed spaces in an optimal way. Since the limited space available within the walls of the *Dunnu*, this is indicative of careful planning. The differences of wall width between buildings moreover indicates that roof height varied, and that this may in fact have been used to allow for a better ventilated and lit upper floor. There is a distinct pattern of heavier architecture integrated on the interior fortification wall, and lighter architecture against the heavier architecture.

The absence of windows is another indication that the settlement may have had a vertical spatial organization as well. Although traditional rural buildings of recent date often feature no windows, the *Dunnu* is probably more akin an urban settlement due to its conglomeration of buildings, people and activities on a small area. The use of windows in Late Bronze Age urban settlements is well attested on depictions and architecture models of the time. The limited application of these windows to upper floors was probably just as common as it was in urban settlements until recently. The absence of windows in archaeological evidence in the *Dunnu*, therefore hints at their probable presence on the second or higher floors. This would be the case with all buildings with a domestic function on the second floor. The tower, with storage as a probable main function, is unlikely to have had windows. Also, even with windows, relatively little light would be able to make it inside the building, due to its 2 to 3 meters thick walls. The residence, for which it is likely that ground floor was used for habitation and human social activities, also has no windows in its walls. Only the main room of the "male wing" had abundant access to air and light due to the presence of additional doorways. It is therefore likely that in this building, clerestory windows were present high up its walls.

Rainwater expulsion and drainage also seems to have played a role in the localization of open spaces and walls. Floors appear are sometimes modified to ensure controlled flow-off. Certain open areas, for instance the elongated alley at the back of the large central buildings, probably formed natural shaped drainage channels on purpose. However, the picture as regards to drainage remains far from complete, and drainage features have not been found on various locations without roofs, where one would expect those. Also, currently, no proof has been found of examples of drainage out of the fortifications, apart from the sewer tubes attached to some toilets. A possibility is that rainwater was collected made possible by a roof water expulsion plan. Since gutters and gargoyles are common features of recent traditional mud brick architecture, such elements may certainly be projected on the reconstruction of the *Dunnu*.

Another way architecture supports functions in a very fundamental way is floor construction. In the *Dunnu* floors were constructed of rammed earth, rammed earth reinforced with pebbles and sherds, rammed earth with a top layer of white plaster, mud brick, and finally fired brick. These reflect different uses of the associated spaces. Fired brick was used in the two courtyards in front of the residence for a large part symbolically, as reflection of special status of this area. But it will also have created a floor that is easier to clean, control water flow off, and still usable during rainfall. In addition, fired brick floors and plinths are used in bathrooms with bitumen sealant for obvious reasons. Pebble and sherd reinforced floors also improve drainage, and create a more resilient and load resistant surface. It is found on certain places which possibly have high intensity usage, possibly in combination with liquids such as in cooking, butchering or possibly beer production zones. In space NW-1b next to the residence, the presence of such a floor is part of the proof that this area was used as stables. Floors with a top layer of white plaster are rare, and interestingly found in the tower only in its earliest phase. For the later phase they are also located in the area of the main gates, and in one room of the residence. Again, it seems to reflect some symbolical usage. Floors made of mud brick are the most elusive in terms of meaning or purpose. Since the smaller backside rooms of the tower contain mud brick floors, it seems that it may have some relation to storage. Special floors designed for storage facilities elsewhere often have fired brick floors suspended on sleeper walls in order to prevent moisture creep. No such floors occur in the *Dunnu*. Nonetheless, the specific and limited application of mud brick floors must have a practical purpose. If their function is related to storage, that has some interesting repercussions on certain other mud brick floor found outside the tower. Room NW-3b in the “office” building, could therefore be a preliminary storage facility rather than the space where the official was housed. Its tiny doorway does also seems to suggest this. Room NE-3b the north-eastern sector has a very large mud brick floor in its oldest phase. If this was indeed a storage facility originally, it was very large. In that case, it may have functioned as main grain storage before the expansion of the tower. Like the tower, it has a large staircase, hypothetically allowing workers to dump grains from above into a huge silo. It was later turned into a domestic area, an apartment or communal space with access to a bathroom instead of stairways.

VII.5.4 Defensive qualities

The defensive qualities of the *Dunnu* architecture have been discussed in detail in section VI.11. The most outstanding features are its location on the summit of a tell, the fosse also known as dry moat, and an inner core with a 2 to 3 meters wide fortification wall, with a reconstructed height of about 6 meters. Such fortifications do not stand lengthy sieges as they are easily undermined or scaled. Nonetheless, there are various protruding features, that would potentially allow for firing control over the lower walls. On the other hand, the absence of clear, consistent evidence for corner towers, indicate that fire control was not a priority. However, we should take into account the possibility that Bronze Age fortification towers had elevated platforms that allowed defenders further reach and defend the foot of the walls against potential attackers that may attempt to breach or scale the walls.

Although strict defensibility against armed attackers may or may not have been a concern for the builders of the *Dunnu*, a certain degree of security clearly was. The architecture was used to ensure control over access and internal visibility, as has been discussed above. The concentrical organization of the main defensive features, and the use of smart access control at the gates point at a high concern for security. This is well in line with the historical information on the security situation in the region at the time (see II.8). The "enemies of the state" were potentially many, and above all, the harvest had to be secured.

The fortification architecture was, like the rest of the *Dunnu*, not a static phenomenon. There were various adaptations. If we look at the structural properties of these adaptations (i.e. wall width), it shows that security or defensibility did not become a lesser concern over time. Nonetheless, one of the most remarkable features of this change is the replacement of the old gate with a new gate, which was a less heavy construction. Whether this points at a potentially more 'military' character of the earlier *Dunnu,* or was simply allowed for by the smarter access control after the gate passage, remains a question.

At some point in time, the entire maintenance of the defensive features was abandoned. The fosse filled up, and walls were left to decay. The decaying walls clearly date to a period of decline, the so-called post-*Dunnu* phase. However, the timing of the filling up of the fosse remains uncertain. By the stacking of many medium thick layers of sediments, it is clear that this was a gradual process. According to the views of the archaeologists of the site, this was a process mostly fueled by thrash disposal, that started immediately after construction and was completed during level 5. Some architecture that is constructed on top of the filled-up fosse, is allocated to that level. However, it has been made clear in this dissertation that stratigraphic links are often unreliable, and site-wide levels that represent a contemporaneous use phase are hard to detect. Moreover, even if the filling was completed at some point during the main phase of the *Dunnu*, it is uncertain when exactly maintenance and regular clearing out of the fosse was quit. It is possible that it was kept open for an extended period before it was left to fill up. Ending maintenance of this defensive feature would imply a change in focus and ideas about the main functions of the *Dunnu*.

VII.6 Synthesis

Based on the material evidence for activities, the structural and spatial characteristics of buildings and spaces, and the activities known from the cuneiform sources, a model of functions of specific buildings can be deduced with varying degrees of certainty. With regards to the activities referred to in the cuneiform sources, these have been summarized in paragraph III.7. Opposed to the direct evidence we may derive from the architecture or artefact distributions, for which we have a concrete location but some uncertainty about the interpretation, the activities mentioned in the sources are well described but have not spatial component. Important functions or activities that the *Dunnu* administration had to make place for were: administrating incoming and outgoing harvest and goods, bulk storage of barley, chariot production, organized social occasions for larger groups, house an estimated 60 people (Wiggermann, 2000), and various animals such as horses, ostriches and possibly cattle.

As has been concluded above, the access pattern of the intramural area indicates a spatial division of two sides, related to the two gates. The north-western side may be characterized based on architectural characteristics and projected usage, as the *Dunnu*'s 'official, administrative, and representative' side. The other side, including much of the eastern and southern *Dunnu*, on the other hand, may be characterized as the more 'domestic' and 'productive' side.

VII.6.1 North-western sector: administration and representation

The western side, in direct access relation with the main gate, is focused around a large, paved courtyard. Before entering this court, visitors would pass through the large gate room that contained bins used for temporary storage for incoming goods, or perhaps more likely as animal throughs. If correct, this large space would have served as waiting area before entering the paved court, which makes the presence of toilet facilities on the western end a useful addition[83]. Passing through the secondary gate into a large court, with a tile pavement and walls with red and white render. Within the context of the *Dunnu*, these architectural features are exceptional, symbolically underlining the importance of this courtyard. Immediately after passing into the courtyard, one would see on the right-hand side the arched doorway of a small building with a single room, a corridor and bathroom. The room with its mud brick pavement and extremely low

[83] Although in the view of Wiggermann (pers. Comm.), these may have been the guard's exclusive bathroom.

entrance, has more the appearance of a storeroom than the private quarters of the main administrator. Nonetheless, its spatial layout is typical of an apartment. Although a second floor is likely from a constructional perspective, no stairs have preserved. The possibility of wooden stairs in the small room, or on the exterior of the building should not be excluded. Due to its position, the entrance of the building-controlled traffic entering the paved court. The presence of the tablet archive of the steward in this building, even though it was found in a secondary deposit, indicates that it was most likely the office of this senior administrator. So in, or in front of this office in the large courtyard, would be the location where business transactions and the agricultural economy was administrated. Following Klinkenberg (2016), a concentration of seals could indicate that the sealing of goods may have taken place on the courtyard as well. It is possible that brought in goods were moved to temporary storage on location. One of the rooms of the "office", with a tiny entrance and mud brick floor, may have been used as a silo. Alternatively, incoming goods and harvested crops could be transferred to the storerooms in the tower. This building was easily accessible through a gate on the eastern side of the large courtyard. In theory, no-one, except for *Dunnu* staff responsible for the storage facilities, would need to pass through this gate. However, the inner *Dunnu* may have been more permeable for outsiders, as is indicated by the presence of an occasional feast and possibly a brewery and inn. With regards to trade goods that are on transit to Aššur, there is evidence in one text for the need of sealing those goods (see III.7.8), on which the interpretation of the *Dunnu* functioning as customs post is based. The question is whether such goods were also administered at the courtyard, or that they were kept outside the *Dunnu* near to the caravan. On the other hand, in the case of valuable goods, the safest location would be withing the walled precinct. The merchants themselves may have stayed elsewhere in that case.

Directly across the gate that gave entry to the main court, a large building would immediately catch the eye of the visitor, as it is visually dominating the courtyard. The residence would have been the political and symbolic centre of power, both representing the central authorities in Assur and the Grand-Vizier, who possessed the *Dunnu* privately and had full control. Although the residence contains very little artefacts related to its original use, its architectural structure is quite clear. It had room for a paved court, a large room in the center, and for two series of rooms that may be characterized as "en suite apartments". Since there are small, but significant differences in spatial integration, size and architectural finishing between the two apartments, it is very tempting to interpret these as the premises of the grand-vizier and his wife. The main reception room of the larger apartment also had direct access to the courtyard, while the main reception room of the smaller apartment did not. This is a significant difference, indicating that these similar rooms had a different social role to support. A large central room, or 'hall', would moreover be an obvious location for the "dinners" organized by the Grand-Vizier that the texts allude to (Wiggermann, 2010, p. 21). More details about a similar dinner organized at another *Dunnu,* also appear in one text found at tell Sabi

Abyad (97-23). An Assyrian general known as Mudammeq-Assur throws a dinner party for Suteans, the local nomadic people that were both ally and enemy to the Assyrians. It is clear therefore that these dinners would have had a political and social dimension and played an important role in the consolidation of power and control. As a side note, it is interesting that Mudammeq-Assur relies on potters and beer brewers at the *Dunnu* of tell Sabi Abyad, to supply for the feast at his own *Dunnu*. It is possible that the residence's kitchen was located south-west of it just outside the walls. An area with stoves or ovens, and bins is most likely related to food preparation. This food could be brought into the residence by a small service door in the western exterior wall. Although excavation reports indicate that this is a later entrance, cut into the residence's wall, it seems more likely that it was always intended to be there. In addition to the food preparation area, it gave access to a large, elongated space with evidence for spatial compartmentalisation and a pebble reinforced surface. Due to these features, in addition to having a direct access to the main court as well as the main reception room of the residence, this space has been tentatively suggested, for the first time in this dissertation, to have been the residence's stables.

VII.6.2 Towards the eastern *Dunnu*

The eastern side, also including much of the south, on the other hand, could be characterized as the more "domestic" and "productive" side of the *Dunnu*. The eastern gate of the paved courtyard was the only means the two halves communicated, indicating that some control existed. Although in terms of access, this area is an integrated whole connected through a continuous string of open spaces without obvious locations for gates, and we can identify various smaller units. As has been argued previously, the spatial identification of such units has no perfect overlap with what we could identify as structural units ("buildings"). That means that in some cases, multiple grouped buildings could have functioned, at least spatially, as single units. On a larger scale, this side of the *Dunnu* can be spatially divided into two parts: the north-eastern sector, and the south-eastern/southern sector. They are separated from each other by a large open space east of the tower. This is an interesting space, that is functionally not well understood, nor has it been excavated to the earliest layers. Nonetheless, this large open space with irregular layout must have been a courtyard. It could have been used for social gatherings as well as economic activities that take up space.

VII.6.3 North-eastern sector: shifting functions

The functions of the north-eastern sector remain somewhat elusive. It saw intense modification over the lifetime of the *Dunnu*, indicating a significant functional shift. It originally housed a large mud brick covered space with multiple arched doorways and access to a stairway. In the absence of any other explanation for the particular use of mud brick floors in certain spaces, it may have been used as store room, a grain silo perhaps. It is possible that it connected to an even much larger building that ran up till the elder gate, that was in function at this time as main gate. The "kitchen" structure was not constructed yet, although we do not know what preceded it as excavation did not reach these levels unfortunately. The structure with the mud brick floor and stairways was later partially demolished and replaced by a large room with access to a bathroom in the place of the stairways. Together with evidence of the presence of a loom, this could indicate the domestic function of this space. Its size relative to the surface area of the entire *Dunnu* would imply the person making use of this area, had a high social status. But considering its size and absence of further elaboration suggesting status, it could also have been a place for larger social group occasions or activities. There may be a relation with the fact that in the same phase a "kitchen" structure was added nearby. In addition, in some structures to the north, a brewery has been tentatively located. The question that remains: who made use of these facilities? The *Dunnu* staff, or the many temporary visitors this place would have had to host on occasion? It is also possible, and quite likely, that *Dunnu* staff cooked for themselves near to their small living units in the southern *Dunnu*. We should also consider the options that a possible second floor gave. The heavy walls of the structures in this area either suggest buildings with high ceilings, and with multiple storeys. However, since the staircase is removed at some point, it seems that the upper floor was not that important for daily use. This would support the hypothesis that room NE-3b was in fact the early granary, and that this function was moved to the tower in a later phase. At the time of the removal of the staircase, the fortifications in this corner were in fact expanded. It is remarkable that the new interior space created by this expansion was not even accessible from the interior of the *Dunnu*, although it is a sizable area. The function of the expansion was therefore either structural, to counter structural problems of this corner, or spatial, to increase surface area at the upper floor. The latter seems more plausible when considering the characteristics of the construction. The new structures would have mainly functioned to create a larger surface area on the level of the battlements, that would only have been accessible through a walkway that ran across the top of the ring wall (see fortification reconstruction). Therefore, although this area on top is structurally part of the ground floor in the north-eastern corner, in terms of access, it is spatially separate.

VII.6.4 South-eastern sector: postern gate administration

Across the large eastern courtyard to the south, we find various structures related to the postern gate access area. This is an area that also saw significant modifications. An earlier situation was excavated here, showing some light-walled rectangular structures reminiscent of those found in the southern *Dunnu*. These may have been domestic structures, spatially and functionally unconnected to the postern gate. This situation changes after the modification. In general, the postern gate seems to be more secure than the main gate, in the sense that more additional spaces and passages with turns had to be taken before being able to enter the inner *Dunnu*. In the early phase, the final gate was located all the way across a long vestibule like space that mimics the one near the new main gate. However, a small building is controlling this access point at the north end of this large space. The small building is a double room structure, with access to a corridor that may originally have connected to a bathroom. The evidence regarding the latter is slim, as it was demolished during the modification, but the corridor system with a 90-degree turn, ending at the remains of a baked tile floor seems to suggest this. Again, this appears to mimic the situation near the new gate, where a small building with access to a bathroom has strong physical and visual control over any traffic coming in. Possibly, during the old phase, a kind of 'office' may have been located at the far end of the vestibule. All physical evidence of administrative activity would have been removed during the constructional overhaul of the area . During this modification, a large part of the architecture was demolished, and a formerly terraced area was made a single level by dumping demolition debris. The formerly 'domestic' structures were replaced by a new building that included a small apartment with courtyard and toilet facilities. The old gate from the vestibule to the *Dunnu* interior was blocked, and a new one was created in a wall rebuild on exactly the same place, that forced people to pass through a tiny inner courtyard space controlled by the building just described. The presence of a discarded, scattered tablet archive makes the identification of this building as administrative building more convincing. In other words, the entire location and focus of control and administration was moved. The plan of this new building, with the curious corridor around the private rooms in the centre may be the result of juggling with the available space within the confines of the walled precinct. Much of the material evidence of the actual use of these spaces (the office building, its courtyard, and the vestibule) shows that the entire area was re-used as potter's workshop. As this clearly represents re-use of structures, this workshop reflects the end of the *Dunnu's* controlling and administrative functions. This is just one of the many cases in which the material evidence for activities reflects a late phase, which is not representative of the *Dunnu's* original purpose of the architectural design.

A last interesting change in this area is the demolition of the building formerly identified as possible administrative building and its replacement by a large single room structure that gave access to a new staircase constructed on the exterior of the fortifications, parallel to the wall. It must be emphasized that due to the modified access situation, this staircase was not accessible from the vestibule, as it was before. Access to the staircase was limited to those that were allowed to pass through the checks that the administrative building may have instated. The construction of this staircase may be tentatively linked to the demolition of a same type of staircase (9 meters long, parallel to the exterior of the fortifications) in the north-eastern sector, described above. As has been described in the section on defensive qualities, the limited number of points required for access to the battlements is remarkable and points at architecture with some, but relatively little concern for defensibility.

VII.6.5 The southern *Dunnu:* food production and domestic

The entire southern zone of the *Dunnu* constitutes one sector. It connects to the rest of the *Dunnu* by means of a narrow alley, with structures lined up alongside it. They all have opening towards the alley. Several spatial units can be identified, that include multiple smaller spaces. Interestingly, the alley has a couple of side passages, short connecting alleys that run up to structures near to the fortifications. There is a distinct difference between structures with walls a single mud brick thick, those with one and a half and finally those with two mud brick wide walls. The difference likely points at the difference between roofed and unroofed spaces, and structures with a single or multiple floors. The result is in effect a variety of roof heights, that may have been a conscious design choice. In the area where lighter walled structures were constructed against the heavier walled buildings integrated with the fortifications, the roofing situation was stepped. As has been argued, this is reminiscent of stepped domestic architecture seen in depictions and ceramic house models. It had the concrete aim, of creating a well-lit and ventilated area used for habitation, on top of a more utilitarian area used for storage and economic activities. Although it is possible that the referred buildings were used as such in the *Dunnu*, this remains hard to proof. Klinkenberg (2016, pp. 211–220) classifies many of these structures as possibly domestic, largely based on their architectural characteristics.

Although the evidence is difficult to interpret, there is ample evidence for food processing, storage and consumption. It is possible therefore that these structures had both a domestic function, as well as storage and functions related to food production. We can expand on Klinkenberg's hypothesis by suggesting there was some vertical organisation of activities as well, using the second floor. Hence there may have been a separation between economic or subsistence activities located on ground floor, and habitation on the upper floors. On the other hand, strict separation of work and private may not have been a luxury that most *Dunnu* staff would have been allowed. One space more can be more concretely identified as the private quarters of the baker Paja. As this person was a relatively major individual who kept his own written archive, and had probably various staff working for him, private quarters are more likely assigned to him. Perhaps not coincidentally, the building with his archive probably had a staircase on its exterior. Some distance away from the bakers possible private quarters, nearing the south-western corner of the *Dunnu*, the presence of numerous bread ovens clearly indicates the use of a cluster of spaces as "bakery". The light walled and somewhat irregularly placed structures in the south-western corner, were probably uncovered, which appears sensible for an area used for a smoke producing activity. But ovens, often of a different type, are also found in roofed spaces with heavier walls a little to the east of the bakery. All the way in the south-western corner, another heavier walled structure is located, that appears to have held another part of the baker's administration. Hence, bread baking, grains processing and possibly beer production were the main activities employed in the south covering most of the area. At the same time, it seems that it may have been integrated with regular domestic uses.

There are indications that in an earlier phase of the *Dunnu*, the south was used in a different way. Underneath the structures, some remnants of other structures and features are found. This seems to correspond to a phase that also the residence was not constructed yet, underneath which there is also evidence of some kind of pre-architectural phase. This may have been the phase during which the old gate was in function, and the general purpose of the *Dunnu* was different than it became later. Or, if it did roughly correspond in functions of the later phase, their spatial organization was different, and clearly with less interior architecture to support it. In general, however, it is surprising how stable the usage of the architecture in the south appears to have been over the entire existence of the *Dunnu* in comparison to other areas that saw significant architectural modifications reflecting deliberate functional repurposing. To this important insight, we will return below.

VII.6.6 The granary

The bulk storage of barley is one of the key functions of the *Dunnu* (Wiggermann, 2000). No irrefutable evidence for a large granary has been found, but when one considers all the possible places, there is just one likely candidate. As has been stated several times before in this dissertation, the large heavy walled building in the center of the *Dunnu* ticks nearly all the boxes. It is structurally sound, suited for heavy loads, well secured, and easily accessible from the main court. Moreover, its location in the center symbolically reinforces the primary role of the *Dunnu* as center of an agricultural estate, and the central position of barley production. There remain some questions regarding its functioning as grain storage. Ancient depictions of granaries from Egypt, Palestine and Southern Mesopotamia always display domed silos (Currid, 1986; Paulette, 2015). Grains are dropped into an opening in the top, and removed through a hatch in the bottom. Archaeological evidence is more diverse, although often the interpretation of small square spaces in larger heavy walled buildings as grain silos is difficult to prove. When it is clear, elevated floor constructions are used with sleeper walls as support, creating a damp proof and aerated middle floor. It is interesting to note that some of the tower's eldest ground floor rooms, possess mud brick floors (Klinkenberg and Lanjouw, 2015). However, the degree to which mud brick floors without suspension may serve as damp proof is debatable. It is common for granaries to function with addition to the top, and extraction of grain at the bottom. In European historical granaries with multiple floors, a chute is connected to the upper floor that allows easy movement of grains downwards. The grain silos known from ancient depictions, simply have an opening near the bottom of the structure, while grains are added through an opening in the top. However, the requirement of such a 'grain tap' near the bottom, is not very strict. Medieval grain silos in northern Africa, built by Berber communities, are multistoried constructions with small stairways often leading up three or four floors[84]. They do have in common with the iconographic examples that they had vaulted roof and ceiling construction are employed for them. Considering the evidence for use of the ground floor rooms (Klinkenberg and Lanjouw, 2015), it is likely that most barley was stored at the second and possibly third floors. However, the rooms with mud brick floors and small doorways, may have been filled from the upper floors, while grain was extracted at the bottom. Interesting in this respect is also the evidence for use of room 1 of the tower, which contains in different phases a large basin. While ceramic vessels commonly understood to be grain measures were also found here. Could such a basin be located underneath the opening of a chute? And could this room have been used to measure and or distribute grain rations?

VII.6.7 Extramural *Dunnu* north: facilities for hosting external people and animals?

Although this dissertation focused on the analysis of the structures withing the walled precinct, a large part of the *Dunnu* was located outside its walls. As this area has not been included in Klinkenbergs analysis of spatial distributions of artefacts, the evidence concerning their use is less well documented. Nonetheless, there is something to say about the potential role of these structures in the functioning of the *Dunnu*. Most of this architecture is found north and east of the *Dunnu*, not coincidentally on the sides that the gates to the inner *Dunnu* are present. Along the entire northern face of the fortifications, relatively heavy structures are located with 2, 2.5 or even locally 3 mud brick wide walls, possibly indicating the presence of multistoried buildings. Between the fortification wall in the north and the fosse, various structures are located that may be related to animal rearing, possibly pens and stables. But a substantial number of ovens are also located here, which would indicate other uses as well. All of these structures are demolished when the northern fortifications of the *Dunnu* are expanded. Hence, they are supposed to have functioned during the old gate phase. The structures north of the fosse may therefore have replaced their function, although about their chronological relation cannot be established based on stratigraphic data.

North of the fosse, the entire area was build-up with buildings following the same orientation, possibly all sharing two long west-east running walls. In the north-western corner, the structures are also running in a southern orientation up till the edge of the fosse, which must be somehow related to the crossing located here in the new gate phase. Most of the other buildings have a relatively large, long spaces with as said up to 2.5 mud brick wide walls, indicating a good possibility of a second floor, or these spaces had very high ceilings. The buildings north of the fortifications are distinctly different from those located just outside the eastern fortification wall: the architecture is heavier and spaces are larger. In the absence of other good evidence for their use, it seems that we may at least conclude they did probably not have a function in some

[84] The width and height of these rooms is approximately 2 meters, while their depth ranges up to 10 meters.

kind of industrial activity, such as pottery production. We could project some uses from what is known from the textual sources, for instance activities related to trade or traders or the military. Hence, a place that could have acted as caravanserai and or barracks. It could have also included a location for the administration of goods that were shipped further into the direction of Assur (see III.7.8, VII.6.1).

VII.6.8 Extramural *Dunnu* east: the potter's district

The area in between the fortifications and the fosse on the eastern side of the *Dunnu* is characterized by an extensive area of structures, both enclosed courtyards as well as roofed buildings. Considering the difference in wall width between the longitudinal (1.5 to 2 bricks) and lateral walls of these structures, it seems that these structures were built for supporting a live load. It therefore seems the roofs were intended to be used in the spatial distribution of activities in this area. Various fragmentarily preserved parallel walls positioned close together, possibly indicate the presence of stairs. The walled structures are structurally and spatially integrated, indicating they were part of a single planned building event. At least three pottery kilns were located here, equally distributed over the area. Each kiln is spatially integrated with a group of connected spaces, possibly indicating the presence of three separately operating workshops. The southern end is a projection, as only the remnants of a few structures preserve, including the kiln, but it must extend further south. In the northern end of the potter's district one additional spatially defined group of spaces is visible. No kiln is associated with it, but the area is incompletely excavated. Smaller fire features and bins varying in size, and a gulley shaped by regular water drainage into the fosse may indicate a more varied assembly of activities than just potting. It is however unclear whether the ovens were used domestically, or industrially. It would be no surprise if the potter's families lived here in these structures as well.

The potter's district is at some point completely razed and levelled. New structures were built on top, but due to limited preservation, it cannot be established what their extent was. Nonetheless, the complete demolition followed by structures on different locations, and of different size, clearly indicates an important functional shift. One important cuneiform archive was buried underneath the demolition debris. This is interpreted as 'a discarded' archive, implying it was buried in a place different from where it was used. Interestingly, its final dates correspond to the archives found elsewhere in the *Dunnu*, indicating that the razing of the potter's district probably corresponds to the interior restructuring of the *Dunnu*. During this phase, potter's activity moved into the walled precinct replacing previous functions, reflecting the demise of the administrative and political importance of the *Dunnu*.

Across the fosse to the east, an apparently unrelated building facing the potter's district was located. No crossing was identified here, so it is clearly spatially separated from the rest of the *Dunnu*. However, the possibility of existence of an unknown crossing cannot be excluded due to the limits of the extent of archaeological investigations. It had rooms of various sizes, accessible from a central space that may have been a courtyard. Although the building does not entirely enclose this courtyard, the western side of the courtyard area is limited by the fosse. It had heavy 2 to 2.5 brick wide walls, suited for at least two storeys, or a very high ceiling. A possible location for the staircase may be identified on the south side of the courtyard, where two parallel walls are located. Like the structures north of the fosse, the function of this building remains elusive. Since it is located outside the defended area enclosed by the fosse, it could have played a role in the dealing with or housing externals.

VII.6.9 Extramural *Dunnu* west: a bead workshop

The extramural area directly west of the *Dunnu* has been excavated incompletely. Nonetheless, two relatively complete structures were brought to light, one with architectural indications of roof top access by stairs. Evidence of decorative bead production has been found here, thus possibly indicating the presence of a bead workshop. These structures appear to have been razed as well, and overbuilt with different, new structures possibly indicating functional changes.

VIII. Conclusion

VIII.1 Answer to the research question

What does the nature of the built environment of the Dunnu, and changes therein, say about the relation between people and built environment, and the purpose and functioning of the complex?

If we trust the written sources, the *Dunnu* was a relatively short-lived settlement. Only 50 years passed between its probable foundation date by grand vizier and king of Hanigalbat, Aššur Idin, around 1230 BCE and its end during the reign of his son, Ilī Padâ, around 1180 BCE. This is the period during which we may assume that the *Dunnu* proper, functioned, i.e. the *Dunnu* with its high stature economic, political and administrative functions, in service of the grand vizier, and through him Aššur. As a settlement, it is likely that the *Dunnu* existed in some form before the advent of an administration, and also after. The latter is clear from the evidence, as building phases and human activity continues stratigraphically far beyond the main contexts with the buried writing tablets. Whether phases of architectural and other types of activity also extended in the other direction of time, is harder to tell. The evidence of a Mitanni phase, is difficult to assess with the few available pottery sherds, and the fuzzy boundaries between pottery traditions. The excavators have suggested that a single structure belonged to this phase, the predecessor building of the tower. However, if this building is not Mitanni in date, but Assyrian, it puts the early Assyrian presence in an interesting light, as it would indicate a much smaller early *Dunnu*. Conversely, if the early Mitanni phase extended beyond the tower, and also included the old phases of the fortifications, the real 'Assyrian' phase would only start after the large-scale renovations that moved the main fortifications. Considering the evidence, the latter is less likely, but it reveals some real problem with establishing the nature of the earliest settlement and its origins. However, that there was an early and a late version of the fortifications is a fact. One of the most significant modifications in the history of the *Dunnu* was the change of the location of the main gate, which modified the *Dunnu's* access structure and created a spatial division between east and west. Due to difficulties with stratigraphy, phases of building and demolition activity, the plan belonging to the old gate phase is far from clear. On the other hand, we have a reasonably well-preserved plan from the latest phase of the *Dunnu*, before it went into decline.

What the historical significance of this transition is, is debatable. As said, it could be that the old gate phase belonged to a Mitanni settlement, and the new gate phase reflects the transition to Assyrian power. On the other hand, the argument can be made that the division between old and new gate phase, reflects the transition of power from Aššur Idin to his son Ilī Padâ, with a brief "in-between-phase" when Shulmānu-Mušabši reigned for three years. This is what the archaeologists who excavated the *Dunnu* opted for

(Akkermans and Wiggermann, 2015). The statement "*when Ilī-padâ and his chariots returned to the fortresses*" found on one of the tablets dating to this power transition (T93-10), is used in support of this view. When Ilī-padâ returned, he started a building restoration campaign, sparking the renovation building activities at the *Dunnu*, it is assumed. We must however emphasize that this still remains a historical and archaeological hypothesis, rather than fact. As is common archaeological wisdom, one should be careful in projecting historical episodes on settlement construction history. Other factors, and other undocumented events, may have instigated renovation and modification. The detailed reassessment of architectural contexts executed as part of this dissertation, can also not conclusively answer the question.

However, other valuable insights were acquired. One thing that has become clear from the investigation of rebuilding activities, is that they correspond to a clear functional change of the affected area. Either the access structure was modified, or areas were repurposed, asking for different structural solutions. Such rebuilding events were preceded by controlled demolition, preserving some of the previous phase due to demolition debris deposition. It is important to emphasize that because of the localised nature if these construction events, and their clear functional cause, these events do not necessarily represent a renovation of dilapidated architecture, as is often suggested in the excavation reports. Other architecture, also with supposedly more "fragile" 1 or 1.5 brick walls, remained in place for the entire duration of the existence of the *Dunnu*.

This leads to the second insight with regards to architectural development of the *Dunnu*. If certain areas remained more or less the same, while others were modified, why is it justified to draw an arbitrary line between building level 6 and building level 5 for the entire settlement? Within buildings and open spaces, the succession of floors also does not always justify such a difference. The picture with regards to floors is varied, and in addition also suffers from some misinterpretations in the field. Multilayered single floor constructions, with a foundation layer and a top layer, were occasionally taken to be different floor levels, i.e. "building phases" for instance. In another example, the top of demolition debris fills, transitioning to levelling fills, often forming temporary surfaces, were sometimes interpreted to be floor levels. But also if we exclude such interpretative errors, there are areas that clearly have a single floor or a continuous stacking of floor levels, in outside areas due to sediment accumulation, all indicating continuous usage. There is no evidence for a phase of increased sedimentation, commonly associated with building dilapidation, in between the supposed levels 6 and 5. There is evidence for this process however, much later, at the transition between levels 5 and 4. Now it is clear that sedimentation rate rapidly increases, suggesting a phase of (partial) abandonment and a different cleaning and building repair regime.

If we cannot make out a clear division between building levels 6 and 5, does this mean construction occurred more organically, or haphazardly, responding to certain new needs and events? This is not necessarily the case. The change from old gate to new gate, and all it does to the global access plan of the *Dunnu* still suggests some kind of single large event that allows us to talk about two significant phases: the old gate phase and the new gate phase. But to what extent was this modification contemporaneous with the other large modifications of the *Dunnu*? Very little can be stated with certainty as most building events occur in stratigraphically isolated areas. That means one construction event in one larger area cannot be securely linked to others in other areas. Some tentative suggestions can be made. For instance, the relocation of the main gate, may very well be contemporaneous with the modification of the access structure at the postern gate. They may be viewed as parts of a larger plan to change the organisation of access to the *Dunnu*. At the same time, the modifications in the area of the postern gate included the addition of a staircase, which may be tentatively linked to the removal of a similar staircase in the north-eastern corner. The removal of this staircase and its replacement by a bathroom reflects a larger functional change in this corner of the *Dunnu*. The large-scale modification of the northern side of the tower on the other hand cannot be linked in functional terms the same way. However, in this case it is stratigraphically plausible to assume this was an earlier renovation, closer to the construction of the old gate. As this renovation in turn is also linked to the construction of the residence, we must assume the existence of the residence before the new gate. This in turn causes a watershed of issues regarding the spatial functioning of the large courtyard, which appears to have been organised exactly with the new gate in mind. Hence, we must assume a different spatial organisation of activities, such as administration of incoming goods and livestock and the movement of associated people, that we can at the moment just not pinpoint precisely. Another option is to assume that the renovation of the tower occurred at the end of the use-phase of the old gate, and that this event was in fact contemporaneous with the other named construction events related to the construction of the new gate. In that case, the new gate and the residence are part of a single construction plan, which would make sense from the point of view of conceptual building type and architectural performance. This would however imply that the old gate phase was much more different than we previously thought, and that the plan of the *Dunnu* still holds some unexcavated secrets.

Regardless all these difficulties of architecture phasing, from a birds-eye perspective, it seems that the *Dunnu* was modified in a few larger constructional events that target a certain area of the *Dunnu* at once. There are even some indications that some of these larger interventions are related and contemporaneous, i.e. part of a single larger modification. Small-scale modifications to individual buildings on the other hand are very limited. In certain cases, some local reinforcements or blockings seem necessary to prevent waste spill and erosion caused by rainwater flows. Internal restructuring of buildings is very rare, and only occur in a single room of the residence (a doorway was blocked), and in the tower (the internal access plan was modified, and in two rooms with a divider wall the compartments were joined). However, the latter was probably part of a larger renovation event that targeted this entire building and should therefore not considered “a small intervention”. Many small adjustments to the architecture (blocking of doorways, sectioning of spaces) appear to have been made after the main *Dunnu* phase ended. During this aftermath, some functional shifts, such as the relocation of pottery workshop inside the walled precinct, and the use of the residence as a barn (possibly), indicate that the original *Dunnu* did not function anymore. The repurposing went hand in hand with some localised modifications of the plan. A good argument can be made, that the *Dunnu* architecture had already started to collapse, as some spaces appear to have been left to fill with building debris before complete abandonment, as others appear to have been in use. This starts in level 5, on the same floors that were used during the *Dunnu* phase, and continues for decades while the main buildings of the *Dunnu* are left to degrade and collapse.

It seems therefore that the original *Dunnu* was an architectural complex designed and constructed by those in power. This is the case for its initial building, but also for most later modifications. As all architectural modifications have a significant effect on vital infrastructure such as the location of administration, the spatial organization of access behind the gateways, and access to the ramparts, these are more likely to have followed from top-down decisions and designs. Only afterwards, a new phase starts with more localised, haphazard and opportunistic modifications of an architectural space, reflecting the absence of central planning.

Refocussing on the builders of the *Dunnu*, who were they? It seems likely, considering the degree of organization and evidence of the building profession in the Bronze Age, that these were not *Dunnu* inhabitants. They were most likely brought in especially for the job, and moved to their next assignment after it was finished. It is interesting to put all the small variations in construction methods and materials into this perspective. Examples are slight variations in arch construction, various manners of corner and T-junction bonding patterns, or simply the variations of size and colour in mud bricks applied in a single wall. Do these variations reflect individual practices of separately operating building teams, perhaps with different backgrounds, on the same large construction site? Or are we witnessing different groups of builders on different moments in time, and do these variations therefore have a chronological dimension? Or is there a functional, structural explanation for such decisions that we may overlook?

As for the inhabitants and external visitors that lived or came temporarily to the *Dunnu*, their movements, and life, was for a large part structured by the built environment. The *Dunnu*, with its heavily controlled gate access structures could have served to keep people in, just as much as it could have kept people out. The location of access points and their characteristics suggests that the north-western official, administrative and representative side could be easily locked off from the eastern and southern, domestic and productive, side. Hence, the external and internal worlds could be kept strictly separated. Whether this was planned like this to limit entry, and improve security against externals, or to limit movement of *Dunnu* staff, or both is uncertain. However, it is unlikely that so much effort was made into controlling space if it was not used. There is some evidence from the written sources that the *Dunnu* was at certain moments more permeable to people moving in and out. For instance, it appears that people came into the *Dunnu* to buy beer. It is also clear that certain groups of people were invited inside for social activities such as dinner parties. Another hint is found in the limited range of activities for which we have evidence that took place within the walled precinct, which indicates that other *Dunnu* staff would work elsewhere. For those that worked inside the walled precinct, it seems unreasonable to assume that the bakers, beer brewing and grain grinding staff were locked in, while others could go about more freely in sectors outside the walled precinct. Also, in terms of practicality with regards to moving items and crops in and out of storage, it seems that some freedom of movement must have been accepted. In addition, the access pattern of the eastern and southern *Dunnu* suggests quite an open and permeable string of spaces.

If we look at the use of architecture, derived from the spatial distribution of moveable objects and fixed features, we may in fact note how limited the range of activities was within the walled precinct. The main economic activities appear to have been bread baking, and related to this grain and other crop processing, cooking and possibly beer brewing. This fits in the available space in the *Dunnu*, which is for the other part used up for storage, general domestic use (living, sleeping, going to the bathroom) and for a conspicuously large courtyard and elite residence. Most other economic activities that we know from the sources were probably located outside the walled precinct. The fact that grain processing and "industrial" bread baking was located here, has probably a logical explanation in that the main grain storage, the granary, was located in the centre of the *Dunnu*. The same is true for the evidence for beer brewing. Hence, the location of these activities appears to have been a very practical and pragmatic decision. Also, of course, because bread and beer were the staple food stuffs at the centre of society. Their location in the centre of the *Dunnu* happens to underline this position symbolically, although in all likelihood, this was unintentional.

There may even be evidence that the people living in the walled precinct had their private domestic spaces. The evidence for the presence of a roofed second floor is reasonable, and one of the possible uses of this second floor could be habitation. The main reason for this interpretation is the common occurrence of such spatial divisions in many Middle Eastern urban and rural architecture traditions. A separation between work and sleeping areas could be considered a luxury, indicative of a certain level of treatment of workers. However, possible other uses of the second floor, storage or other work-related activities remain feasible as well.

The built environment of the *Dunnu* structured for a large part the lives of the inhabitants, and was designed as such. The variety of architectural structures, the spatial concentration of activities within certain areas, and the high degree of access control indicates that the *Dunnu* was largely shaped by a top-down enforced design, where everything had its premediated place. This design was streamlined to execute the functions of the *Dunnu* efficiently and effectively. This was not just practical streamlining of tasks and activities, but could also be viewed in terms of symbolic representation.

VIII.2 Assessment of used methodology

In this study legacy excavation data was analysed to come to novel conclusions about the history of use and functional change of a so-called *Dunnu* type settlement, a fortified estate from the Middle Assyrian period, Late Bronze Age Northern Syria. Here, the effectiveness of the used methodology will be assessed. The first step was a systematic description and re-analysis of deposits related to aspects of architectural change: building, modification, decay and demolition. Information from section drawings was combined with unillustrated sequences that could be reconstructed using the day notes and deposit forms. This resulted in a standardised classification of deposits, and a classification of patterns of deposit sequences that could be observed across the site. A vital element in this approach was the creation of deposit sequence graphs, which use a standardised symbology for the deposits. These allowed for easy visual comparison of deposit sequences across the site, and the identification of various patterns in the order and type of deposits. Although these are simplified representations of the stratigraphy, they are on scale and metrically as accurate as the source data allowed, which also makes them useful for linking up the deposit sequences across the site. This was used later in the chapter on architectural analysis to critically assess the overall level stratigraphy as formulated by the excavators of the site in earlier reports.

Secondly, the architectural remains, the ruined buildings, were described and interpreted from the perspective of construction techniques and methods. The wider technological and cultural context of construction in ancient Western Asia using mud brick technology was used to inform the interpretations of this data from the *Dunnu*. Construction and deposit formation are, especially in mud brick architecture, two sides of the same coin. Understanding how people construct, modify and demolish, thus helped to clarify the formation of deposits. In addition to the deposits, the approach helped to obtain a better understanding of the builders and their techniques and methods. It showed the choices they made for foundations, wall bonding, and brick selection. Although this picture is far from clear, as such information was not systematically recorded during the excavation, various architectural contexts could be clarified, and certain interesting new patterns were described.

In chapter VI multiple approaches were used in an attempt to distil the internal logic of the architecture: how was it designed or build to match certain functional requirements? The question of phasing, which has direct repercussions on the interpretation of changing architectural functioning, was tackled first. The insights regarding deposits (chapter IV) and building methods (chapter V) were combined, underscoring how both types of information can be used for the reconstruction of architectural phasing. This was put to use in the context of reconstructing architectural phasing and a critical assessment of the so called 'level hypothesis', forwarded by the original excavators. The systematic analysis of deposits had already revealed that some levels are very hard to distinguish between, indicating continuity of building activity and use of the settlement. At the same time, looked at from the perspective of construction methods, many debris deposits could be related to renovation and functional change, rather than abandonment and rebuilding. Together, this information was used to conclude that the existence of a site wide phase of decay in between the levels 6 and 5, as is suggested in the level hypothesis, remains very hard to proof. This is also true for the postulated correlation of stratigraphic layers with historical events causing building activity on the site.

The architectural analysis was taken further by focussing on understanding the logic of construction as viewed from the perspectives of constructional height, living, circulation, defence and various types of activities. Like the analysis of constructional methods, this helped me to better interpret the recorded architectural features in relation to these functions, but it also allowed for extrapolation of these features into a hypothetical reconstruction. With this it could be assessed to what degree the architecture was optimised to perform a certain function and therefore reveal something about intentions in the design or the absence thereof. An example of an insight that developed from using this methodology include that building height variations and presence of open spaces may have been used strategically to allow for access to light at various building levels. Another example is that the concentration of fixed features in certain places would make passage very hard, which could imply the presence of circulation routes on a higher building level.

The analysis could be improved in various ways. By looking at multiple aspects of the architecture, rather than focussing on one, not all analyses could be worked out exhaustively. Some aspects of the analysis are perhaps incomplete, and could have been more detailed or rigorous. On the other hand, it is important to underscore that focussing on multiple aspects was a decision based on the believe that the form and temporal change of the buildings of the *Dunnu* is the result of a complex of factors. A single factor model of causation would not have yielded good results, as is also always emphasised by those who study architectural forms (e.g. Figure 39). Many examples throughout this study show how different factors interact and constitute each other, resulting in surprising hypothetical relationships: between circulation and fixed features, light and building height, wall thickness and various factors that could determine it.

On the other hand, one could also say that the analysis may be improved by adding further or different perspectives. One critical question one may ask is why these analytical categories were used to assess the architecture and not certain others. For example, why a solely functional perspective was chosen and no attention spend to symbolical (e.g. Amos Rapoport, 1990), social interaction (e.g. Fisher, 2009), psychological (Hall, 1966) or phenomenological (e.g. McMahon, 2013) factors in the interpretation of space or architecture? These are indeed possible avenues for further study, but these should not be executed in isolation. The functional analysis focusing on building methods, processes of decay and human or social requirements of the architecture would be a necessary first step. It is a powerful framework for discerning patterns and discovering the rationale of construction and thus helps us to an understanding and explanation of many seen and unseen archaeological features.

Aside from adding more theoretical perspectives, there is much potential improvement possible on the level of data collection and analysis. This study relied on existing excavation records, but discovered in the process that the character or genesis of deposits and building materials and methods could often not be established reliably during fieldwork. Individual experience and knowledge of the archaeologist determines the quality and reliability of the data. Indeed, archaeological interpretation in the field is still characterised by many unverified assumptions. Therefore, both the study of deposits and the analysis of construction techniques and methods could be improved significantly by adding microstratigraphic, petrographic and chemical tools of analysis. Various studies show how fruitful such approaches can be for more detailed and better understanding of the relation between deposits and processes of construction, decay and collapse (Friesem, Karkanas, *et al.*, 2014; Friesem, Tsartsidou, *et al.*, 2014) or the relation between building material, technology and social and cultural dimensions of construction (Love, 2013a, 2013b).

What this study revealed is the big effect of in the field interpretations and interpretations that led to the reconstruction of certain phases, drawn on site plans. It would be a very interesting subject of future study, to look at how different versions of the interpretation of archaeological stratigraphy, architecture, and site formation directly affect reconstructions or hypothetical models on a higher level, such as site phasing, but ultimately also use and function, or spatial organisation. Related to this, further interpretation of the data resulting in 3D reconstructions could also be analysed and validated in the same way by testing the effect of different options on accessibility, visibility, or defensibility. The suggested options would move away from archaeology working towards one single interpretation that finds its way in a definitive publication, but allows for multiple interpretations, and would ultimately be more honest about the real uncertainties that affect our discipline.

IX. Bibliography

Akkermans, P.M.M.G. (1993) *Villages in the steppe. Later Neolithic settlement and subsistence in the Balikh valley, northern Syria*. Leiden.

Akkermans, P.M.M.G. (1999) “La forteresse de tell sabi abyad,” *Archéologia*, (358), pp. 56–65.

Akkermans, P.M.M.G. (2006) “The Fortress of Ili-pada. Middle Assyrian Architecture at Tell Sabi Abyad, Syria,” in P. Butterlin et al. (eds.) *Les Espaces Syro-Mésopotamiens, Dimensions de l’Expérience Humaine au Proche-Orient Ancien, Volume d’Hommages Offert à Jean-Claude Margueron*. Subartu. Turnhout: Brepols, pp. 201–212.

Akkermans, P.M.M.G. and Duistermaat, K. (2001) “A Middle Assyrian Pottery Kiln at Tell Sabi Abyad, Syria,” in J.-W. Meyer, M. Novák, and A. Pruß (eds.) *beiträge zur Vorderasiatischen Archäologie Winfried Orthmann gewidmet*. Frankfurt am Main, pp. 12–19.

Akkermans, P.M.M.G., Limpens, J. and Spoor, R.H. (1993) “On the frontier of Assyria: excavations at Tell Sabi Abyad, 1991,” *Akkadica*, 84–85, pp. 1–52.

Akkermans, P.M.M.G. and Rossmeisl, I. (1990) “Excavations at Tell Sabi Abyad, Northern Syria: A Regional Centre on the Assyrian Frontier,” *Akkadica*, 66, pp. 13–60.

Akkermans, P.M.M.G. and Wiggermann, F. a M. (2015) “West of Aššur: the life and times of the middle assyrian Dunnu at Tell Sabi Abyad, Syria,” in B. Düring (ed.) *Understanding Hegemonic Practices of the Early Assyrian Empire. Essays Dedicated to Frans Wiggermann*. Leiden: NINO, pp. 79–113.

Aurenche, O. (1977) *Dictionnaire illustré multilingue de l’architecture du Proche Orient ancien*. Lyon; Paris: Maison de l’Orient ; Diffusion de Boccard.

Aurenche, O. (1981) *La maison orientale. L’architecture du Proche-Orient ancien des origines au milieu du quatrième millénaire.* Paris: P. Geuthner.

Aurenche, O. *et al.* (1997) *Villages engloutis : enquête ethnoarchéologique à Cafer Höyük (vallée de l’Euphrate)*. Lyon/Paris: Maison de l’Orient méditerranéen/Diffusion de Boccard.

Aydin, S., Yardimci, M.Y. and Ramyar, K. (2007) “Mechanical Properties of Four Timber Species Commonly Used in Turkey,” *Turkish Journal of Engineering and Environmental Sciences*, 31, pp. 19–27.

Baloi, M.D.L. (1995) “Archaeology and Mud Wall Decay in the Bobirwa Area: An Ethnoarchaeological Study,” *Pula: Botswana Journal of African Studies*, 15(1), pp. 46–59.

Bartl, P. V. (2012) "Giricano and Ziyaret Tepe: Two Middle Bronze Age Sites in the Upper Tigris Region," in N. Laneri, P. Pfälzner, and S. Valentini (eds.) *Looking North The Socioeconomic Dynamics of Northern Mesopotamian and Anatolian Regions during the Late Third and Early Second Millenium BC*. Wiesbaden: Harrassowitz Verlag, pp. 176–191.

Van Beek, G.W. (1987) "Archi e volte nell'antico Vicino Oriente," *Le Scienze*, 229, pp. 82–90.

Berger, C. (2012) *World history of beer brewing*, *beer-studies.com*. Available at: https://beer-studies.com/en/world-history.

Berghuijs, K. (2013) *Black and White Negatives. Basketry impressions from late Neolithic Tell Sabi Abyad (Syria)*. Leiden University.

Besenval, R. (1984) *Technologie de la voûte dans l'Orient ancien*, *Synthèse*. Paris: Éditions Recherche sur les civilisations.

Bonatz, D. (2014) "Tell Fekheriye in the Late Bronze Age : Archaeological Investigations into the Structures of Political Governance in the Upper Mesopotamian Piedmont," in D. Bonatz (ed.) *The Archaeology of Political Spaces: The Upper Mesopotamian Piedmont in the Second Millennium BCE*. Berlin: De Gruyter, pp. 61–84.

Botta, P. (1850) *Letters on the discoveries at Nineveh*. London.

Braidwood, R.J. and Howe, B. (1960) *Prehistoric investigations in Iraqi Kurdistan*, *Studies in ancient oriental civilization*. Chicago: University of Chicago Press.

Breton, J.-F. (1985) "Shibam and the wadi Hadramaut," in H.-U. Khan (ed.) *Mimar 18: Architecture in Development*. Singapore: Concept Media, pp. 8–20.

Brown, B. (2013) "The Structure and Decline of the Middle Assyrian State : the Role of Autonomous and Nonstate Actors," *Journal of Cuneiform Studies*, 65(May), pp. 97–126.

Brown, B. (2014) "Settlement Patterns of the Middle Assyrian State: Notes toward an Investigation of State Apparatuses," in D. Bonatz (ed.) *The Archaeology of Political Spaces. The Upper Mesopotamian Piedmont in the Second Millennium B.C. (Topoi - Berlin Studies of the Ancient World, 12)*. Berlin/Boston: De Gruyter, pp. 85–106.

Brown, F.E. (1990) "Analyzing small building plans," in R. Samson (ed.) *The social Archaeology of Houses*. Edinburgh: Edinburgh University Press.

Bruno, A. *et al.* (1969) "Contributions to the study of the preservation of mud-brick structures," *Mesopotamia*, 3/4, pp. 443–473.

Bürger, U. and Miglus, P.A. (2014) *Bakr Awa new excavation*. Available at: https://www.assur.de/Themen/Bakr_Awa/Bakr_Awa_new_excavation/bakr_awa_new_excavation.html.

Burke, A.A. (2008) *Walled up to heaven. The Evolution of Middle Bronze Age Fortification Strategies in the Levant*. Edited by L.E. Stager. Winona Lake: Eisenbrauns (Studies in the archaeology and history of the Levant).

Cancik-Kirschbaum, E.C. (1996) *Die mittelassyrischen Briefe aus Tall Šēḫ Ḥamad*. Berlin: D. Reimer.

Carver, G. (2015) "Preliminary reflections upon the unnatural history of archaeological stratigraphy."

Cavallo, C. (2002) "The faunal remains from the Middle Assyrian 'Dunnu' at Sabi Abyad, Northern Syria," in H. Buitenhuis et al. (eds.) *Archaeozoology of the Near East*, pp. 228–240.

Cline, E.H. (2014) *1177 B.C. : the year civilization collapsed*. [S.l.]: Princeton University Press.

Connan, J. (1999) "Use and trade of bitumen in antiquity and prehistory: molecular archaeology reveals secrets of past civilizations," *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*. Edited by M.K. Jones et al., 354(1379), pp. 33–50. Available at: https://doi.org/10.1098/rstb.1999.0358.

Correas-Amador, M. (2011) "A Survey of the Mud-Brick Buildings of Qena," *Egyptian Archaeology*, 38, pp. 14–16.

Currid, J.D. (1986) "The Beehive Buildings of Ancient Palestine," *Biblical Archaeologist*, 49(1), pp. 20–24.

Curvers, H. (1991) *The Bronze Age in the Balikh Valley, Syria*. Leiden University.

Daker, N. (1984) "Contribution à l'étude de l'évolution de l'habitat bédouin en Syrie," in O. Aurenche (ed.) *Nomades et sédentaires : perspectives ethnoarchéologiques.* Paris: Éditions Recherche sur les Civilisations, pp. 51–79.

Dalokay, Y. (1966) *Lehmflachdachbauten in Anatolien*. Technischen Universität Carolo-Wilhelmina zu Braunschweig.

Damerow, P. (2012) "Sumerian beer: the origins of brewing technology in ancient Mesopotamia," *Cuneiform Digital Library Journal*, 2(January), pp. 1–20. Available at: http://www.cdli.ucla.edu/pubs/cdlj/2012/cdlj2012_002.html.

Damluji, S.S. (2007) *Urban Development Project. Shibam, Yemen*.

Daniels, R. (1997) "The need for the solid modelling of structure in the archaeology of buildings," *Internet Archaeology*, 2(2). Available at: http://dx.doi.org/10.11141/ia.2.1.

Delougaz, P. (1940) *The temple oval at Khafājah*. Chicago Ill.: University of Chicago Press.

Delougaz, P., Hill, H.D. and Lloyd, S. (1967) *Private houses and graves in the Diyala region*. Chicago: University of Chicago Press.

Dipasquale, L., Onnis, S. and Paglini, M. (2009) "Building culture of corbelled dome architecture," in L. Dipasquale and S. Mecca (eds.) *Earthen Domes et Habitats. Villages of Northern Syria : An Architectural tradition shared by East and West*. Pisa: ETS, pp. 323–350.

Duistermaat, K. (2007) *The pots and potters of Assyria : technology and organisation of production, ceramic sequence and vessel function at late Bronze Age Tell Sabi Abyad, Syria*. Leiden University.

Duistermaat, K. (2014) "The Pots of Assur in the Land of Hanigalbat - The Organization of Pottery Production in the Far West of the Middle Assyrian Empire," in B. Düring (ed.) *Understanding Hegemonic Practices of the Early Assyrian Empire. Essays Dedicated to Frans Wiggermann*. Leiden: NINO, pp. 115–142.

Dunham, S.S. (1982) *A study of ancient Mesopotamian foundations*. Columbia University.

Düring, B. (2012) "The trouble with stratigraphy: case studies from the Near East," *Analecta Praehistorica Leidensia*, 43/44, pp. 325–333.

Düring, B. (2015) "Reassessing the Dunnu Institution in the Context of the Middle Assyrian Empire," *Ancient Near Eastern Studies*, 52, pp. 47–68. Available at: https://doi.org/10.2143/ANES.52.0.3082865.

Düring, B. (2020) "The Assyrian Threshold. Explaining Imperial Consolidation in the Early Assyrian Empire," in B.J. Boozer, A.L.; Düring, B.S.; Parker (ed.) *Archaeologies of Empire. Local Participants and Imperial Trajectories*. University of New Mexico Press, pp. 145–165.

Düring, B.S. (2020) *The Imperialisation of Assyria: An Archaeological Approac*, *Cambridge University Press*. Cambridge University Press. Available at: https://doi.org/10.1017/9781108778701.

Faist (2006) "Iteneraries and travellers in the Middle Assyrian period," *State Archives of Assyria Bulletin*, XV, pp. 147–160.

Fantone, F. (2015) "Agriculture at the Fringe : Reconsidering the Role of Barley in Middle Assyrian Agriculture," in B. Düring (ed.) *Understanding Hegemonic Practices of the Early Assyrian Empire. Essays*

Dedicated to Frans Wiggermann2. Leiden: NINO, pp. 217–229.

Fathy, H. (1976) “Architecture for the poor an experiment in rural Egypt.” Chicago: University of Chicago Press. Available at: http://public.eblib.com/choice/publicfullrecord.aspx?p=485967.

Fisher, K.D. (2009) “Placing Social Interactions: An Integrative Approach to Analyzing Past Built Environments,” *Journal of Anthropological Archaeology*, 28(4), pp. 439–457. Available at: https://doi.org/DOI 10.1016/j.jaa.2009.09.001.

Fisher, K.D. (2014) “Investigating monumental social space in Late Bronze Age Cyprus: an integrative approach,” *Spatial analysis and social spaces, Interdisciplinary approaches to the interpretation of prehistoric and historic built environments*, pp. 167–202. Available at: https://doi.org/10.1515/9783110266436.167.

Frances, R. (2013) “The three-arched middle bronze age gate at tel dan - A structural investigation of an extraordinary archaeological site,” *Construction and Building Materials*, 41, pp. 950–956. Available at: https://doi.org/10.1016/j.conbuildmat.2012.07.015.

Frank, D.R. (1975) “Versuch zur Rekonstruktion von Bauregeln und Massordnung einer nordsyrischen Stadt des vierten Jahrtausends - Untersucht anhand von Grabungsergebnissen der Deutschen Orient-Gesellschaft in Habuka Kabira - Ernst Heinrich zum 75. Geburtstag.,” *Mitteilungen der Deutschen Orient-Gesellschaft*, 107, pp. 7–16.

Frey, W., Jagiella, C. and Kürschner, H. (1991) “Holzkohlfunde in Dūr-katlimmu/Tall Šēẖ Ḥamad und ihre Interpretation,” in H. Kühne and C. Becker (eds.) *Die rezente Umwelt von Tall Šēẖ Ḥamad und Daten zur Umweltrekonstruction der Assyrischen Stadt Dūr-katlimmu (Berichte der Ausgrabung Tall Šēẖ Ḥamad / Dur-katlimmu 1)*. Berlin: Dietrich Reimer Verlag, pp. 137–162.

Friedl, E. and Loeffler, A.G. (1994) “The ups and downs of dwellings in a village in West Iran : the history of two compounds,” *Archiv für Völkerkunde*, 48, pp. 1–44.

Friesem, D. *et al.* (2011) “Degradation of mud brick houses in an arid environment: A geoarchaeological model,” *Journal of Archaeological Science*, 38(5), pp. 1135–1147. Available at: https://doi.org/10.1016/j.jas.2010.12.011.

Friesem, D.E., Karkanas, P., *et al.* (2014) “Sedimentary processes involved in mud brick degradation in temperate environments: A micromorphological approach in an ethnoarchaeological context in northern Greece,” *Journal of Archaeological Science*, 41, pp. 556–567. Available at: https://doi.org/10.1016/j.jas.2013.09.017.

Friesem, D.E., Tsartsidou, G., *et al.* (2014) "Where are the roofs? A geo-ethnoarchaeological study of mud brick structures and their collapse processes, focusing on the identification of roofs," *Archaeological and Anthropological Sciences*, 6(1), pp. 73–92. Available at: https://doi.org/10.1007/s12520-013-0146-3.

Gasche, H. and Birschmeier, W. (1981) "Contribution à l'étude de la voûte en briques crues," *Akkadica*, 24, pp. 1–16.

de Groene, D. (2015) *Report internship Donna de Groene: fire features of the dunnu*. Leiden.

Hall, E. (1966) *The hidden dimension*. Garden City N.Y.: Doubleday.

Hall, G., McBride, S. and Riddell, A. (1973) "Aşvan 1968-1972: An Interim Report (1973). Architectural Study," *Anatolian Studies*, 23, pp. 245–269.

Hallet, S. and Samizay, R. (1980) *Traditional architecture of Afghanistan*. New York: Garland STPM Press.

Heimpel, W. (2009) *Workers and Construction Work at Garšana*. Bethesda (Md.): CDL Press (Cornell University Studies in Assyriology and Sumerology 5).

Heinrich, E. (1950) "Moderne arabische Gehofte und ihre Beziehungen zur Babylonischen Hofhaus," *MDOG*, 82, pp. 19–46.

Heinrich, E. and Seidl, U. (1967) "Grundrisszeichnungen aus dem Alten Orient," *Mitteilungen der Deutschen Orient-Gesellschaft zu Berlin*, 98, pp. 46–55.

Heinrich, E. and Seidl, U. (1968) "Mass und Obermass in der Dimensionierung von Bauwerken im alten Zweistromland," *Mitteilungen der Deutschen Orient-Gesellschaft zu Berlin*, 99, pp. 5–54.

Hermon, S. (2014) "Scientific Method, chaîne opératoire and Visualization: 3D Modelling as a Research Tool in Archaeology," in A. Bentkowska-Kafel, H. Denard, and D. Baker (eds.) *Paradata and Transparency in Virtual Heritage*. Farnham/Burlington: Ashgate, pp. 13–22.

Herzfeld, E. (1938) *Altpersische Inschriften*. Berlin: Dietrich Reimer Verlag.

Hillier, B. (2007) *Space is the Machine*. Space Syntax.

Hillier, B. (2014) "Spatial analysis and cultural information : the need for theory as well as method in space syntax analysis," in E. Paliou, U. Lieberwirth, and S. Polla (eds.) *Spatial analysis and social spaces. Interdisciplinary approaches to the interpretation of prehistoric and historic built environments*. Berlin/Boston: De Gruyter, pp. 19–48.

Hillier, B. and Hanson, J. (1984) *The social logic of space*. New York: Cambridge University Press. Available at: https://doi.org/10.1016/0169-2046(86)90038-1.

Hole, F. and Zaitchik, B.F. (2007) “Policies, plans, practice, and prospects: Irrigation in northeastern Syria,” *Land Degradation and Development*, 18(2), pp. 133–152. Available at: https://doi.org/10.1002/ldr.772.

Hölscher, U. (1941) *The excavation of Medinet Habu - Volume III: The Mortuary Temple of Ramses II, Part I*. Chicago: The University of Chicago Oriental Institute Publications.

Homsher, R.S. (2012) “Mud Bricks and the Process of Construction in the Middle Bronze Age Southern Levant,” *Bulletin of the American Schools of Oriental Research*, 368, pp. 1–27.

Horne, L. (1982) “Rural Habitats and Habitations: A Survey of Dwellings in the Rural Islamic World,” in B.B. Taylor (ed.) *The Changing Rural Habitat; Volume 2: Background Papers*. Singapore: Concept Media/Aga Khan Award for Architecture, pp. 27–63.

Horne, L. (1991) “Reading village plans. Architecture and social change in northeastern Iran,” *Expedition*, 33(1), pp. 44–52.

Horne, L. (1993) “Occupational and locational instability in arid land settlement,” in C.M. Cameron and S.A. Tomka (eds.) *Abandonment of settlement and regions. Ethnoarchaeological and archaeological approaches*. Cambridge/New York: Cambridge University Press, pp. 43–53.

Horne, L. (1994) *Village Spaces: Settlement and Society in Northeastern Iran*. Washington/London: Smithsonian Institution Press.

Houben, H. and Guillaud, H. (1994) *Earth construction: a comprehensive guide*. Warwickshire: Practical Action Publishers.

Hritz, C. (2013) “Urbanocentric Models and ‘Rural Messiness’: A Case Study in the Balikh River Valley, Syria,” *American Journal of Archaeology*, 117(2), pp. 141–161. Available at: https://doi.org/10.3764/aja.117.2.0141.

Jachvliani, D. (2015) *Bins at Tell Sabi Abyad*. Leiden.

Jakob, S. (2002) *Mittelassyrische Verwaltung und Sozialstruktur : Untersuchungen*. Leiden/Boston: Brill.

Jakob, S. (2009) *Die mittelassyrischen Texte aus Tell Chuēra in Nordost-Syrien*. Wiesbaden: Harrassowitz Verlag.

Jakob, S. (2014) “Daily Life in the Wild West of Assyria,” in B. Düring (ed.) *Understanding Hegemonic Practices of the Early Assyrian Empire. Essays Dedicated to Frans Wiggermann*. Leiden: NINO, pp. 167–

177.

Kertai, D. (2009) “The history of the middle-assyrian empire,” *Talanta*, XL–XLI, pp. 25–51.

Khalesi, Y. (1977) “Tell al-Fakhar (Kurruhanni), A dimtu-settlement. Excavation report,” *Assur*, 1(6), pp. 1–42.

King, C. (1995) *An archaeological survey in the Pontine Region, Italy (June 11th - 24th 1995)*.

King, G.R.D. (1998) *The traditional architecture of Saudi Arabia*. New York: I.B. Tauris.

Kingery, W.D., Vandiver, P.B. and Prickett, M. (1988) “The Beginnings of Pyrotechnology, Part II: Production and Use of Lime and Gypsum Plaster in the Pre-Pottery Neolithic Near East,” *Journal of Field Archaeology*, 15(2), pp. 219–244. Available at: https://doi.org/10.1179/009346988791974501.

Klinkenberg, V. and Düring, B.S. (2023) “the Taphonomy of Middle Assyrian Cuneiform Tablet Clusters: Archives or Refuse?,” *Journal of Cuneiform Studies*, 75, pp. 61–73. Available at: https://doi.org/10.1086/725218.

Klinkenberg, V. and Lanjouw, T.J.R. (2015) “The Central Building of the Tell Sabi Abyad Dunnu,” in B. Düring (ed.) *Understanding Hegemonic Practices of the Early Assyrian Empire. Essays Dedicated to Frans Wiggermann*. Leiden: NINO, pp. 143–165.

Klinkenberg, V.M. (2016) *Reading rubbish. Using object assemblages to reconstruct activities, modes of deposition and abandonment at the late Bronze Age dunnu of Tell Sabi Abyad, Syria*. Leiden University.

Kolinski, R. (2002) “Tell al-Fakhar: A dimtu-Settlement or the City of Kurruhanni?,” in D.I. Owen and G. Wilhelm (eds.) *SCCNH 12, General Studies and Excavations at Nuzi 10/3*. Bethesda, Md.: CDL Press, pp. 3–31.

Kolinski, R. (2014a) “Making Mittani Assyrian,” in B. Düring (ed.) *Understanding Hegemonic Practices of the Early Assyrian Empire. Essays Dedicated to Frans Wiggermann*. Leiden: NINO, pp. 9–32.

Kolinski, R. (2014b) “Settled Space. Evidence for Changes in Settlement Patterns of Northern Mesopotamia at the Advent and at the Turn of the Mittani Era,” in *Constituent, Confederate, and Conquered Space : The Emergence of the Mittani State*. TOPOI Berl. Berlin/Boston: De Gruyter, pp. 179–212.

Koliński, R. (2001) *Mesopotamian dimātu of the second millennium BC*. Oxford: Archaeopress.

Koyunlu, A. (1982) “The village settlement of Munzuroglu - observations on housing,” in *Keban Projesi : 1974-1975 Çalişmalari = Keban Project : 1974-1975 activities.* Ankara: Türk Tarih Kurumu Basımevi, pp. 249–265.

Krafeld-Daugherty, M. (1994) *Wohnen im Alten Orient : Eine Untersuchung zur Verwendung von Räumen in altorientalischen Wohnhäusern*. Münster: Ugarit-Verlag.

Kramer, C. (1979) “An Archaeological View of a Contemporary Kurdish Village: Domestic Architecture, Household Size and Wealth,” in C. Kramer (ed.) *Ethnoarchaeology: Implications of Ethnography for Archaeology*. New York: Columbia University Press, pp. 139–163.

Kramer, C. (1982) *Village ethnoarchaeology : rural Iran in archaeological perspective*. New York: Academic Press.

Kreppner, F. (2013) *Stratigraphie und Architektur des “Roten Hauses” von Tall Šēḫ Ḥamad Dūr-Katlimmu*.

Kubba, S. (1998) *Architecture and linear measurement during the Ubaid period in Mesopotamia*. Oxford: British Archaeological Reports.

Kühne, H. (1983) “Tall Seh Hamad/Dur-Katlimmu 1978-1983,” *Les Annales Archeologiques Arabes Syriennes*, XXXIII, pp. 240–248.

Kühne, H. (2000) “Dur-Katlimmu and the Middle Assyrian Empire,” in, pp. 271–279.

Lawrence, D.L. and Low, S.M. (1990) “The Built Environment and Spatial Form,” *Annual Review of Anthropology*, 19(1990), pp. 453–505.

Layard, A.H. (1882) *Nineveh and Babylon: A Narrative of a Second Expedition to Assyia, During the Years 1849, 1850, 1851*.

Lehmann, M. (2013) “Skylines , Bridges and Mud in the Delta and elsewhere. A comparison of Egyptian and Yemeni Tower Houses,” *Proceedings of the Delta Survey Workshop 22-23 March 2013 British Council, Cairo*, (March 2013), pp. 1–24. Available at: http://www.ees.ac.uk/userfiles/file/DW13 Lehmann.pdf.

Lewin, J.S. and Gross, M.D. (1996) “Resolving Archaeological Site Data With 3D Computer Modeling: The Case of Ceren,” *Automation in Construction*, 6, pp. 323–334.

van der Linde, S. (2002) *Leembouw in Dia. Het bouwproces in archaeologisch perspectief. BA thesis*. Leiden University.

Lloyd, S. and Brice, W. (1951) “Harran,” *Anatolian Studies*, 1, pp. 77–111.

Loud, G. and Altman, C.B. (1936) *Khorsabad.* Chicago: The University of Chicago Press.

Loud, G. and Altman, C.B. (1938) *Khorsabad. II, the citadel and the town*. Chicago: University Press.

Love, S. (2013a) "An Archaeology of Mudbrick Houses from Çatalhöyük," *Substantive Technologies at Çatalhöyük: Reports from the 2000-2008 Seasons (Volume 9)*, (December), pp. 81–96. Available at: http://espace.library.uq.edu.au/view/UQ:319414.

Love, S. (2013b) "The performance of building and technological choice made visible in mudbrick architecture," *Cambridge Archaeological Journal*, 23(2), pp. 263–282. Available at: https://doi.org/10.1017/S0959774313000292.

Luis, J., Fenollós, M. and Caramelo, F. (2012) "New Data on the Middle Assyrian Expansion in the Valley of the Euphrates," in G. del Olmo Lete, J. Vidal, and N. Wyatt (eds.) *The Perfumes of Seven Tamarisks. Studies in Honour of Wilfred G. E. Watson*. Münster: Ugarit-Verlag, pp. 51–62.

Luschan, F. von (1893) *Ausgrabungen in Sendschirli, vol. 1: Einleitung und Inschriften*. Berlin: W. Spemann.

Lyon, J.D. (2000) "Middle Assyrian expansion and settlement development in the Syrian Jezira; The view from the Balikh Valley," in R.M. Jas (ed.) *Rainfall and agriculture in Northern Mesopotamia : proceedings of the 3rd MOS Symposium, Leiden, May 21 - 22, 1999*. Leiden: NINO, pp. 89–126.

Mallowan, M.E.L. (1946) "Excavations in the Baliḫ Valley , 1938," *Iran*, 8(1946), pp. 111–159.

Margueron, J.-C. (1982) *Recherches sur les palais mésopotamiens de l'Âge du bronze*. Paris: Geuthner.

Margueron, J.-C. (1992) "Le bois dans l'architecture : premier essai pour une estimation des besoins dans le bassin mésopotamien," *Bulletin of Sumerian Agriculture*, VI, pp. 79–96.

Margueron, J.-C. (1996) "La maison orientale," in K.R. Veenhof (ed.) *Houses and households in ancient Mesopotamia. Papers read at the 40e Rencontre Assyriologique Internationale, Leiden, July 5-8, 1993, Istanbul 1996*. Istanbul: Nederlands Historisch-Archaeologisch Instituut te Istanbul, pp. 17–38.

Margueron, J.-C. (1999a) "Du plan au volume : les bases méthodologiques de la restitution architecturale," in H. Kühne, R. Bernbeck, and K. Bartl (eds.) *Fluchtpunkt Uruk : Archäologische Einheit aus methodischer Vielfalt. Schriften für Hans Jörg Nissen*. Leidorf: Rahden, pp. 191–200.

Margueron, J.-C. (1999b) "Notes d'archéologie et d'architecture orientales : Architecture circulaire dans l'univers syro-mésopotamien au début du IIIe," *Syria*, 76, pp. 19–55.

Margueron, J.-C. (2004) *Mari, métropole de l'Euphrate au IIIe et au début du IIe millénaire av. J.-C.* Paris: Picard.

Margueron, J.-C. (2005) "Notes d'Archéologie et d'Architecture Orientales. 12 - Du bitanu, de l'étage et des salles hypostyles dans les palais néo-assyriens," *Syria*, 82(1), pp. 93–138. Available at: https://doi.org/10.3406/syria.2005.8685.

Maspero, G. (1903) *History of Egypt, Chaldea, Syria, Babylonia, and Assyria*. London: Grolier Society.

Mathys, T. (2017) "Land use Dataset for the Jazira Region of Syria, [Dataset]." University of Edinburgh. Available at: https://doi.org/https://doi.org/10.7488/ds/1771.

Matson, F.R. (1985) "The brickmakers of Babylon," in W.D. Kingery (ed.) *Ancient technology to modern science: ceramics and civilisation I*. Columbus, Ohio, Ohio: American Ceramics Society, pp. 61–75.

Matthews, W. and Farid, S. (1996) "Exploring the 1960's surface, The stratigraphy of Çatalhöyük," in I. Hodder (ed.) *On the surface, Çatalhöyük 1993-95*. McDonald Institute for Archaeological Research / British Institute, pp. 271–300.

Matthiae, P. (1990) "The Reception Suites of the Old Syrian Palaces," in Ö. Tunca (ed.) *De la Babylonie à la Syrie, en passant par Mari. Mélanges offerts à Monsieur J.-R. Kupper à l'occasion de son 70e anniversaire*. Liege, pp. 209–228.

McCown, D. (1967) *Nippur, excavations of the joint expedition to Nippur of the University Museum of Philadelphia and the Oriental Institute of the University of Chicago,*. Chicago: University of Chicago Press.

McEwan, C. (1958) *Soundings at Tell Fakhariyah*. Chicago: University of Chicago Press.

McHenry, P. (1984) *Adobe and rammed earth buildings : design and construction*. New York: Wiley.

McIntosh, R.J. (1974) "Archaeology and mud wall decay in a West African village," *World Archaeology*, 6(2), pp. 154–171. Available at: https://doi.org/10.1080/00438243.1974.9979599.

McIntosh, R.J. (1977) "The excavation of mud structures: An experiment from West Africa," *World Archaeology*, pp. 185–199. Available at: https://doi.org/10.1080/00438243.1977.9979695.

McMahon, a (2013) "Space, Sound, and Light: Toward a Sensory Experience of Ancient Monumental Architecture," *American Journal of Archaeology*, 117(2), pp. 163–179. Available at: https://doi.org/10.3764/aja.117.2.0163.

Mecca, S. and Dipasquale, L. (2009) *Earthen domes and habitats : villages of Northern Syria : an architectural tradition shared by East and West*. Edited by L. Dipasquale and S. Mecca. Pisa: ETS.

Micale, M.G. (2005) "Immagini di architectura : struttura e forma della architettura mesopotamica attraverso le ricostruzioni moderne," *CMAO*, X, pp. 121–166.

Van de Mieroop, M. (2007) *A history of the ancient Near East, ca. 3000-323 B.C.*, *Blackwell history of the ancient world*.

Miglus, P.A. (1999) *Städtische Wohnarchitektur in Babylonien und Assyrien*. Mainz am Rhein: P. von Zabern.

Miglus, P.A. *et al.* (2013) "Excavation at Bakr Awa 2010 and 2011," *Iraq*, 75, pp. 43–88. Available at: https://doi.org/10.1017/S0021088900000413.

Miller Rosen, A. (1986) *Cities of clay : the geoarcheology of tells*, *Geoarchaeology*. Chicago: University of Chicago Press.

Molyneaux, M. (2006) *Real life experiments that reveal the ancient art and techniques of building Egyptian pyramids*. Available at: http://www.catchpenny.org/mmbuild.html.

Montero Fenollós, J.-L. (2015) *Asirios en el medio Éufrates. La cerámica mediosiria de Tell Qabr Abu al-'Atiq en su contexto histórico-arquelógico*. Proyecto Arqueológico Medio Éufrates Sirio (PAMES-UDC) y Sociedade Luso-Galega de Estudos Mesopotámicos.

Montero Fenollós, J.L. *et al.* (2011) "Tell Qubr Abu al- ' Atiq : A Middle Assyrian Fort in the Gorge of Khanuqa. 6th Season Report of the Proyecto Arqueológico Medio Éufrates Sirio (2010)," *Aula Orientalis*, 29, pp. 267–278.

Moorey, P. (1994) *Ancient mesopotamian materials and industries : the archaeological evidence*. Oxford ;;New York: Clarendon Press.

Mulders, M.A. (1969) *The Arid soils of the Balikh Basin (Syria)*. Rijksuniversiteit Utrecht.

Murgatroyd, P. (2008) "Appropriate Levels of Detail in 3-D Visualisation: the House of the Surgeon, Pompeii," *Internet Archaeology*, 23.

Naumann, R. (1955) *Architektur Kleinasiens von ihren Anfängen bis zum Ende der hethitischen Zeit.* Tübingen: E. Wasmuth.

Neumann, H. (1996) "Der sumerische Baumeister (šidim)," in K.R. Veenhof (ed.) *Houses and households in ancient Mesopotamia. Papers read at the 40e Rencontre Assyriologique Internationale, Leiden, July 5-8, 1993, Istanbul 1996*. Istanbul: Nederlands Historisch-Archeologisch Instituut te Istanbul, pp. 153–169.

Nijst, A.L.M.T. *et al.* (1973) *Living on the edge of the Sahara. A study of traditional forms of habitation and types of settlement in Morocco*. The Hague: Government Publishing Office.

Numoto, H. (2008) "Excavations at Tell Taban, Hassake, Syria (6) : preliminary report of the 2006 season of work.," *al-Rāfidān* [Preprint].

Oates, D. (1990) "Innovations in mudbrick: Decorative and structural techniques in ancient Mesopotamia," *World Archaeology*, 21(3), pp. 388–406. Available at: https://doi.org/10.1080/00438243.1990.9980115.

Oates, D., Oates, J. and McDonald, H. (1998) *Excavations at Tell Brak 1: The Mitanni and Old Babylonian Periods*. London: British School of Archeology in Iraq. Available at: http://www.amazon.com/Excavations-Tell-Brak-Babylonian-Monograph/dp/0951942050.

Paliou, E., Wheatley, D. and Earl, G. (2011) "Three-dimensional visibility analysis of architectural spaces: Iconography and visibility of the wall paintings of Xeste 3 (Late Bronze Age Akrotiri)," *Journal of Archaeological Science*, 38(2), pp. 375–386. Available at: https://doi.org/10.1016/j.jas.2010.09.016.

Paulette, T. (2024) *In the Land of Ninkasi: A History of Beer in Ancient Mesopotamia.* Oxford University Press.

Paulette, T.S. (2015) *Grain Storage and the Moral Economy in Mesopotamia (3000-2000 BC)*. University of Chicago.

Peters, E. (1982) "Ländliche bauweisen im Keban-Gebiet," in *Keban Publications 7 (1975-75)*. Middle Eastern Technical University, pp. 217–232.

Pittman, H. (1996) "The White Obelisk and the problem of historical narrative in the art of Assyria," *The Art Bulletin*, 78(2), pp. 334–355. Available at: https://doi.org/10.2307/3046178.

Porada, E. (1967) "Battlements in the military architecture and in the symbolism of the ancient near east," in D. Fraser, H. Hibbard, and M.J. Lewine (eds.) *Essays in the history of architecture presented to Rudolf Wittkower*. London: Phaidon press, pp. 1–12.

Postgate, J.N. (1992) "The land of assur and the yoke of assur," *World Archaeology*, 23(3), pp. 247–263. Available at: https://doi.org/10.1080/00438243.1992.9980178.

Powell, M. (1987) "Maße und Gewichte," in D.O. Edzard (ed.) *Reallexicon der Assyriologie, vol. 7*. Berlin: De Gruyter, pp. 457–517.

Preusser, C. (1954) *Die Wohnhäuser in Assur*. Berlin: Gebr. Mann.

Puljiz, I. and Qasim, H.A. (2020) "The Middle Assyrian rural complex of Muqable," *Zeitschrift Für Orient-Archäologie*, 13, pp. 90–126.

Pütt, K. (2005) *Zelte, Kuppeln und Hallenhäuser : Wohnen und Bauen im ländlichen Syrien*. Petersberg: Imhof.

Radner, K. (2004) *Das mittelassyrische Tontafelarchiv von Giricano/Dunnu-ša-Uzibi*. Edited by K. Radner. Turnhout: Brepols. Available at: http://www.worldcat.org/title/mittelassyrische-tontafelarchiv-von-giricanodunnu-sa-uzibi-ausgrabungen-in-giricano-1-excavations-at-giricano-1/oclc/470717066&referer=brief_results (Accessed: June 5, 2017).

Ragette, F. (1980) *Architecture in Lebanon : the Lebanese house during the 18th and 19th centuries*.

Ragette, F. (2003) *Traditional domestic architecture of the Arab Region*. Stuttgart: Edition Axel Menges.

Rapoport, A. (1980) “Vernacular architecture and the cultural determinants of form,” in A.D. King (ed.) *Buildings and Society: Essays on the Social Development of the Built Environment*. Routledge & Kegan Paul, pp. 158–169.

Rapoport, Antos (1990) “Systems of activities and systems of settings,” in S. Kent (ed.) *Domestic architecture and the use of space. An interdisciplinary cross-cultural study*. Cambridge: Cambridge University Press, pp. 9–20.

Rapoport, Amos (1990) *The Meaning of the Built Environment : a nonverbal communication approach*. Tucson: The University of Arizona Press. Available at: https://doi.org/10.1016/0197-3975(84)90014-6.

Rapoport, A. (2006) “Archaeology and Environment – Behavior Studies,” *Archeological Papers of the American Anthropological Association*, 16, pp. 59–70. Available at: https://doi.org/10.1525/ap3a.2006.16.1.59.

Rayne, L. (2015) “Imperial irrigated landscapes in the Balikh Valley,” *Water History*, 7(4), pp. 419–440. Available at: https://doi.org/10.1007/s12685-015-0128-8.

Reade, J. (1975) “Ashurnasirpal I and the White Obelisk,” *Iraq*, 37(2), pp. 129–150.

Reiche, A. (2014) “Tell Abu Hafur ‘East’, Tell Arbid (Northeastern Syria), and Nemrik (Northern Iraq) as Examples of Small-Scale Rural Settlements in Upper Mesopotamia in the Mittani Period,” in D. Bonatz (ed.) *The Archaeology of Political Spaces: The Upper Mesopotamian Piedmont in the Second Millennium BCE*. Berlin: De Gruyter, pp. 43–60.

Reilly, P. (1992) “Three-dimensional modelling and primary archaeological data,” in P. Reilly and S. Rahtz (eds.) *Archaeology and the Information Age*. London: Routledge, pp. 147–176.

Reuther, O. (1910) *Das Wohnhaus in Bagdad und anderen Städten des Irak*. Berlin: Ernst Wasmuth.

Richardson, S. (2015) “Building Larsa : Labor-Value , Scale and Scope-of- Economy in Ancient Mesopotamia,” in P. Steinkeller and M. Hudson (eds.) *Labor in the Ancient World*. Dresden: ISLET Verlag, pp. 238–328.

Roberts, B.K. (1996) *Landscapes of Settlement. Prehistory to the present*. New York: Routledge.

Robson, E. (1996) "Building with bricks and mortar: quantity surveying in the Ur III and Old Babylonian periods," in K.R. Veenhof (ed.) *Houses and households in ancient Mesopotamia. Papers read at the 40e Rencontre Assyriologique Internationale, Leiden, July 5-8, 1993*. Leiden/Istanbul: Nederlands Historisch-Archaeologisch Instituut te Istanbul, pp. 181–190.

Robson, E. (1999) *Mesopotamian mathematics, 2100-1600 BC. Technical Constants in Bureaucracy and Education*. Oxford: Clarendon Press (Oxford edition of cuneiform texts XIV).

Robson, E. (2002) "More than Metrology : Mathematics Education in an Old Babylonian Scribal School," in A. Imhausen and J.M. Steele (eds.) *Under one sky : mathematics and astronomy in the Ancient Near East*. Münster: Ugarit-Verlag, pp. 325–365.

Russell, A. and Buitenhuis, H. (2008) "Tell Damishliyya Faunal Bone Report," *Anatolica*, 34(0), pp. 315–327. Available at: https://doi.org/10.2143/ana.32.0.2012551.

Sallaberger, W. (2012) *Bierbrauen in Versen: Eine neue Edition und Interpretation der Ninkasi-Hymne*, *Altorientalische Studien zu Ehren von Pascal Attinger*.

Salonen, A. (1972) *Die Ziegeleien im alten Mesopotamien*. Helsinki: Suomalainen Tiedeakatemia.

Sanders, D.H. (1990) "Behavioral conventions and archaeology: methods for the analysis of ancient architecture," in S. Kent (ed.) *Domestic architecture and the use of space*. Cambridge: Cambridge University Press, pp. 43–72.

Sauvage, M. (1998) *La brique et sa mise en œuvre en Mésopotamie: des origins à l'époque achéménide*, *Centre de recherche d'archéologie orientale, Université de Paris I*. Paris: Ministère des affaires étrangères : Editions recherche sur les civilisations.

Sauvage, M. (2015) "La construction des maisons à Garsana: commentaires," in C. Michel (ed.) *De la maison à la ville dans l'Orient ancien : la maison et son mobilier*. Nanterre: CNRS/ArScAn/HAROC, pp. 239–250.

Schachner, A. (2004) "Die mittelassyrischen Siedlungsschichten von Giricano," in K. Radner (ed.) *Das mittelassyrische Tontafelarchiv vor Giricano/Dunnu-ša-Uzibi: Ausgrabungen in Giricano I (Subartu XIV)*. Turnhout: Brepols, pp. 1–14.

Schachner, A. (2007) *Bilder eines Weltreichs : Kunst- und kulturgeschichtliche Untersuchungen zu den*

Verzierungen eines Tores aus Balawat (Imgur-Enlil) aus der Zeit von Salmanassar III, König von Assyrien. Turnhout: Brepols.

Schiffer, M.B. (1983) "Toward the identification of formation processes," *Society for American Archaeology*, 48(4), pp. 675–706. Available at: https://doi.org/10.2307/279771.

Schiffer, M.B. (1996) *Formation Processes of the Archaeological Record*. Salt Lake City: University of Utah Press.

Sollberger, E. (1974) "The White Obelisk," *Iraq*, 36(1), pp. 231–238.

Starr, R. (1939) *Nuzi*. Cambridge Mass.: Harvard Univ. Press.

Steadman, S.R. (1996) "Recent research in the archaeology of architecture: Beyond the foundations," *Journal of Archaeological Research*, 4(1), pp. 51–93. Available at: https://doi.org/10.1007/BF02228838.

Stein, J.K. (1987) "Deposits for Archaeologists," in M.B. Schiffer (ed.) *Advances in Archaeological Method and Theory 11*. San Diego: Academic Press, pp. 337–395. Available at: https://doi.org/10.1016/B978-0-12-003111-5.50009-9.

Stöger, H. (2011) *Rethinking Ostia : a Spatial Enquiry into the Urban Society of Rome's Imperial Port-town*. Leiden: Leiden University Press.

Stone, E.C. (1981) "Texts, architecture and ethnographic analogy: patterns of residence in old babylonian Nippur," *Iraq*, 43(1), pp. 19–33.

Szabo, A. and Barfield, T.J. (1991) *Afghanistan : an atlas of indigenous domestic architecture*. 1st ed. Austin: University of Texas Press.

Tenu, A. (2023) "Assyrian Military Strategy in the 12th and 11th Centuries BCE on the Euphrates.," in *Études Mésopotamiennes – Mesopotamian Studies: N°2 – 2022*, pp. 131–164. Available at: https://doi.org/10.2307/jj.608098.12.

Tkáčová, L. (2013) *Near-Eastern Tannurs Now & Then: A Close-Up View of Bread Ovens with Respect to the Archaeological Evidence and Selected Ethnographical Examples from Khabur Region*. Masaryk University.

Torraca, G., Chiari, G. and Gullini, G. (1972) "Report on mud brick preservation," *Mesopotamia*, 7, pp. 259–286.

Warburton, D. (2003) *Archaeological stratigraphy: a Near Eastern approach*. Neuchâtel: Recherches et publications.

Watson, P. (1979) *Archaeological Ethnography in Western Iran, 1959-1960*, *Viking Fund Publications in Anthropology*. Tucson, Arizona: University of Arizona Press. Available at: https://doi.org/10.1179/eth.2010.2.2.235.

Wiggermann, F.A.M. (2000) "Agriculture in the northern Balikh Valley: the case of Middle Assyrian Tell Sabi Abyad," *the third MOS symposium*. 3rd ed. Edited by R.M. Jas. Leiden: Nederlands Historisch Archeologisch Instituut te Istanbul, pp. 171–231.

Wiggermann, F.A.M. (2006) "The Seal of Ili-padâ, Grand Vizier of the Middle Assyrian Empire," in P. Taylor (ed.) *The iconography of Cylinder Seals*. London, pp. 90–99.

Wiggermann, F.A.M. (2007) "Cuneiform texts from tell Sabi Abyad related to pottery," in K. Duistermaat (ed.) *The Pots and Potters of Assyria Technology and organization of production, ceramic sequence, and vessel function at Late Bronze Age Tell Sabi Abyad, Syria.*, pp. 377–381.

Wiggermann, F.A.M. (2010) "Wein, Weib und Gesang in een midden-assyrische nederzetting aan de Balikh," *Phoenix*, 56(1–2), pp. 17–60.

Wilkinson, T.J. (1998) "Water and Human Settlement in the Balikh Valley, Syria: Investigations from 1992-1995," *Journal of Field Archaeology*, 25(1), p. 63. Available at: https://doi.org/10.2307/530458.

Wiseman, D.J. (1972) "A Babylonian Architect?," *Anatolian Studies*, 22, pp. 141–147.

Woolley, L. (1955) *Alalakh: an account of the excavations at Tell Atchana in the Hatay, 1937-1949*. London: Society of Antiquaries.

Woolley, L. (1965) *Ur Excavations VIII: The Kassite Period and the Period of the Assyrian Kings*. London: British Museum.

Woolley, L. (1974) *The buildings of the Third Dynasty*. London: Trustees of the Two Museums.

Woolley, L., Mallowan, M.E.L. and Mitchell, T.C. (1976) *Ur excavations VII, The Old Babylonian period*. London: British Museum Publications.

Wright, G.R.H. (1985) *Ancient building in south Syria and Palestine*. Leiden: Brill.

Wright, G.R.H. (2000) *Ancient building technology. Volume 1: Historical background*, *Technology and change in history*. Leiden: Brill.

Wright, G.R.H. (2009) *Ancient Building Technology, Volume 3: Construction*, *Technology and change in history*. Leiden: Brill.

Wulff, H.E. (1966) *The traditional crafts of Persia; their development, technology, and influence on Eastern and Western civilizations*. Cambridge: M.I.T. Press.

Yeomans, D.T. (2009) *How structures work : design and behaviour from bridges to buildings*. Chichester U.K. ;;Ames Iowa: Wiley-Blackwell.

Zarnkow, M. *et al.* (2006) “Kaltmaischverfahren – eine mögliche Technologie im Alten Orient,” *Brauwelt*, 10(10), pp. 272–275.

Zarnkow, M. *et al.* (2008) “Kaltmaischverfahren – eine Basistechnologie zum altoroientalische Bierbrauen. Interdiszipinäre Untersuchungen in der Siedlung von Tall Bazi/Nordsyrien vor rund 3200 Jahren,” in *Gesellschaft für Geschichte des Brauwesens e.V. Jahrbuch*. Berlin: Gesellschaft für Geschichte des Brauwesens e.V., pp. 59–80.

Zeder, M.A. (1998) “Pigs and emergent complexity in the ancient Near East,” *MASCA research papers in science and archaeology*, 13, pp. 109–122.

Summary

Building Assyrian Society: The Case of the Tell Sabi Abyad Dunnu

This dissertation investigates the construction, function, and social significance of the so-called *Dunnu* of Tell Sabi Abyad, an exceptionally well-preserved fortified settlement from the Middle Assyrian period (ca. 1230–1180 BCE) in the Balikh Valley of northern Syria. The study forms part of the research project *Consolidating Empire* and combines archaeological, architectural, and textual analyses to explore the relationship between the built environment and the imperial strategies of the Assyrian state.

The *Dunnu* is generally interpreted as a “fortified agricultural production centre”, and more broadly as a rural settlement serving as an administrative, economic, and military hub within the Middle Assyrian state. Because Tell Sabi Abyad represents the only nearly completely excavated example of such a settlement, it provides a unique opportunity to examine in depth the architecture, organization, and social meaning of this settlement type. The central research question concerns how the physical structure of Tell Sabi Abyad shaped activities and interactions within and around it. Key sub-questions address how the *dunnu* was constructed - its design and building process - and who was responsible for these choices. The issue is approached from both a top-down perspective (imperial planning and control) and a bottom-up one (local adaptation and everyday use).

First, the geographical and historical context in which the *dunnu* was established likely influenced its form and functions. The *dunnu* were institutions within the Middle Assyrian state structure and must be understood in the broader context of Assyrian expansionist policy and the efforts to integrate conquered regions economically. The Tell Sabi Abyad *dunnu* occupied a strategic location in the fertile yet vulnerable Balikh Valley, which for some time functioned as a frontier zone. This was also the area where the building materials necessary for the construction of the *dunnu* were sourced.

The Tell Sabi Abyad *dunnu* consisted of a walled settlement with several functional zones, including residential areas, storage facilities, administrative spaces, workshops, and defensive structures. Clay tablets inscribed in cuneiform confirm the Assyrian origin and administrative role of the complex. Archaeological data indicate a carefully planned settlement that underwent substantial modifications within a relatively short period.

The dissertation analyses how sequences of construction activities and the deposition of mudbrick debris reveal building phases, maintenance practices, and reuse patterns. These data are essential for understanding the life cycle of the settlement and the ways in which its inhabitants physically shaped their environment. One key outcome is that the *dunnu* was not rebuilt as a whole but was modified, repaired, or dismantled in clusters. This conclusion is supported by the internal consistency of construction techniques and depositional features within building groups. The degree to which these interventions occurred synchronously remains difficult to determine. However, there is little evidence to support the hypothesis that decay or collapse prompted these alterations; rather, they seem to reflect deliberate functional and spatial reorganization.

A proper understanding of such settlements requires insight into the building culture of Late Bronze Age societies, particularly their mudbrick architecture. The full construction process is discussed - from material

selection to structural techniques, including foundations, bonding patterns, vaults, and roofs. In this context, the architectural characteristics of the *dunnu* are examined in detail. Traces within the wall construction demonstrate that the complex was built by professional craftsmen familiar with the techniques and the properties of materials. The overall approach reveals pragmatic efficiency, yet subtle variations in masonry and material choice point to a greater complexity whose meaning remains only partly understood. Technical aspects of architectural modifications, such as the opening and closing of doorways and the relocation of walls, are likewise considered.

Based on architectural analysis, the building phases are reconstructed and the spatial configuration of the *dunnu* is examined. Using architectural, archaeological, and spatial criteria, individual buildings and the distinction between roofed and open areas are formally defined. Spatial modelling and accessibility analysis reveal how routes, thresholds, and sightlines structured movement within the settlement. The influence of smaller built features, such as bread ovens and storage bins, on internal circulation is also examined. Special attention is paid to lighting, ventilation, and drainage, which demonstrate practical solutions for comfort and hygiene in a semi-arid climate. Wall thicknesses are used to estimate building heights, and a possible relationship is observed between height variation, the positioning of open spaces, and light distribution - indicating a deliberate design. The defensive architecture - walls, gates, and towers - is analysed systematically as well, revealing that security and control were central design principles.

Analyses of activity and circulation patterns form the basis for exploring functional differentiation within the site. To complete the picture, earlier research on activity patterns based on artefact distributions and textual evidence from the cuneiform tablets is also included. The results point to a clear spatial zoning of functions, visible in the architecture, infill processes, and access patterns. The northwestern sector likely functioned as an administrative centre, while the southern and eastern zones were primarily devoted to food production, craft activities, and habitation. Extramural areas accommodated potters, craftsmen, and possibly facilities for travellers and animals. The large central tower is identified as the most probable location for grain storage, based on its proximity to the main courtyard (where harvests were likely received), its massive construction, and its secure position. Although it is difficult to generalize from a single example, it seems plausible that *dunnus*, as multifunctional settlements, were organized modularly, with buildings and architectural forms flexibly adapted to local conditions and changing needs.

In summary, the *dunnu* of Tell Sabi Abyad exhibits a series of purposeful, top-down–initiated renovations in which controlled demolition and spatial reorganization served functional rather than restorative aims. As a result, the previously assumed boundary between building levels 6 and 5 becomes blurred, and continuity of occupation dominates until a later phase of decline. Major building campaigns reorganized access and use, while smaller, local adjustments occurred mainly after the administrative peak and during the much later reuse of the complex. Architecture influenced movement, labour, and social hierarchy, structuring distinctions between representational, domestic, and productive zones.

Methodologically, the study demonstrates how reanalysis of older excavation data - through systematic stratigraphic classification, sequence diagrams, and constructional studies - can yield new insights into phasing and use. The integration of stratigraphic and constructional evidence proved essential for recognizing both continuity and functional change. At the same time, the study highlights the limitations of existing field data and the need for future microstratigraphic, petrographic, and digital (3D) research. It

emphasizes the importance of making interpretive uncertainties explicit and of modelling their impact on archaeological interpretation.

Samenvatting

Assyrische samenleving gebouwd: de casus van de Dunnu van Tell Sabi Abyad

Deze dissertatie onderzoekt de constructie, functie en sociale betekenis van de zogenoemde *Dunnu* van Tell Sabi Abyad, een uitzonderlijk goed bewaarde versterkte nederzetting uit de Midden-Assyrische periode (ca. 1230–1180 v.Chr.) in de Balikhvallei in Noord-Syrië. De studie maakt deel uit van het onderzoeksproject *Consolidating Empire* en combineert archeologische, architectonische en tekstuele analyse om de relatie tussen de gebouwde omgeving en de imperiale strategieën van de Assyrische staat te begrijpen.

De *Dunnu* wordt doorgaans geïnterpreteerd als een "fortified agricultural production centre": een versterkte landbouwnederzetting die diende als bestuurlijk, economisch en militair knooppunt binnen de Midden-Assyrische staat. Omdat Tell Sabi Abyad het enige bijna volledig opgegraven voorbeeld van een dergelijke nederzetting is, biedt de site een unieke kans om de architectuur, organisatie en sociale betekenis van dit type nederzetting diepgaand te onderzoeken. De centrale onderzoeksvraag luidt hoe de fysieke structuur van Tell Sabi Abyad interacties en activiteiten in en rondom beïnvloedt. Belangrijke deelvragen zijn hoe de *Dunnu* is gerealiseerd (vormgeving en bouw) en wie hierin de keuzes maakte. Dit vraagstuk wordt benaderd vanuit zowel een top-down perspectief (imperiale planning en controle) als een bottom-up benadering (lokale aanpassing en dagelijks gebruik).

De geografische en historische context waarin de *Dunnu* tot stand is gekomen is van invloed geweest op de vorm en functies van het complex. De *dunnu* zijn instituties binnen de Midden-Assyrische staatsstructuur. Zij moeten worden geplaatst binnen de bredere context van Assyrische expansiepolitiek en de pogingen om veroverde gebieden economisch te integreren. Die van Tell Sabi Abyad had een geografische ligging in de vruchtbare maar kwetsbare Balikh vallei, die enige tijd als grens functioneerde. Hier zijn tevens de bouwmaterialen gewonnen die nodig waren voor het realiseren van de *Dunnu*.

De Tell Sabi Abyad *Dunnu* bestond uit een ommuurde nederzetting met verschillende functionele zones, waaronder woonruimten, opslagplaatsen, administratieve vertrekken, werkplaatsen en defensieve structuren. Kleitabletten met spijkerschrift bevestigen de Assyrische herkomst en de administratieve rol van het complex. De archeologische gegevens wijzen op een zorgvuldig geplande nederzetting die in korte tijd aanzienlijke aanpassingen onderging.

De dissertatie analyseert hoe sequenties van bouwactiviteiten en deposities van leem en puin inzicht bieden in bouwfasen, onderhoud en hergebruik. Deze gegevens zijn essentieel om de levenscyclus van de nederzetting en de manier waarop bewoners hun omgeving fysiek vorm gaven te begrijpen. Een uitkomst van de analyse is dat de *Dunnu* niet geheel maar per cluster werd aangepast, hersteld of afgebroken. Dit blijkt uit het feit dat gebouwgroepen interne overeenkomsten vertonen in bouwkundige oplossingen en kenmerken van de deposities. In hoeverre deze ingrepen synchroon verliepen, blijft moeilijk vast te stellen. Wel is er weinig bewijs gevonden voor de hypothese dat verval en instorting de vernieuwingen hebben veroorzaakt; de aanpassingen lijken eerder voort te komen uit een behoefte aan functionele en ruimtelijke herinrichting.

Essentieel om dit soort nederzettingen te bestuderen is kennis van de bouwcultuur van samenlevingen in de Late Bronstijd, met nadruk op leemtichelarchitectuur. De volledige bouwketen wordt behandeld - van

materiaalkeuze tot constructietechnieken, waaronder fundering, muurverbanden, gewelven en daken. In dat licht worden de bouwkenmerken van de *Dunnu* uitvoerig geanalyseerd. Sporen in de muurbouw tonen aan dat het complex werd gerealiseerd door professionele bouwers met technische kennis van materialen en technieken. De aanpak getuigt van pragmatische efficiëntie. Subtiele variaties in metselverbanden en materiaalkeuze wijzen op een grotere complexiteit, waarvan de betekenis nog niet geheel duidelijk is. Ook de bouwtechnische kenmerken van aanpassingen, zoals het openen en sluiten van deuren en het verleggen van muren, worden besproken.

Op basis van de bouwkundige analyses worden de bouwfasen gereconstrueerd en de ruimtelijke configuratie van de *Dunnu* onderzocht. Op basis van architectonische, archeologische en ruimtelijke criteria worden afzonderlijke gebouwen en het onderscheid tussen overdekte en open ruimtes formeel bepaald. Met behulp van ruimtelijke modellering en toegankelijkheidsanalyse wordt zichtbaar hoe routes, drempels en zichtlijnen de beweging binnen de nederzetting bepaalden. Daarbij wordt ook gekeken naar de invloed van kleinere bouwwerken, zoals broodovens en opslagbakken, op de interne circulatie. Speciale aandacht gaat uit naar lichtinval, ventilatie en drainage, die wijzen op praktische oplossingen voor comfort en hygiëne in een semi-aride klimaat. Aan de hand van muurdiktes worden gebouwhoogtes gereconstrueerd. Een mogelijk verband wordt gezien tussen de ruimtelijke variatie van gebouwhoogtes, plaatsing van open ruimtes en lichtinval. Dit alles duidt op een weloverwogen ontwerp. De verdedigingsarchitectuur - muren, poorten en torens - wordt eveneens systematisch geanalyseerd. Daaruit blijkt dat veiligheid en controle cruciale uitgangspunten vormden in het ontwerp.

Op basis van de analyse van activiteiten en circulatiepatronen worden functionele verschillen onderzocht. Hierbij wordt de link gelegd met eerder gepubliceerd onderzoek naar de activiteiten binnen de *Dunnu* op basis van gegevens uit de vondstverspreidingen en uit de kleitabletten. Hieruit blijkt een duidelijke zonering van ruimtelijke functies, die zichtbaar is in zowel de architectuur, de invulprocessen als het toegangspatroon. De noordwestelijke sector functioneerde vermoedelijk als administratief centrum, terwijl de zuidelijke en oostelijke zones meer gericht waren op voedselproductie, ambachtelijke activiteiten, en bewoning. Extramurale zones herbergden pottenbakkers, ambachtslieden en mogelijk voorzieningen voor reizigers en dieren. De grote centrale toren wordt als meest waarschijnlijke locatie voor graanopslag gezien op basis van nabije toegang tot het grote hof, waar de oogst vermoedelijk werd binnengebracht, zijn zware bouw en de veiligheid van deze locatie. Hoewel het op basis van één voorbeeld moeilijk te generaliseren is, lijkt het niet onredelijk te veronderstellen dat *dunnus* als multifunctionele nederzettingen modulair waren opgebouwd, waarbij gebouwen en bouwvormen flexibel konden worden ingezet afhankelijk van lokale omstandigheden en veranderende behoeften.

Samenvattend kunnen we zeggen dat de *Dunnu* een reeks doelgerichte, top-down aangestuurde renovaties aantoont, waarbij gecontroleerde sloop en herinrichting eerder functionele doeleinden dan herstel van vervallen architectuur weerspiegelen. Hierdoor vervaagt de eerder gepostuleerde tussen de bouwniveaus 6 en 5; de bewoningscontinuïteit overheerst tot aan een latere fase van verval. Grote bouwcampagnes reorganiseerden toegang en gebruik. De veelal kleinere lokale aanpassingen vinden pas plaats in de nasleep van de administratieve hoofdperiode en bij het veel latere hergebruik van de gebouwen van de *Dunnu*. De architectuur had invloed op bewegingen, arbeid en sociale hiërarchie, met een scheiding tussen representatieve, huishoudelijke en productieve zones.

Methodologisch laat het onderzoek zien hoe een heranalyse van oudere opgravingsdata met behulp van systematische stratigrafische classificatie, sequentiediagrammen en constructiestudies nieuwe inzichten kan opleveren over fasering en gebruik. De combinatie van stratigrafie en bouwtechniek bleek cruciaal voor het herkennen van continuïteit en functionele verandering. Tegelijk wijst de studie op de beperkingen van velddata en de noodzaak van microstratigrafisch, petrografisch en digitaal (3D) vervolgonderzoek. Hierbij wordt het belang van het expliciet maken van onzekerheden en het modelleren van de invloed van deze op interpretaties benadrukt.

Curriculum Vitae

Tijm Lanjouw (Groningen, 1982) earned his BA (2005) and RMA (2011, *cum laude*) in Archaeology from the University of Groningen. His RMA thesis focused on Mediterranean landscape archaeology, combining field surveys with spatial analysis in GIS. During this period, he gained extensive field experience through projects in Italy, Romania, and Ukraine, and also worked as a fieldwork assistant in Dutch commercial archaeology.

From 2012 to 2016, he pursued a PhD track at Leiden University as part of the project "Consolidating Empire", where he investigated the Middle Assyrian fortified settlement (*dunnu*) of Tell Sabi Abyad in northern Syria. His research concentrated on building techniques and architectural analysis.

Following his academic work, Tijm broadened his professional experience as a bicycle messenger, self-employed web designer, and videographer. He later joined the 4D Research Lab at the University of Amsterdam as a 3D Technician and Modeler, where he deepened his expertise in 3D modeling and expanded into digital humanities.

At the 4D Research Lab, he collaborates with a wide range of specialists, academic institutions, and museums - both nationally and internationally. His primary focus lies in virtual reconstruction, particularly of historical architecture in Amsterdam from the 17th to 19th centuries. Maintaining a strong connection to archaeology, he continues to participate in fieldwork projects in the Netherlands, Turkey, and Greece as a 3D capture and drone remote sensing specialist.