Building Assyrian society: the case of the Tell Sabi Abyad Dunnu

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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.

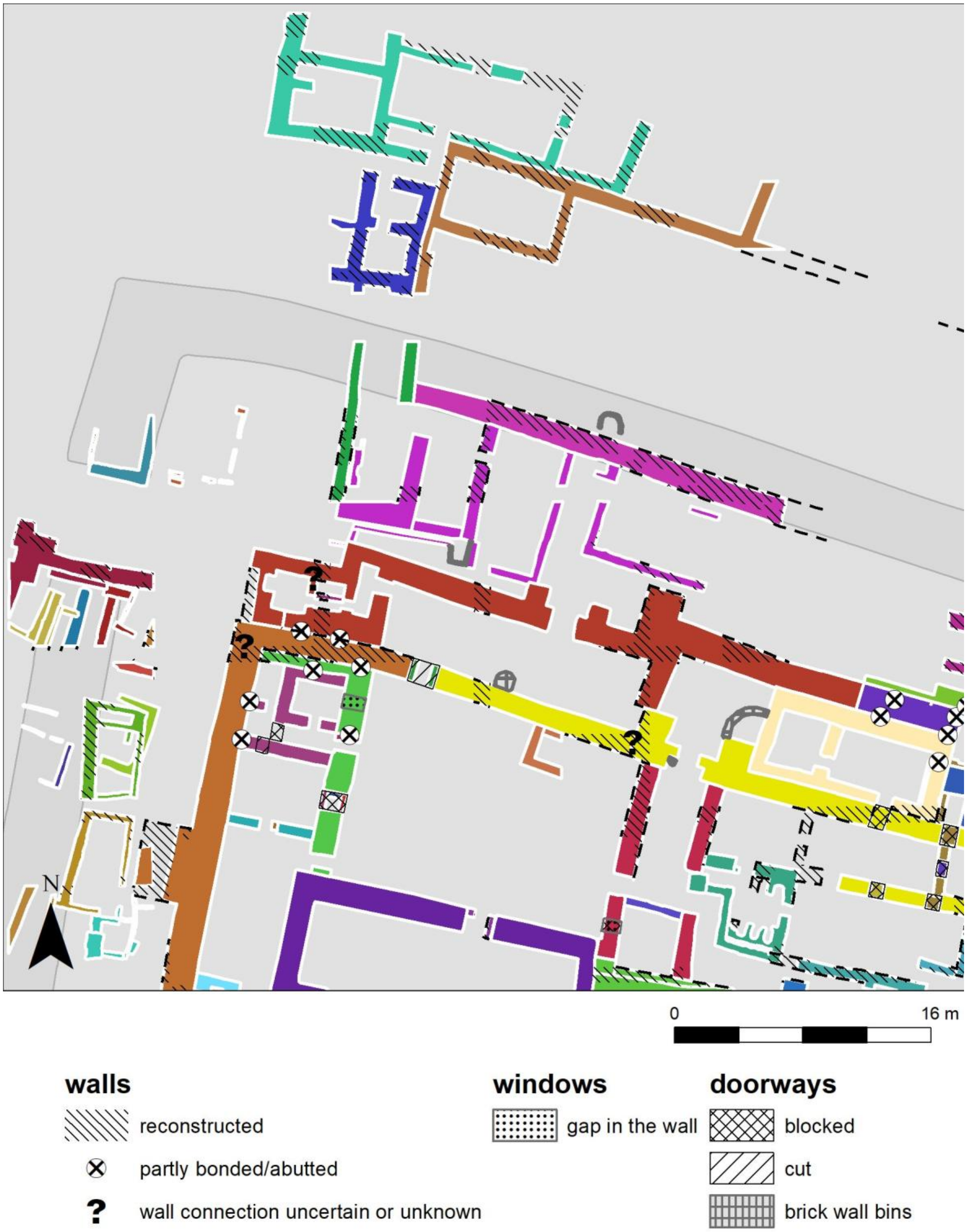


Figure 126. Construction units north-west.

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.

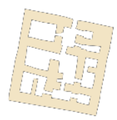
Probably the most important observation is that the *Dunnu* had two consecutive gates: the old gate and the new gate. The presence of the gates imply the existence of a closed ring of fortification, which must therefore also have existed at the same time. In the section analysing the fortifications, 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.



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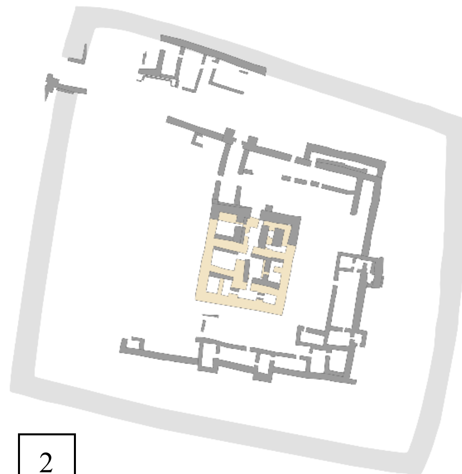

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Figure 130 (previous page). Alternative site phasing. This is just one of various options possible.

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.

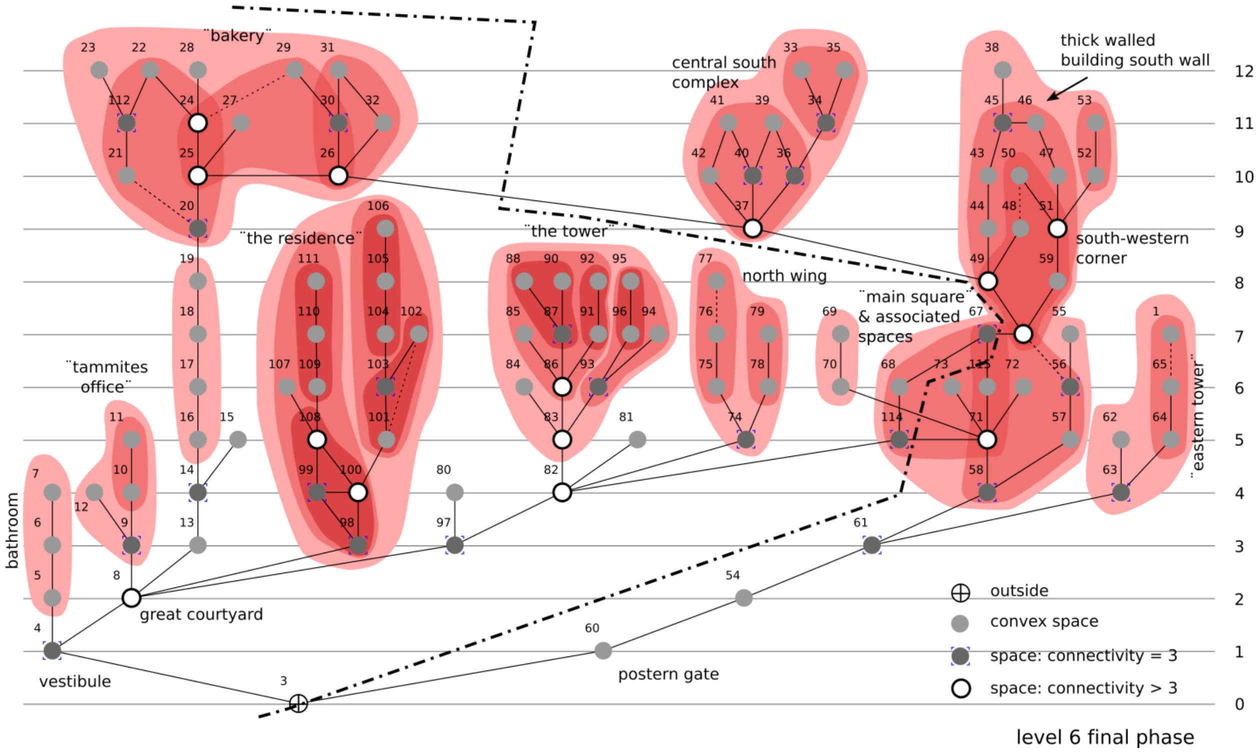

Figure 131. Spatial units as defined by connectivity graphs, early phase.

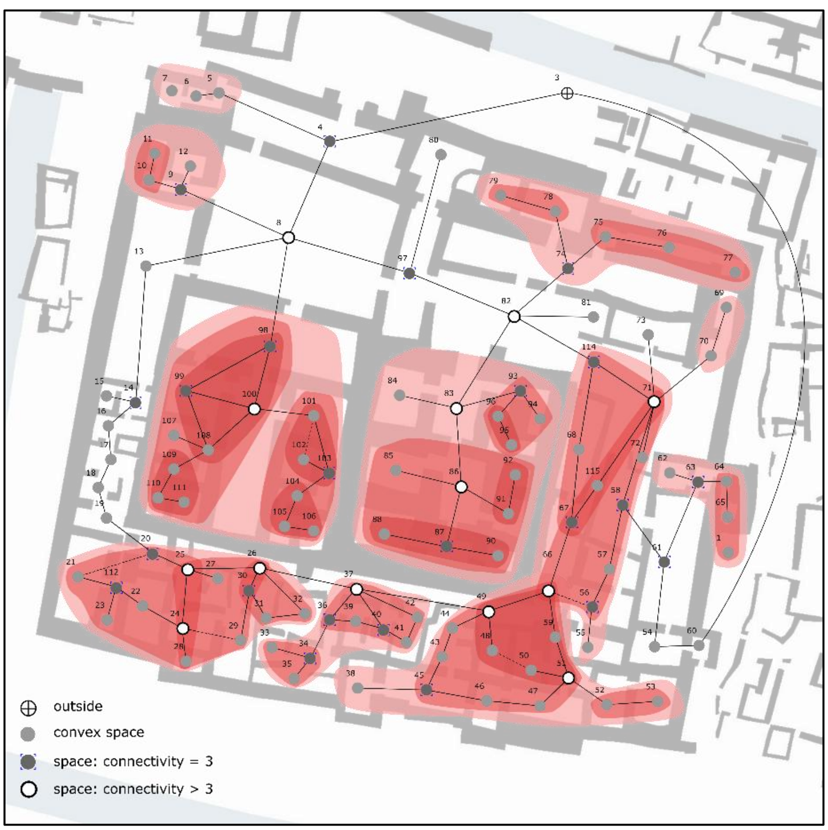

Figure 132. Projection of figure 131 on plan.

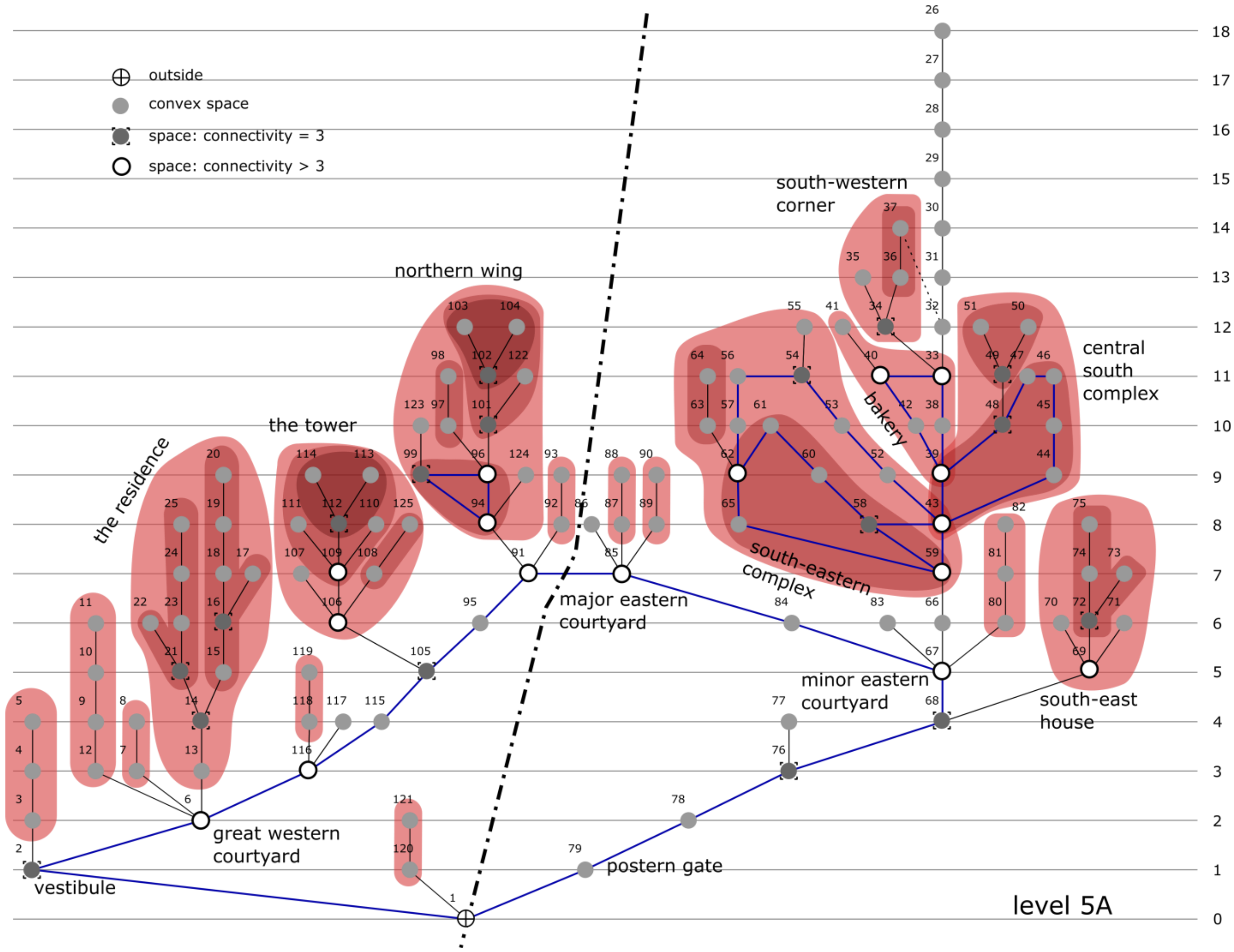

Figure 133. Spatial units as defined by connectivity graphs, later phase.

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).

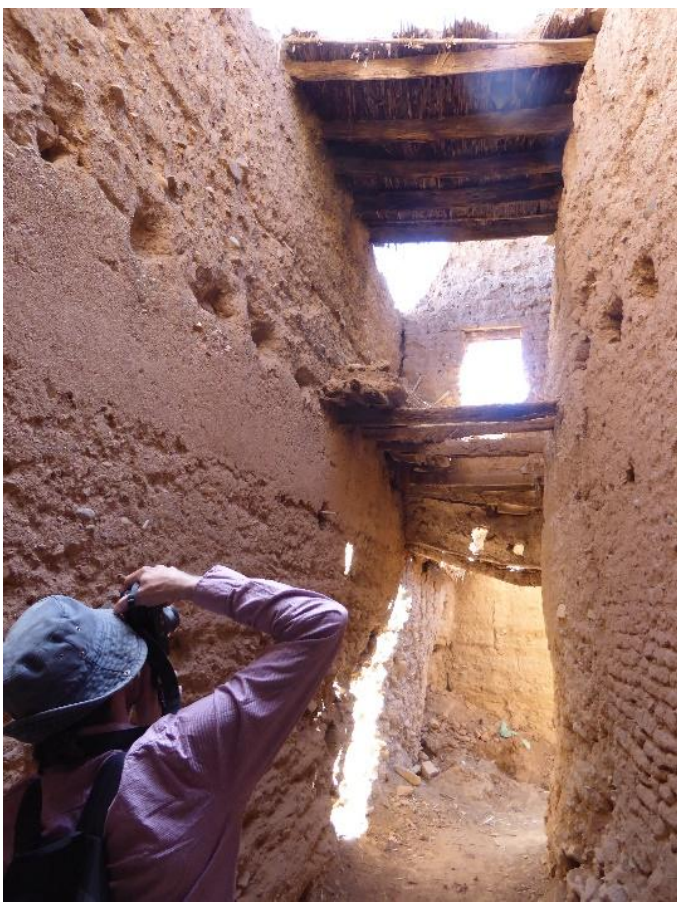

Figure 134. This alleyway in an abandoned walled settlement in south-eastern Morocco was once largely covered. The walking surface is that of an alley: untreated and irregular, with an erosion channel at the bottom. This would archaeologically not easily be identifiable as roofed area.

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.

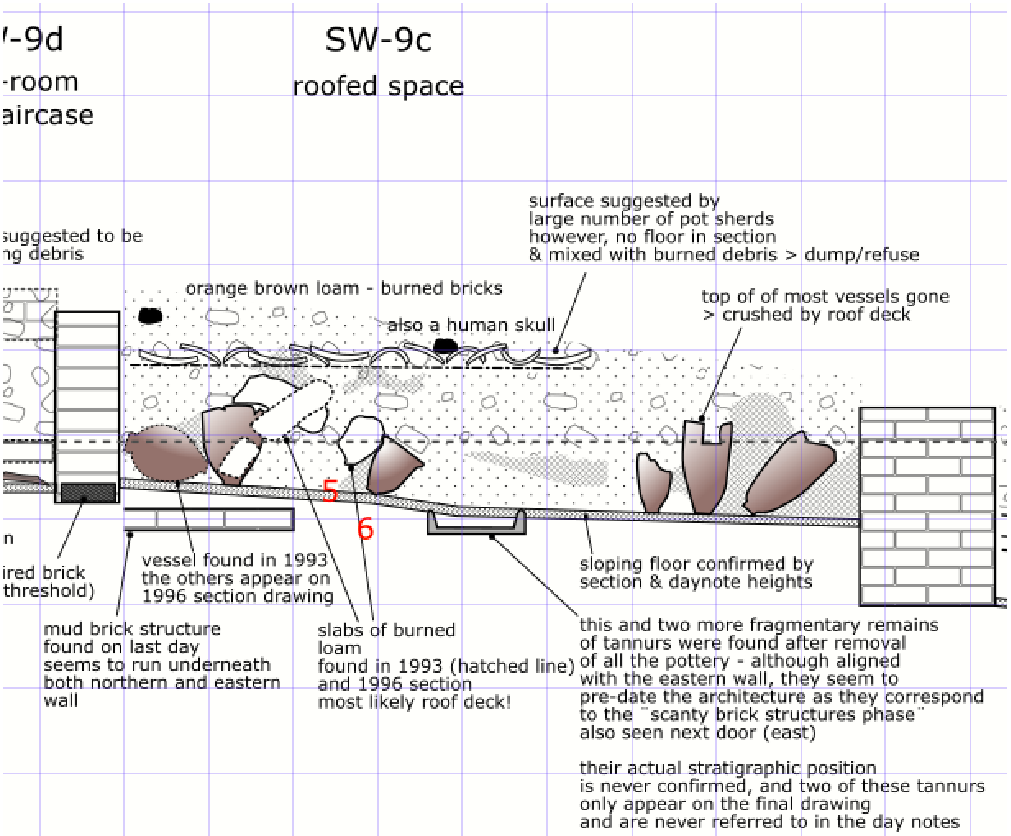

Figure 136. Deposit sequence graphs for space SW-9c, in which large slabs of burnt loam were noted that may very well be remains of a roof collapse.

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.

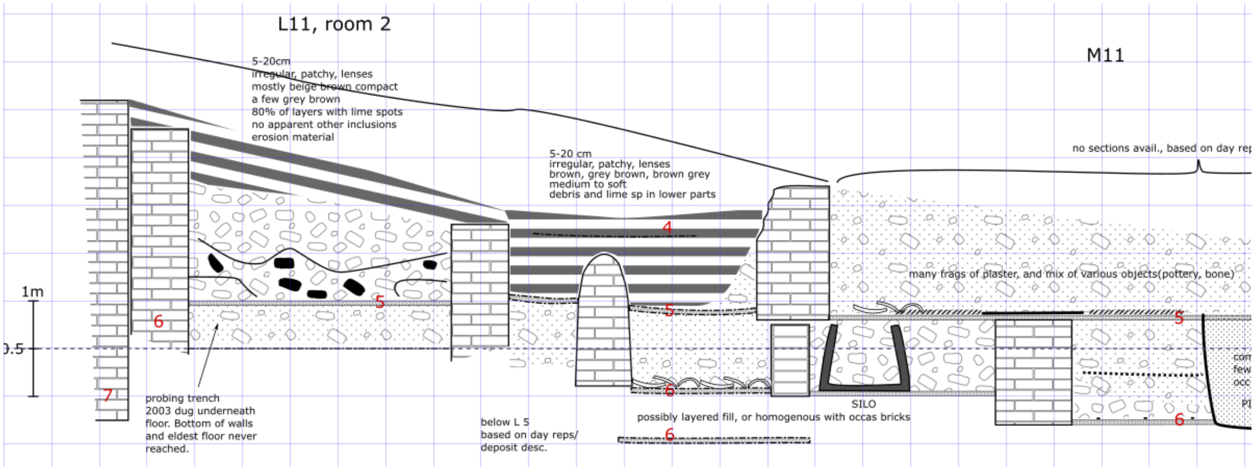

Figure 137. Typical difference between infills of potentially roofed and unroofed spaces. There is a marked lack of building collapse deposits in the middle space, and a presence of gradual (sedimentary) deposition associated with outside areas.

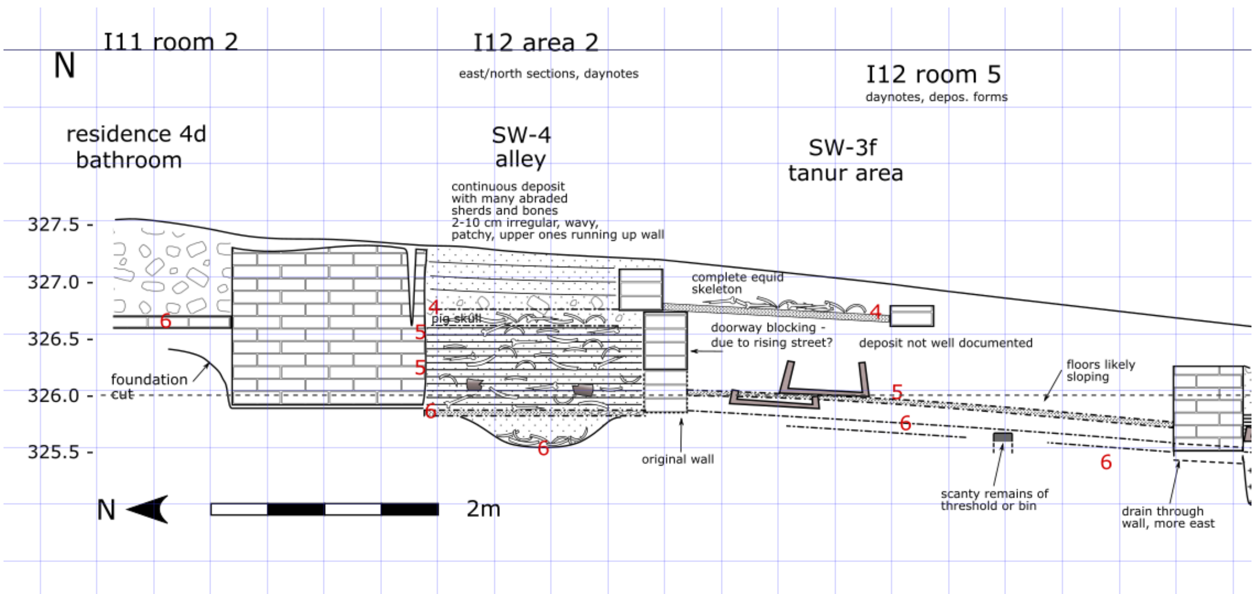

Figure 138. Deposit sequence graph, showing the difference between deposition inside a large building (left) and an open alleyway (right). The area on the right was most likely unroofed, as floor levels gradually raised, but the documentation did not allow to complete the graph drawing.

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.

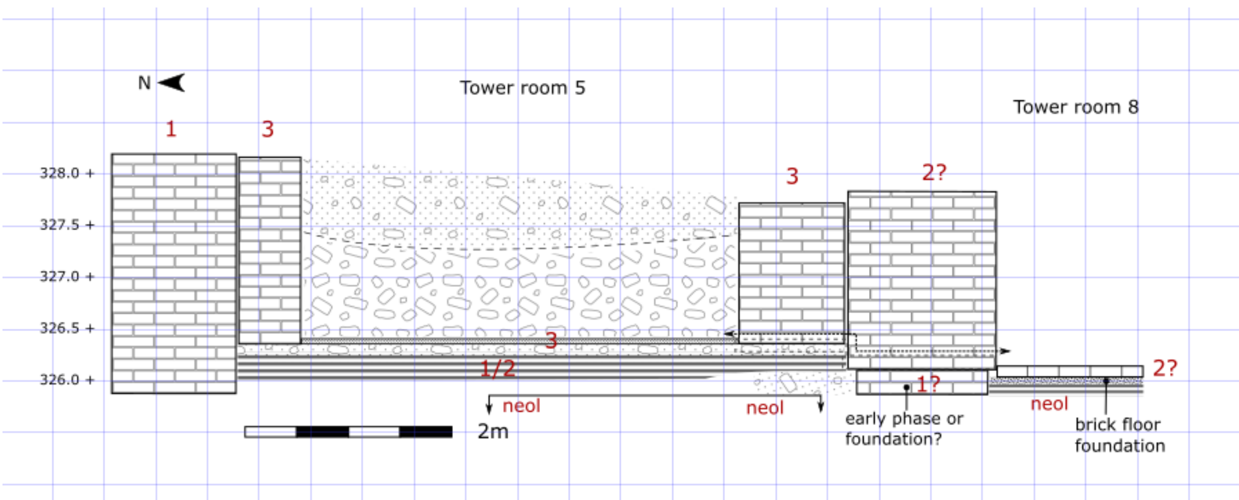

Figure 139. Deposit sequence graph of tower room 5.

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.

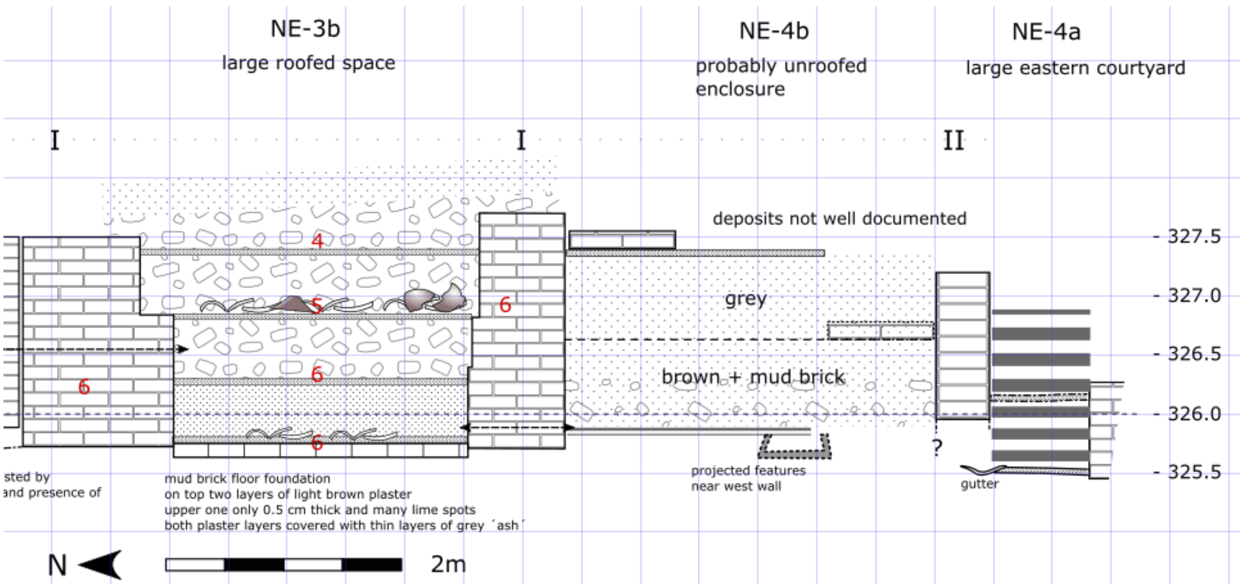

Figure 140. Deposit sequence graph showing the difference between a building with a high volume, much debris (left), and an area with significant lower concentration of debris (middle), and a courtyard (right). Based on this infill pattern it is uncertain whether the middle area was roofed or not, but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

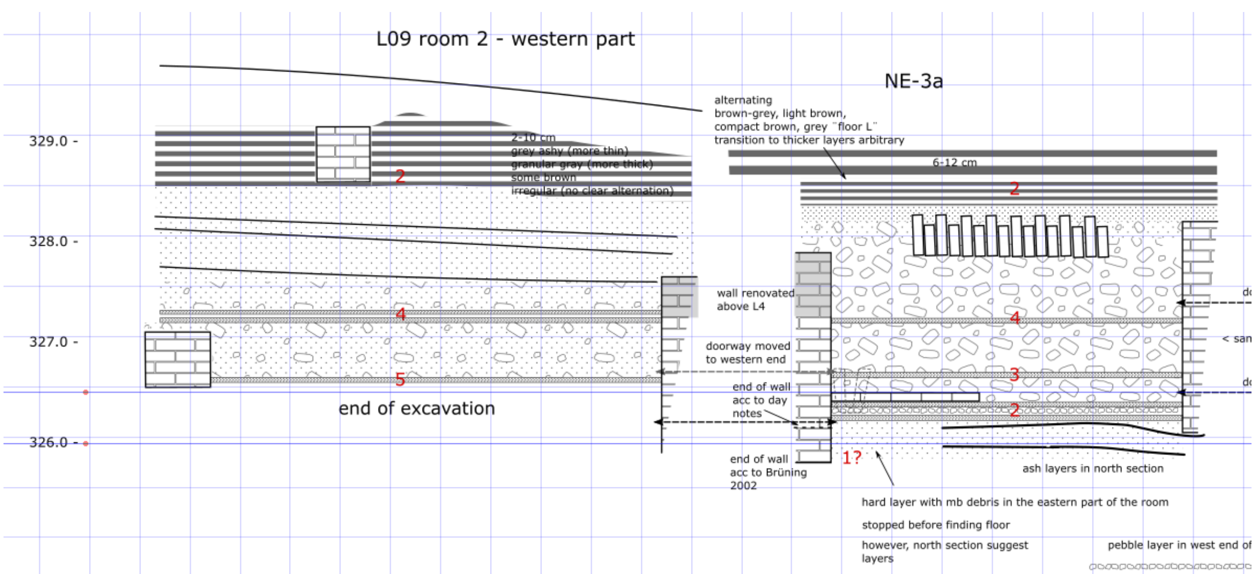

Figure 141. Example of two adjoining spaces showing a distinct difference in infill pattern and wall preservation, most likely attributable to the difference in roof coverage. Relative size of the spaces, and the presence of the old fortification wall on the right may however also have played a role.

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*.

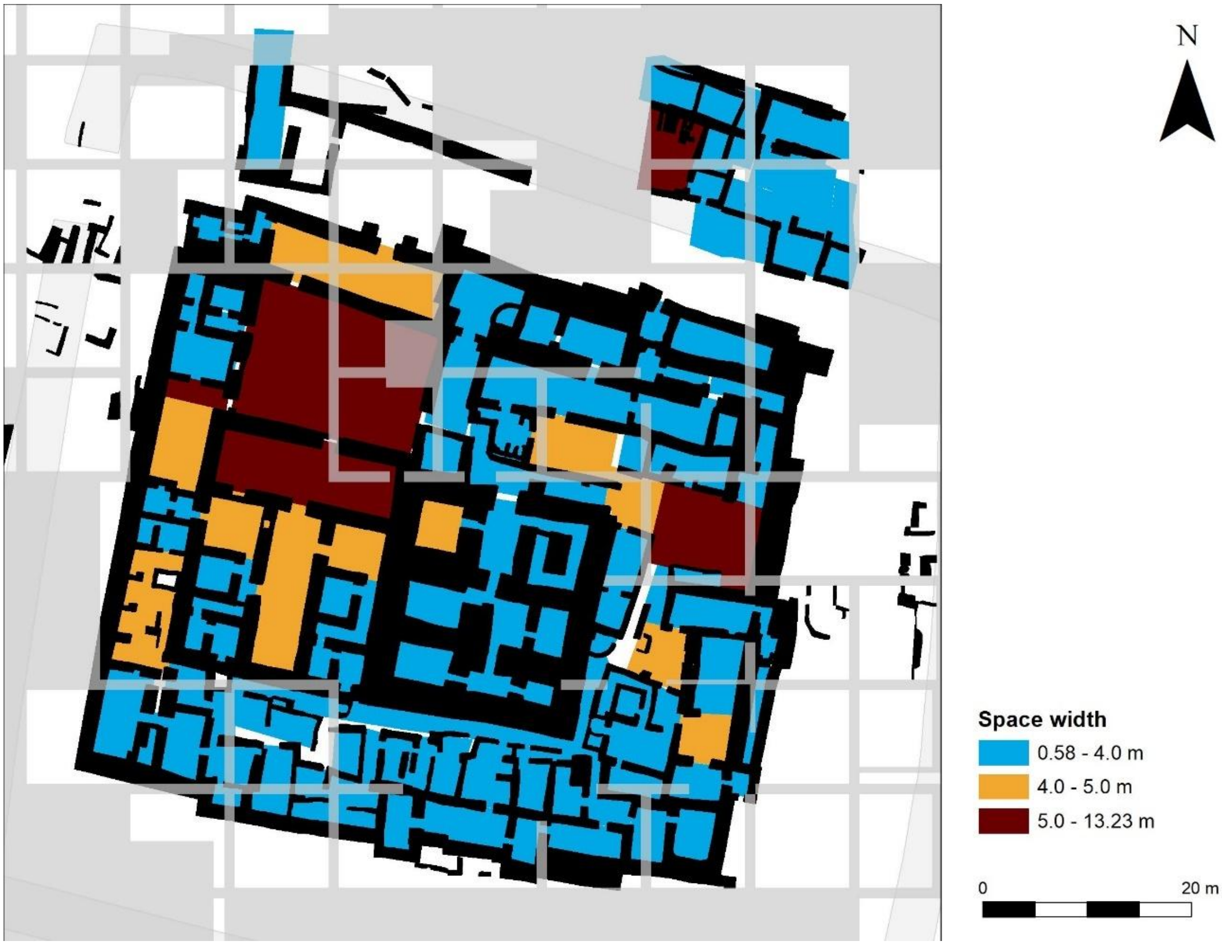

Figure 143. Width of spaces in the Dunnu.

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

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[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.

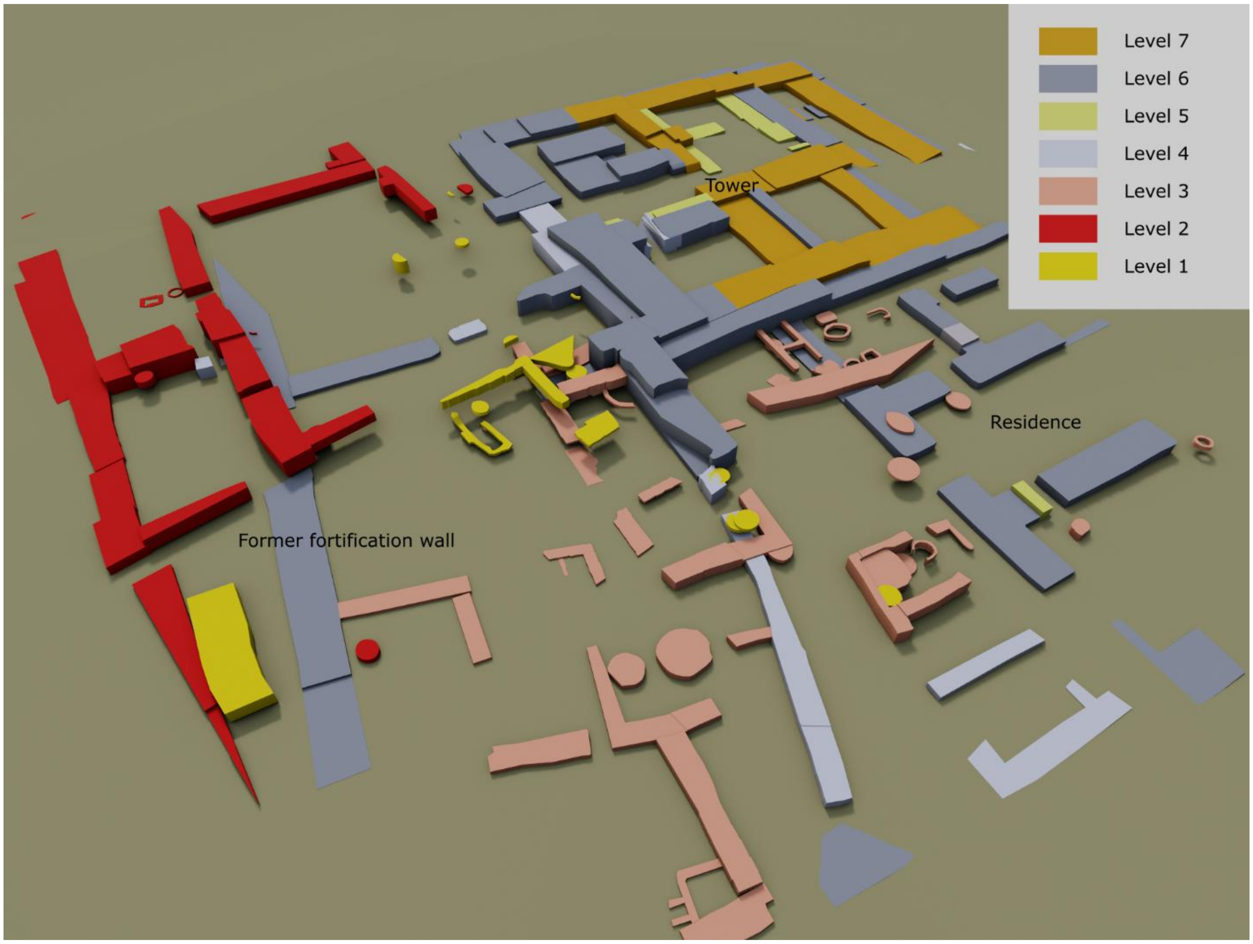

Figure 146. Approximation of level 2/3 walk surface and visibility of older architecture. Except for the tower, all other heavy architecture of the former Dunnu is now buried and overbuilt.

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,

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[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.

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[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 Haǧǧi 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 Meǧnūne (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

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[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).

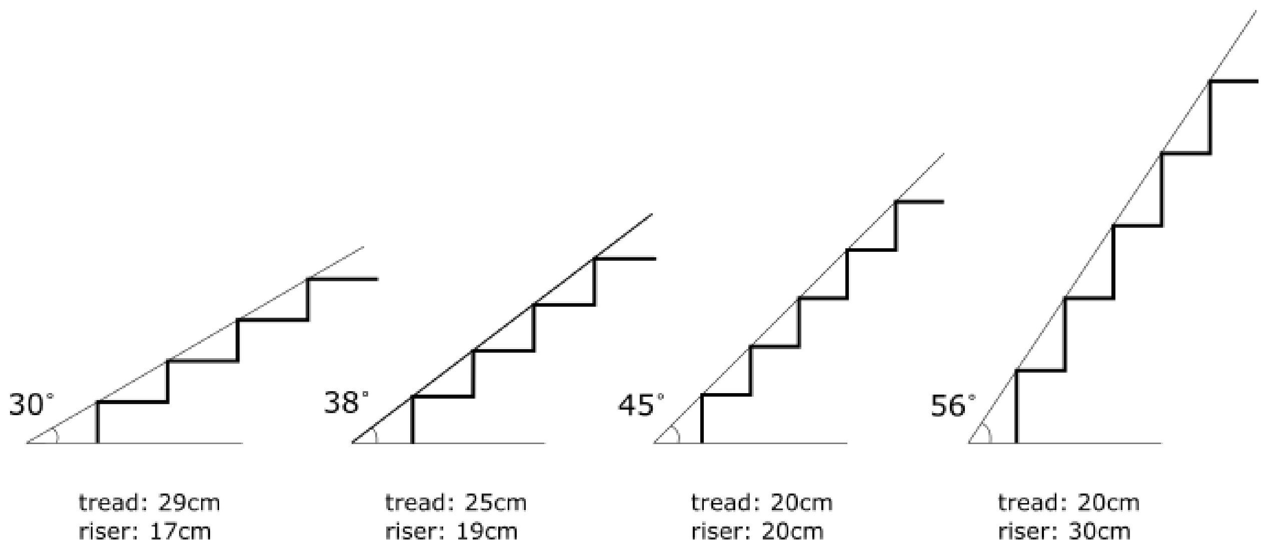

Figure 150. Step dimensions and incline. The two on the left are common dimensions of stairs in modern houses in the Netherlands. In the past, house stairs were steeper.

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.

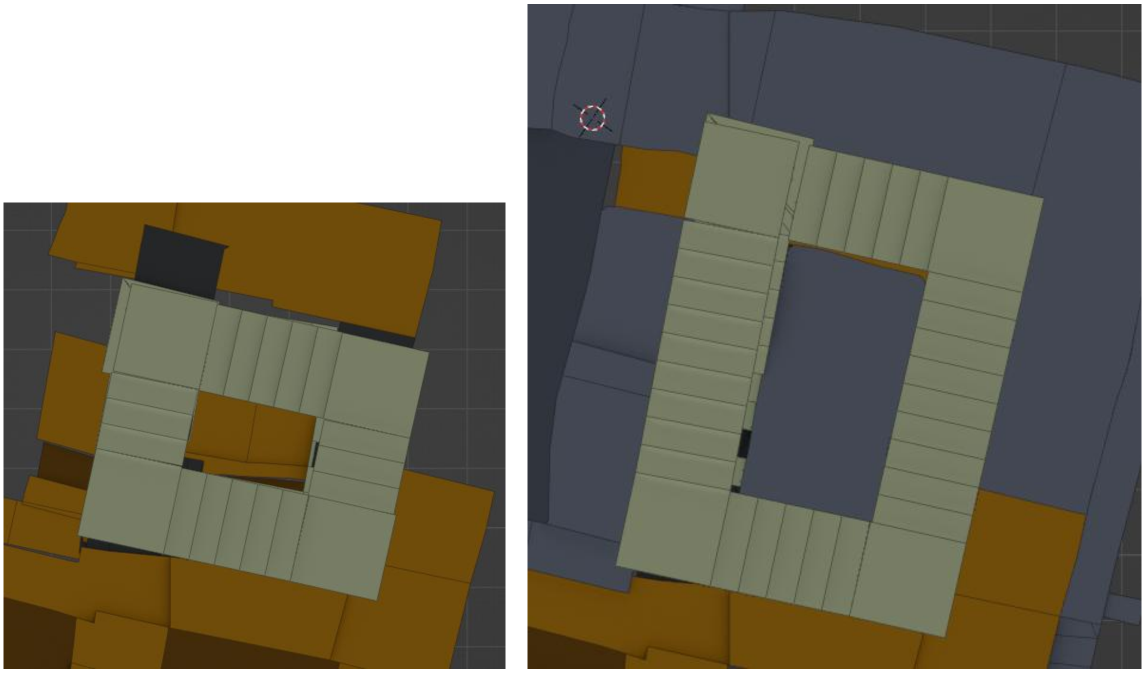

Figure 151. Plan comparison between earlier and later phase staircase.

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.

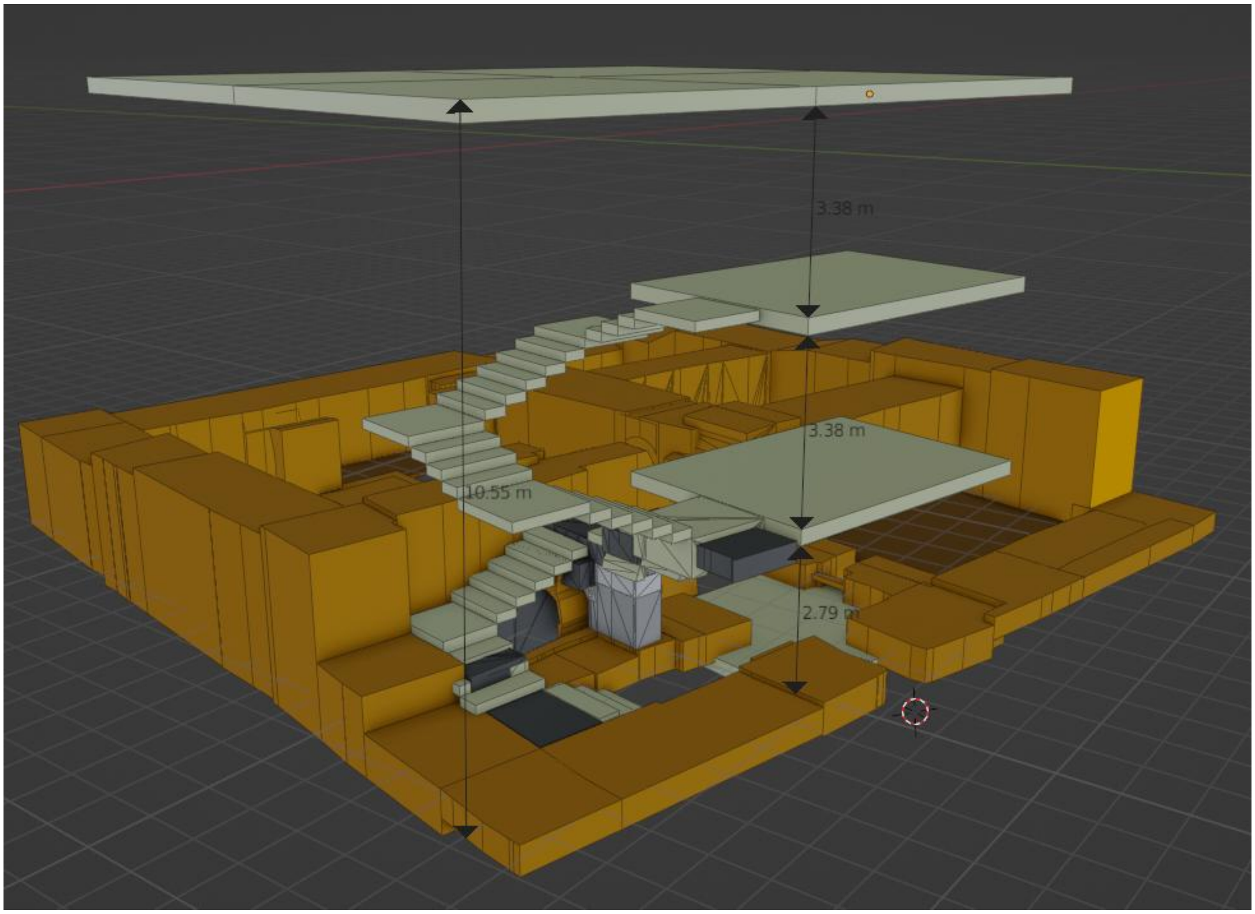

Figure 152. Reconstruction of staircase of the tower in the earlier phase.

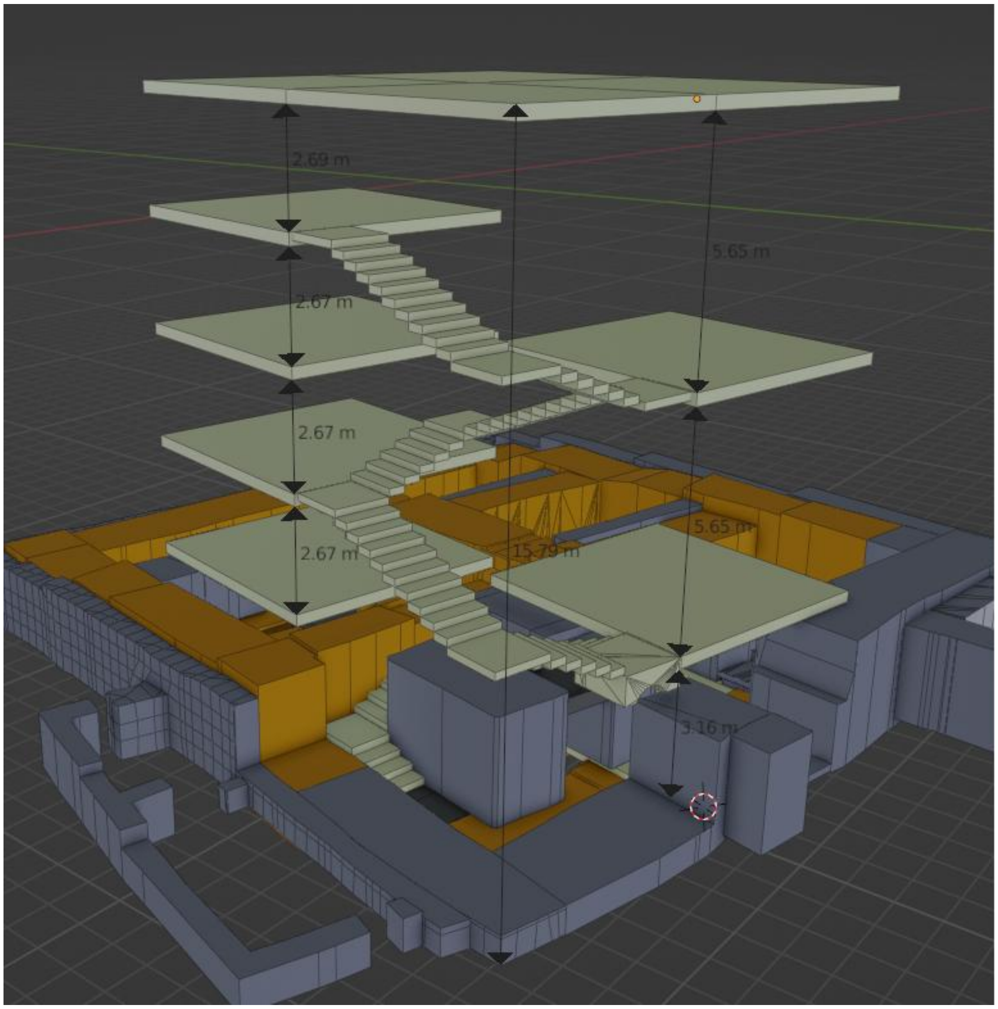

Figure 153. Reconstruction of the staircase in the later phase, with on the right the interdistance of the floors matching a full rotation of the stairs, and on the left the interdistance matching half a rotation.

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.

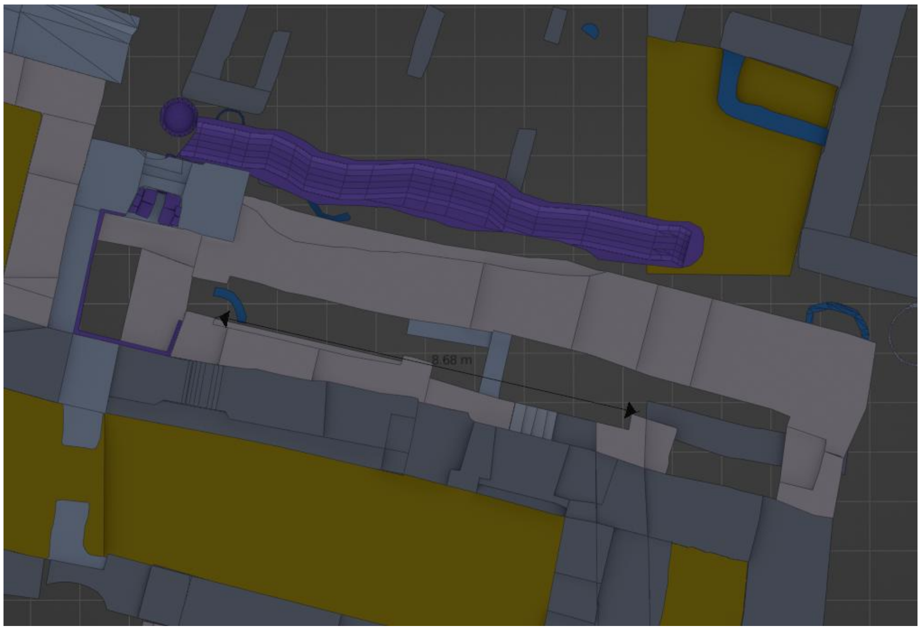

Figure 154. Elongated room with abutment constructed alongside the old fortification wall in the north-eastern corner of the Dunnu.

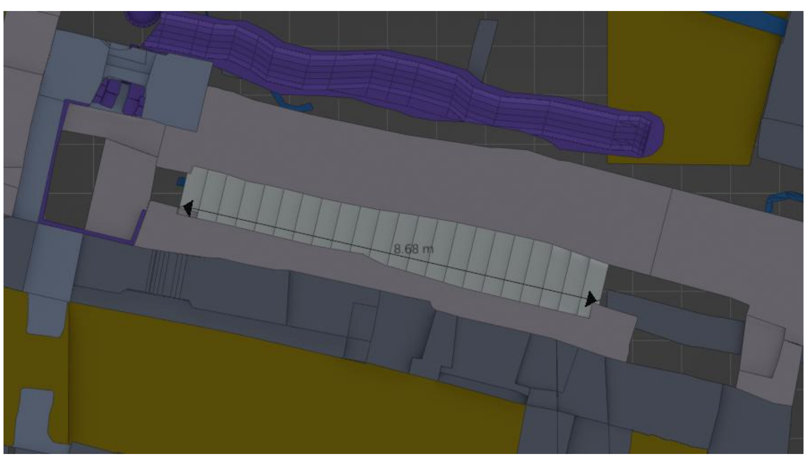

Figure 155. Placement of the steps in the ca. 8.70 m long space.

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.

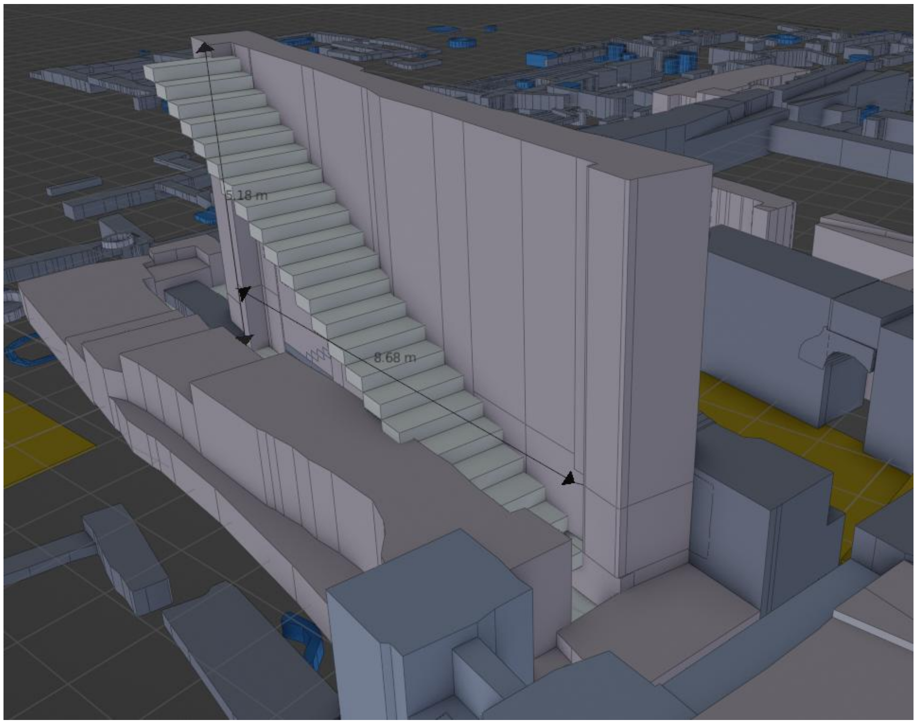

Figure 156. Hypothetical reconstruction of the staircase in north-eastern corner. Riser is 20 cm (two mud bricks), and tread is 40 cm (one mud brick).

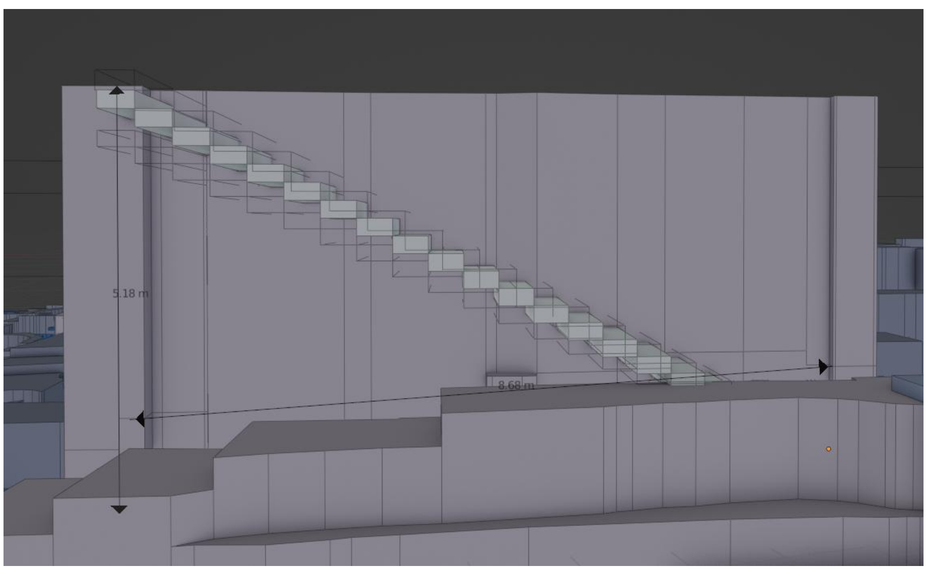

Figure 157. Visualisation of reconstruction range, using different riser and tread dimensions. The lower option has a reduced riser height (18 cm instead of 20 cm). The higher has both an increased riser height (22 cm) and tread length (42 cm).

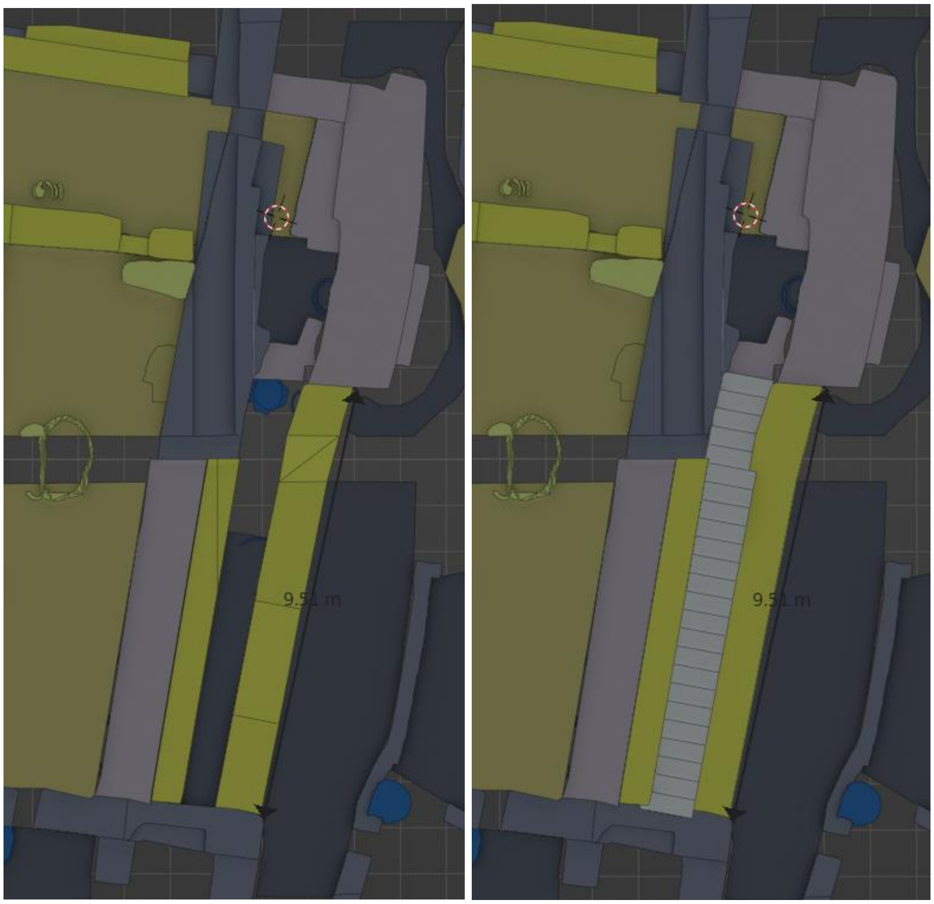

Figure 158. Construction most likely identified as a staircase in the south-eastern corner of the Dunnu. Left: reconstructed archaeological remains, right: reconstructed steps.

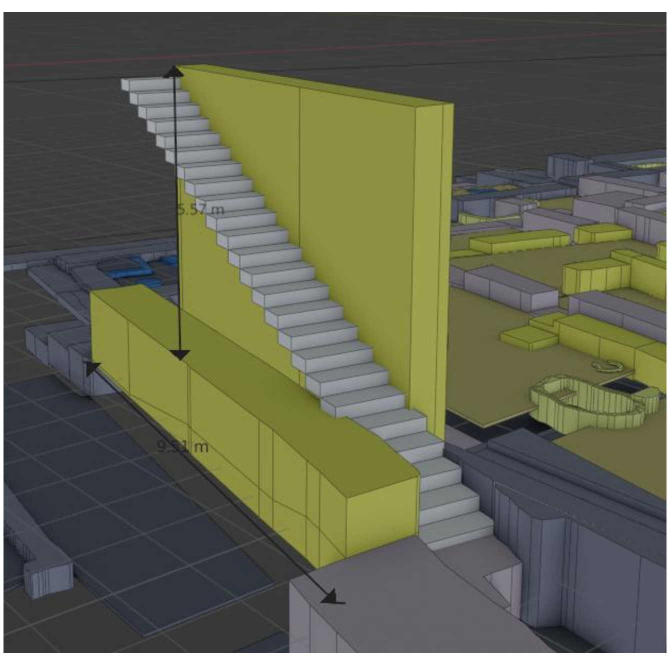

Figure 159. Reconstructed height of the staircase in the south-eastern corner.

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.

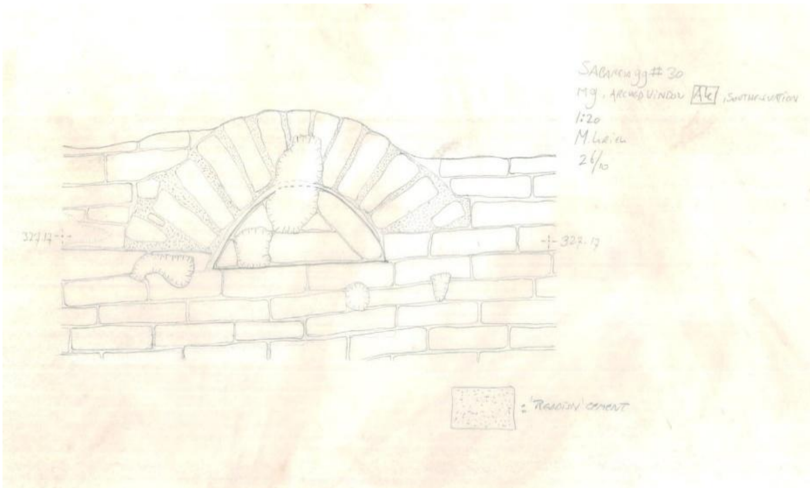

Figure 160. Window in the older phase fortification wall in M09.

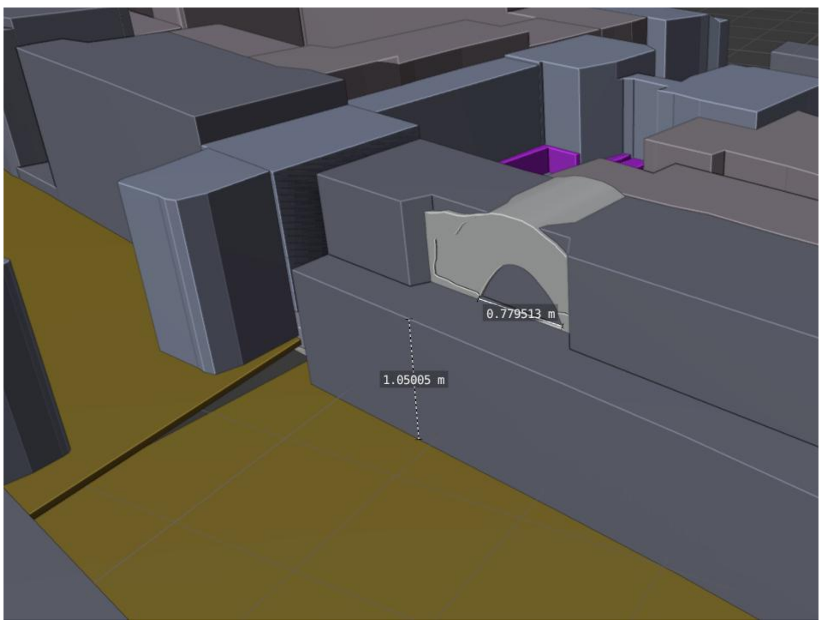

Figure 161. Architectural context of the window in M09.

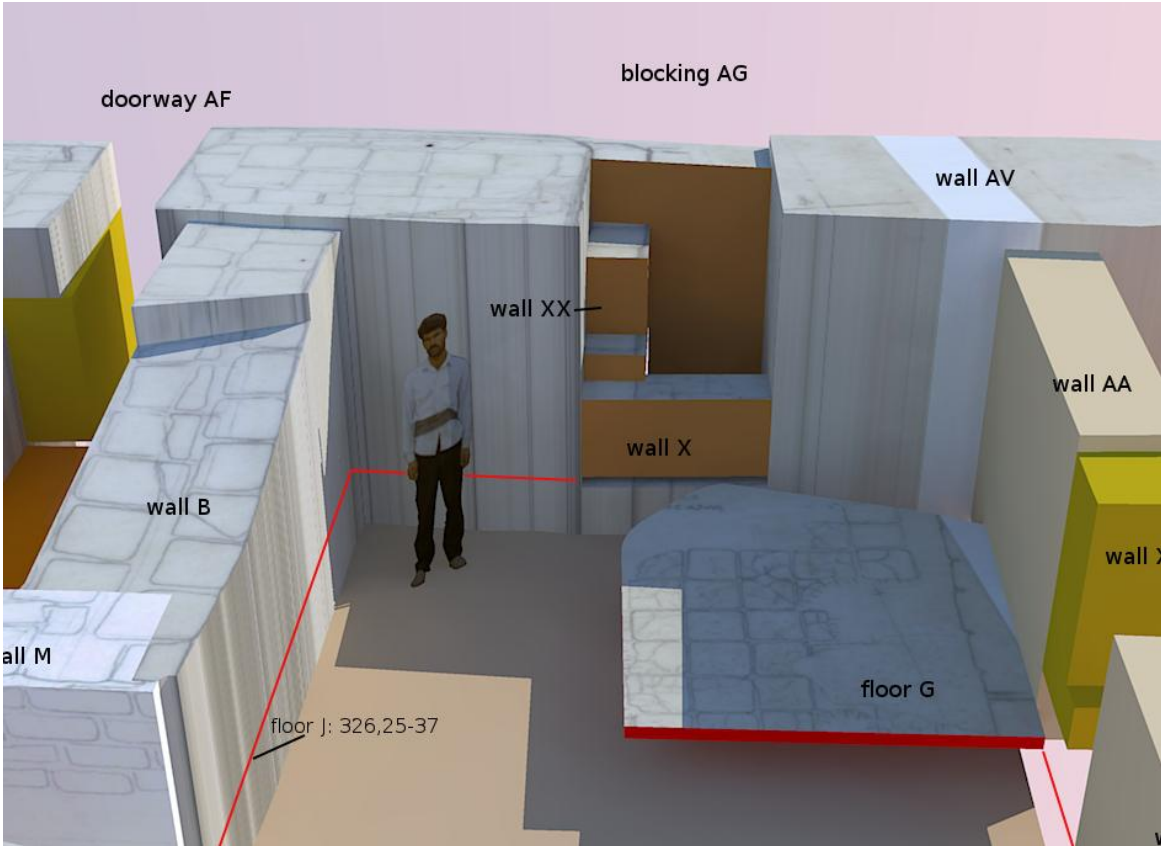

Figure 162. Window or doorway between central court (at the back) and space west of it (in front). It has odd blockings or modifications, sometimes even being characterised as 'stairway', in the excavation documentation.

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.

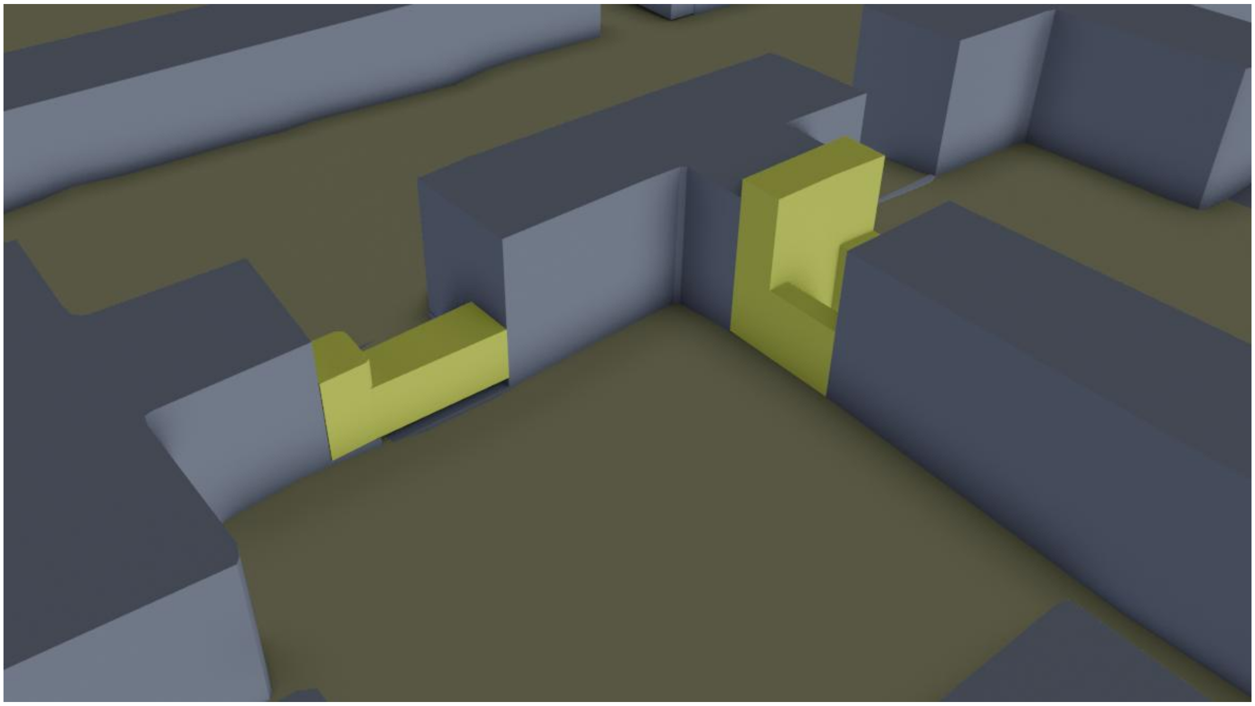

Figure 163. Two features potentially identifiable as windows or modified doorways in the largest 'private room' of the residence (2a).

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.

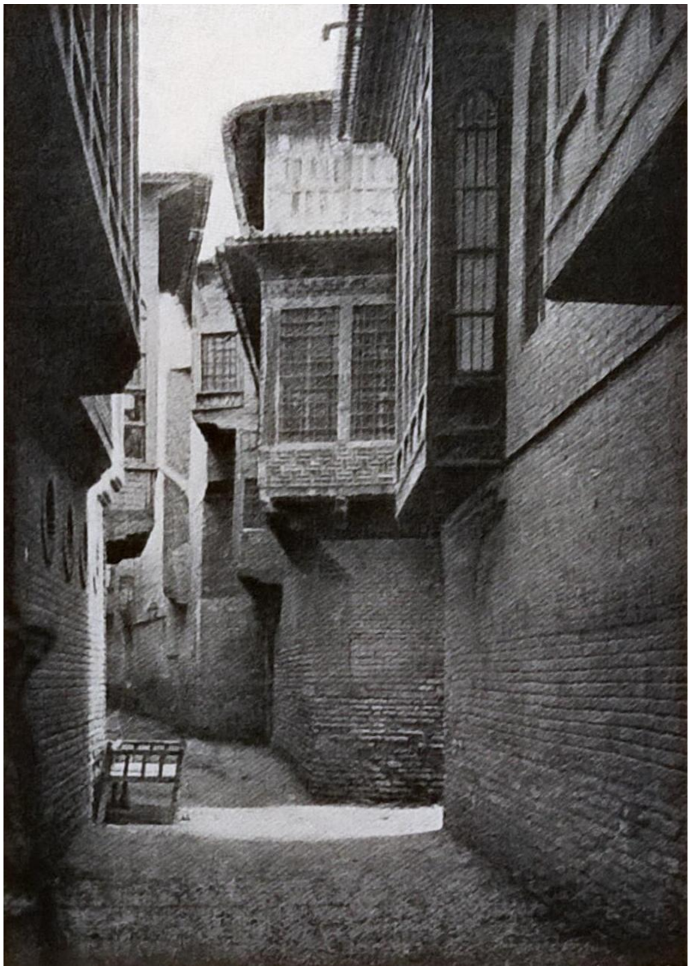

Figure 165. Street in Bagdad around 1900 showing no windows on ground level. Habitation occurs mainly on the first floor, which is amply fitted with the typical bay windows or mashrabiyyahs (after Reuther, 1910, fig. 76).

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.

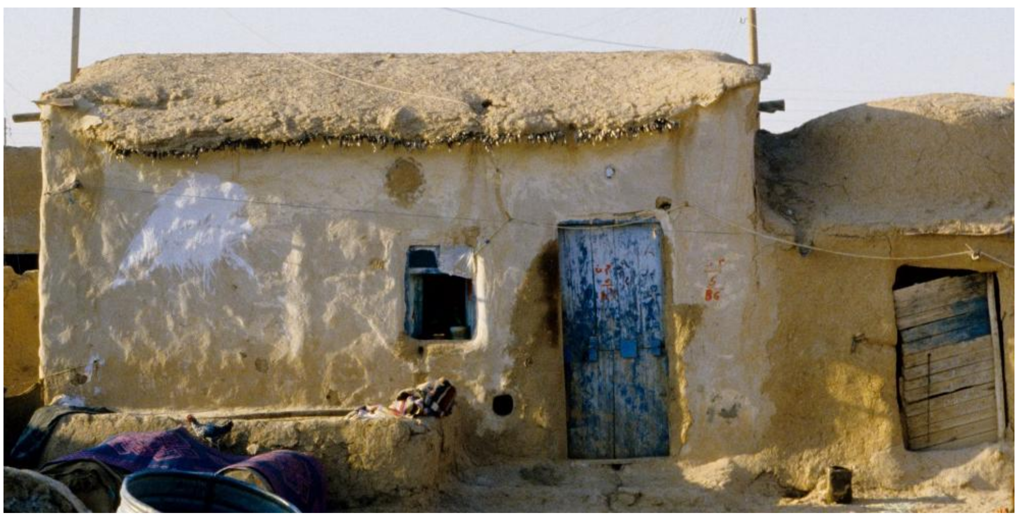

Figure 166. Simple single-storey dwelling in northern Syria. This house has one window next to the front door and a large ventilation hole at the bottom (photo by P. Akkermans).

[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).

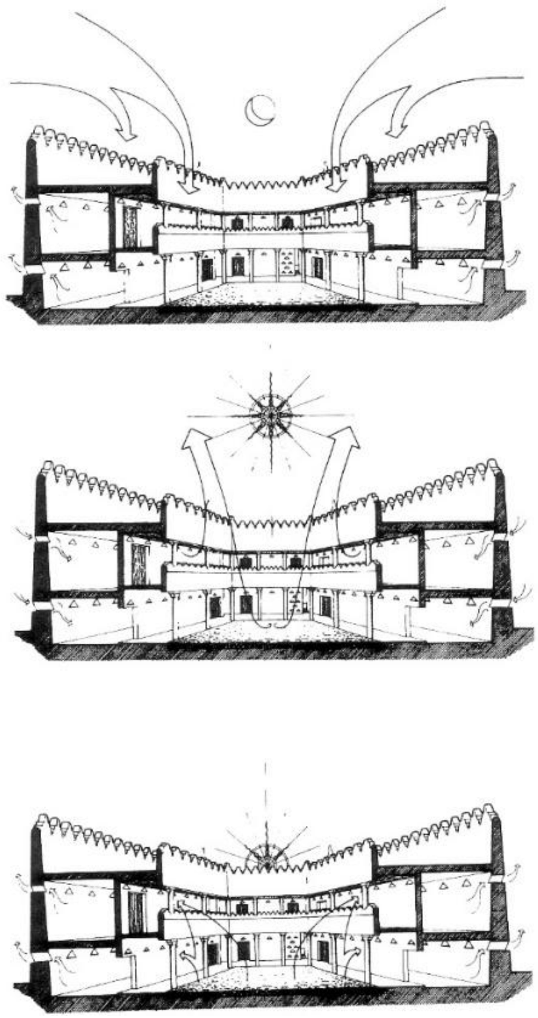

Figure 167. The function of a courtyard as airflow regulator. From top to bottom: at night, noon and sunset.

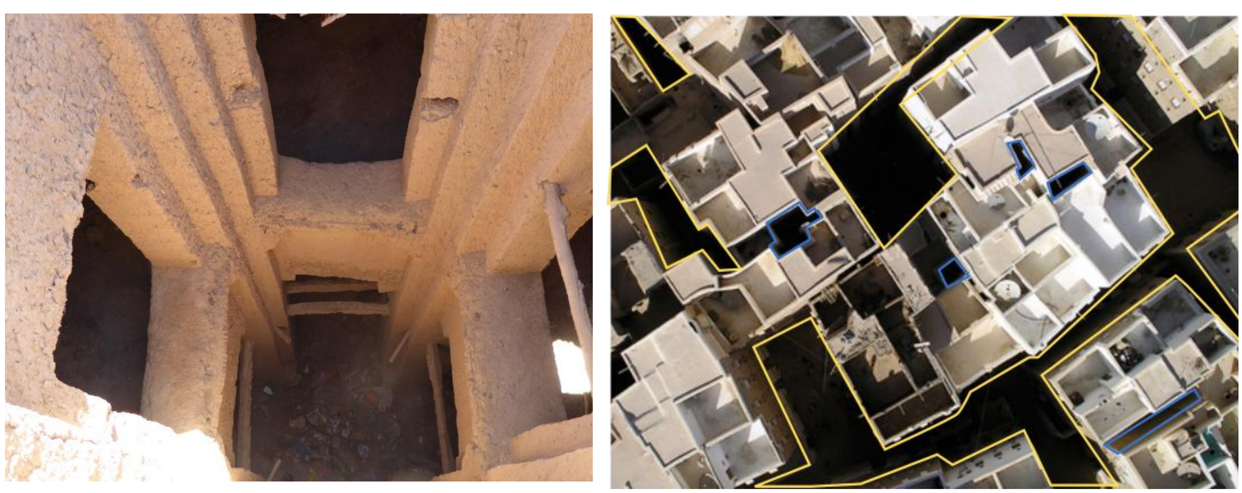

Figure 168. Air and light wells in recent architecture. Left: small central courtyard or light well in an abandoned town house, southeast Morocco (photo by author). Right: City of Shibam, Yemen. Lines indicate where light and air wells are placed. Yellow are public spaces (small squares, alleys), blue 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)

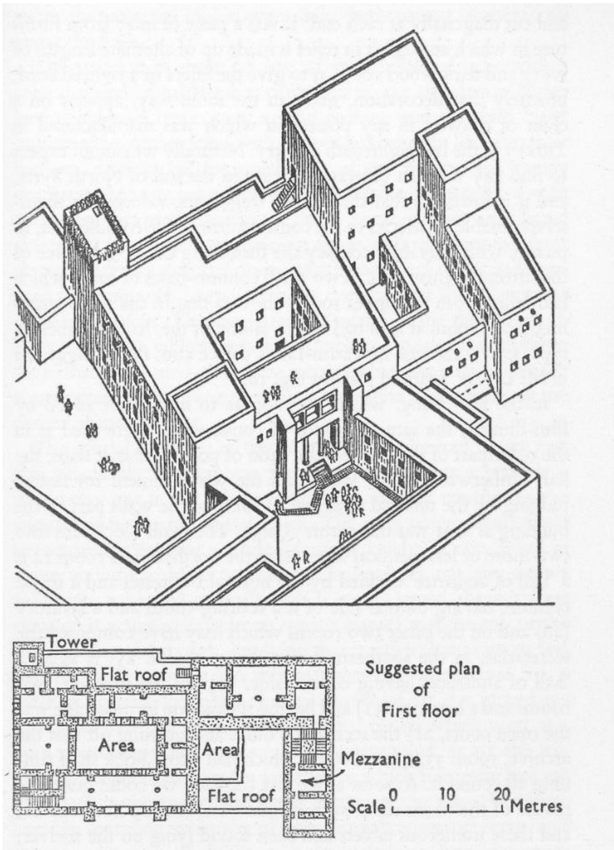

Figure 169. Reconstruction of the palace of Alalakh showing varying roof heights. This helped to ensure entry of light and air circulation in interior rooms (Woolley, 1955, fig. 16)

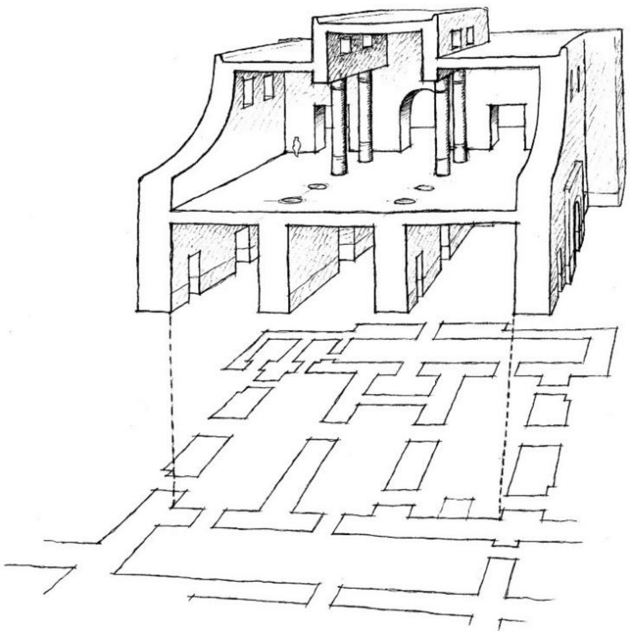

Figure 170. Tripartite architectural structure at the palace of Khorsabad, interpreted by Margueron with raised central roof and clerestory windows. According to Margueron, the lower floor was uninhabitable and was mainly used for circulation of people and storage. The dual floors and colonnade on the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

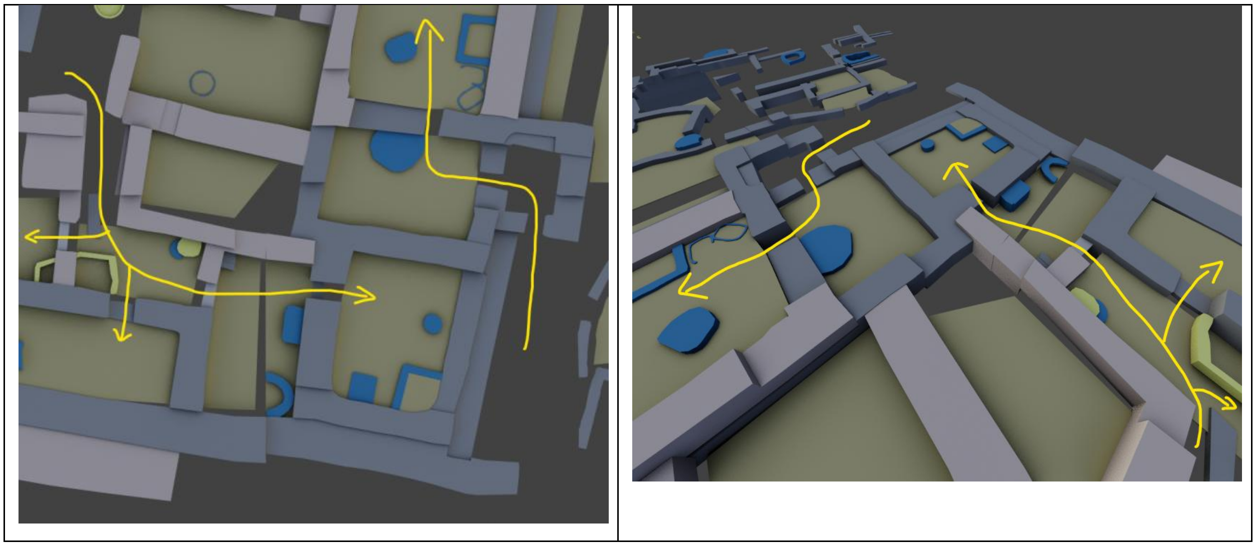

Figure 171. Building in SE corner of Dunnu, 3D reconstruction of excavated remains and access structure.

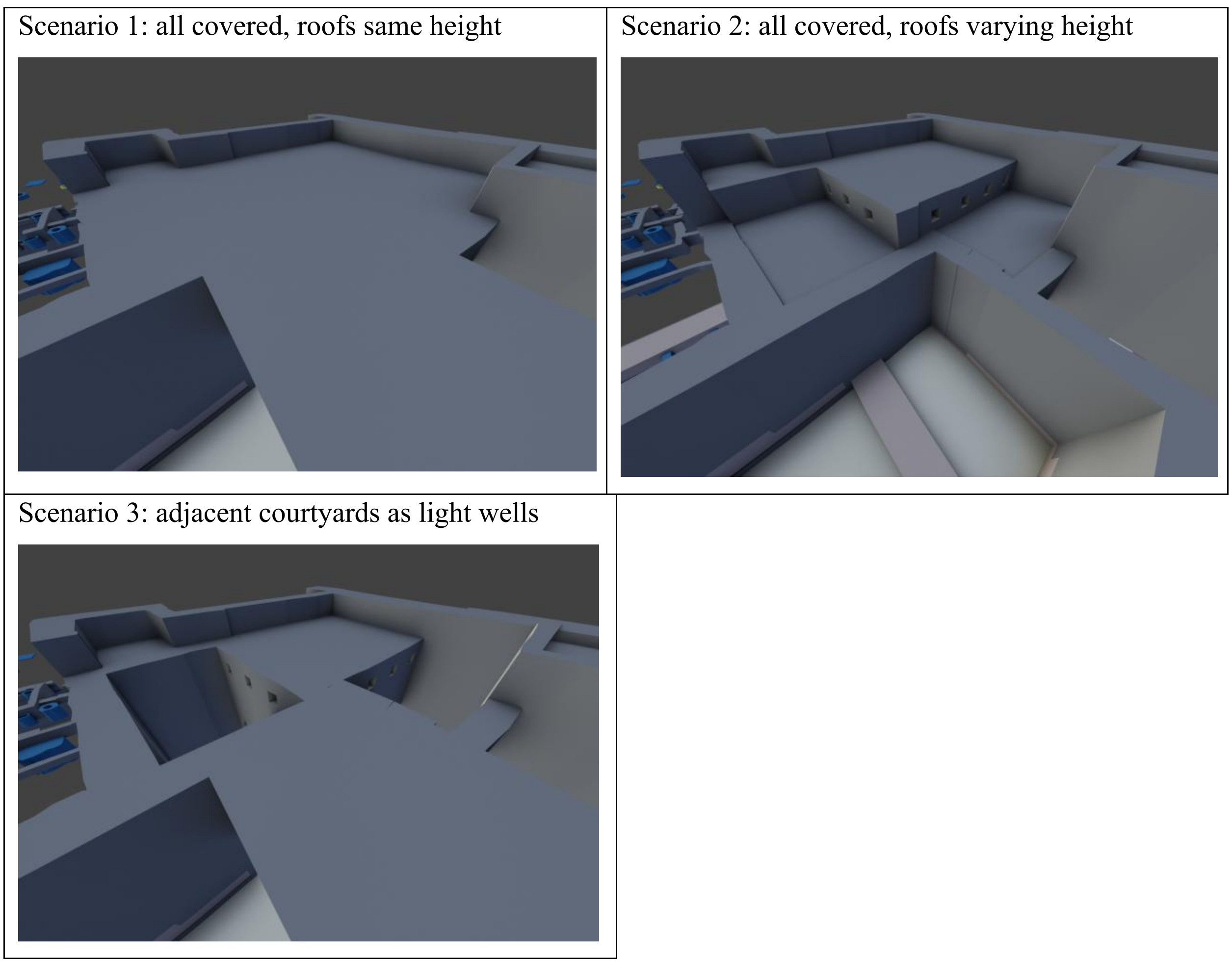

Figure 172. Alternative reconstruction scenarios have a significant effect on interior light conditions in building SE corner.

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.

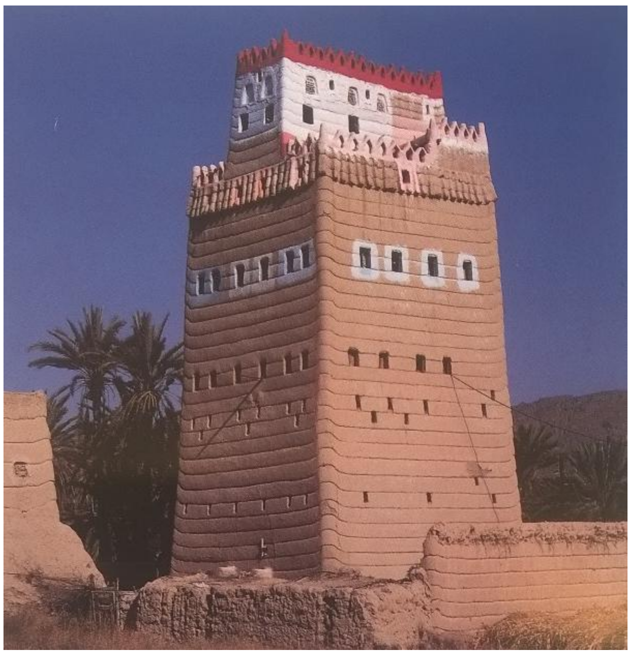

Figure 173. A tower house in Saudi Arabia. The ground floor has a few ventilation holes, but real windows are only found high up, where the living quarters are. Still, windows are small (King, 1998).

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.

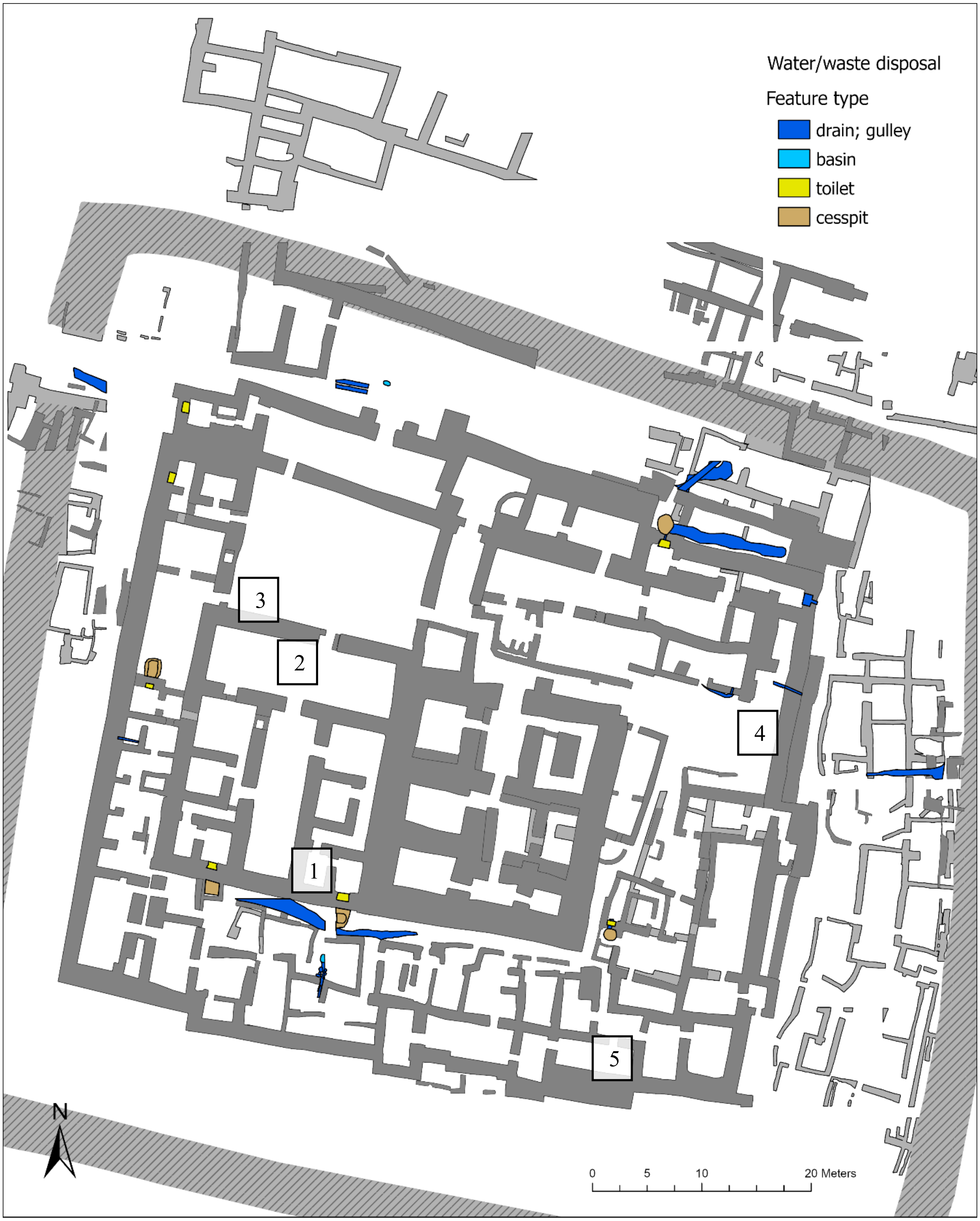

Figure 174. Excavated water and waste disposal features with numbers referred to in the text.

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.

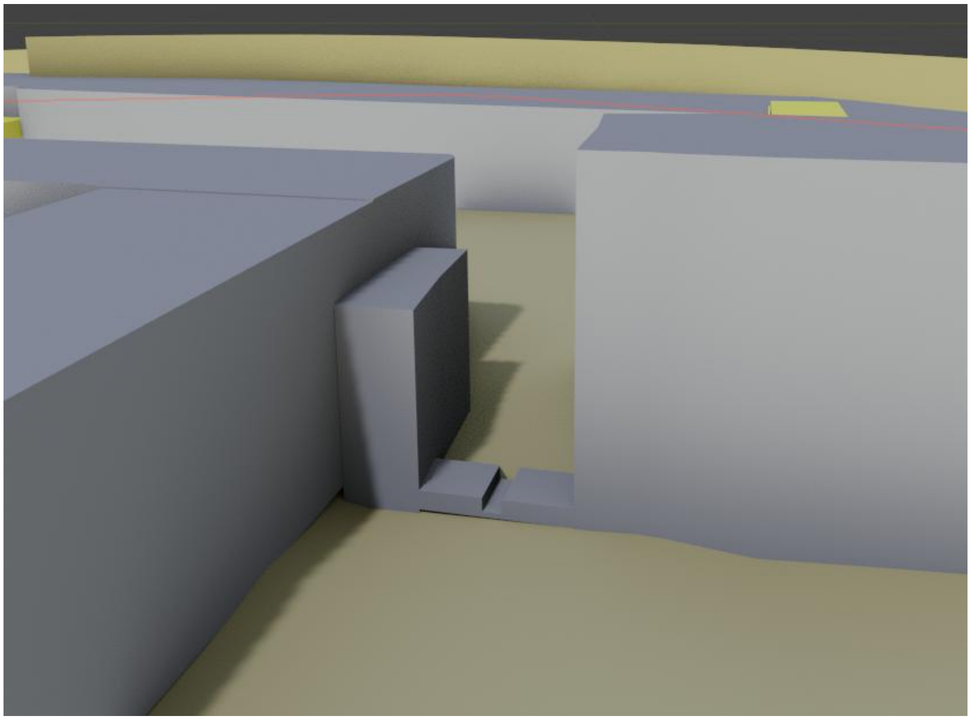

Figure 175. Drainage channel in threshold of passage in south-western corner of the large courtyard. Location is indicated on Figure 174: 3.

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.

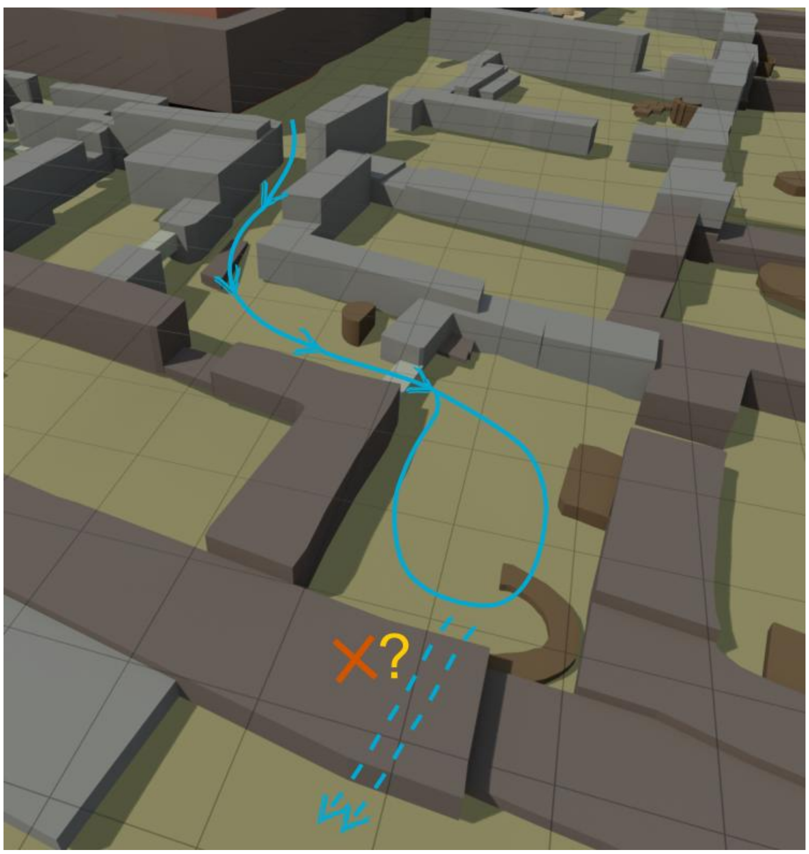

Figure 176. Potential water trap in space SW-10a. Location indicated on Figure 174: 5.

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.

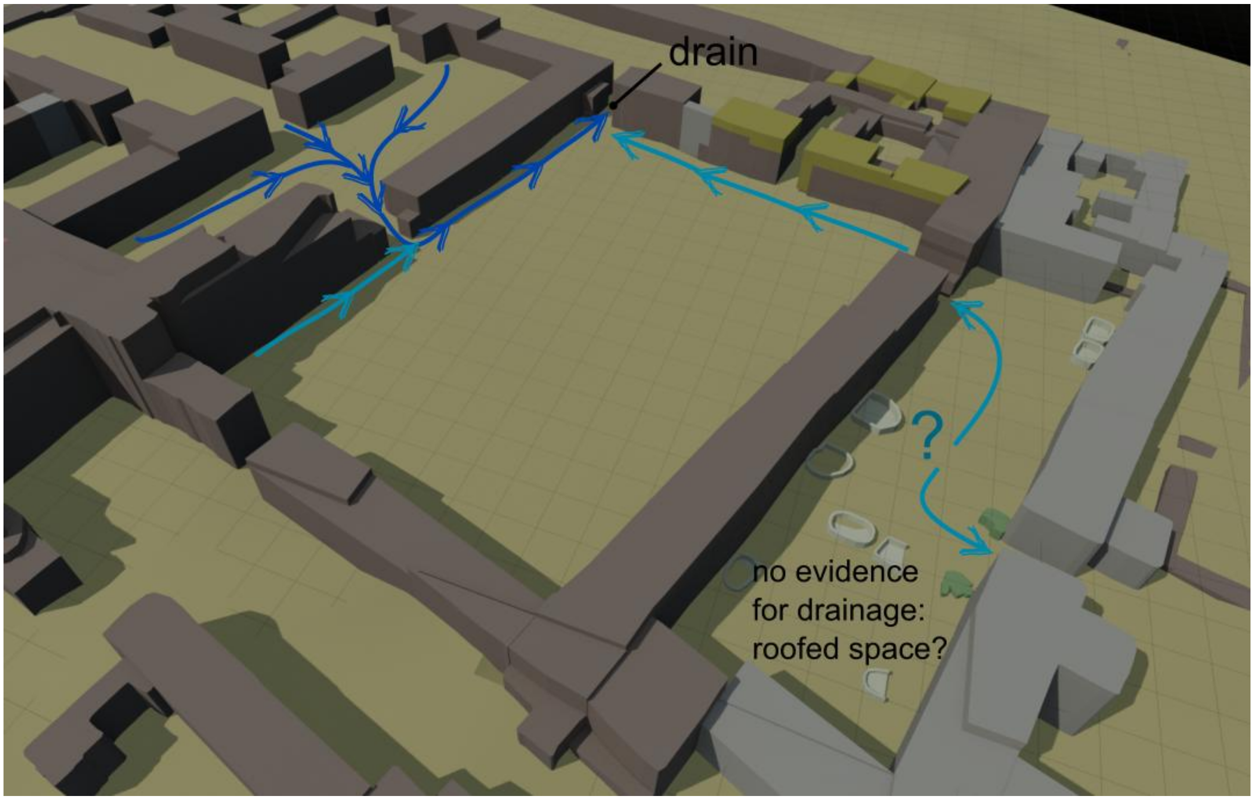

Figure 177. Drainage system of the large courtyard area. Blue = suggested by elevation data. Teal = hypothetical.

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).

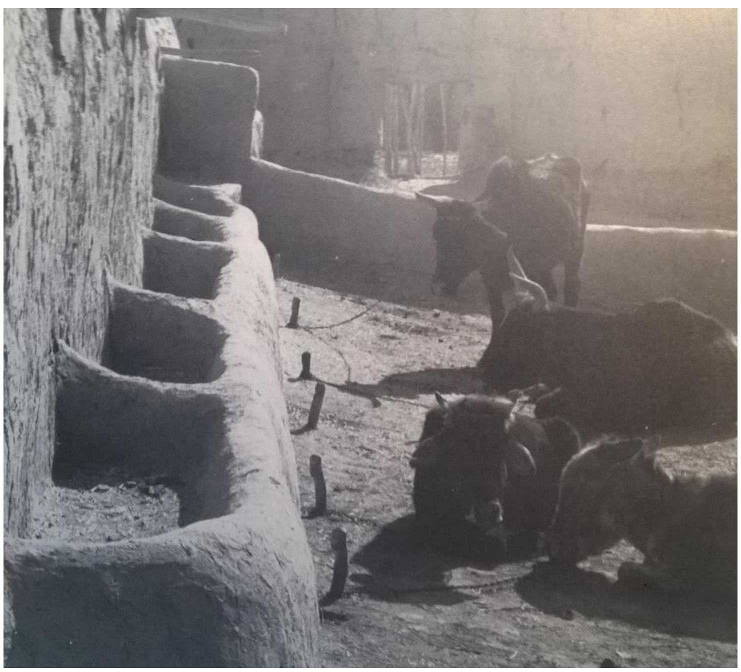

Figure 178. Feeding bins outside a fortified farmstead or Qala in the Bamiyan valley, Afghanistan (after Hallet and Samizay, 1980, p. 130).

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).

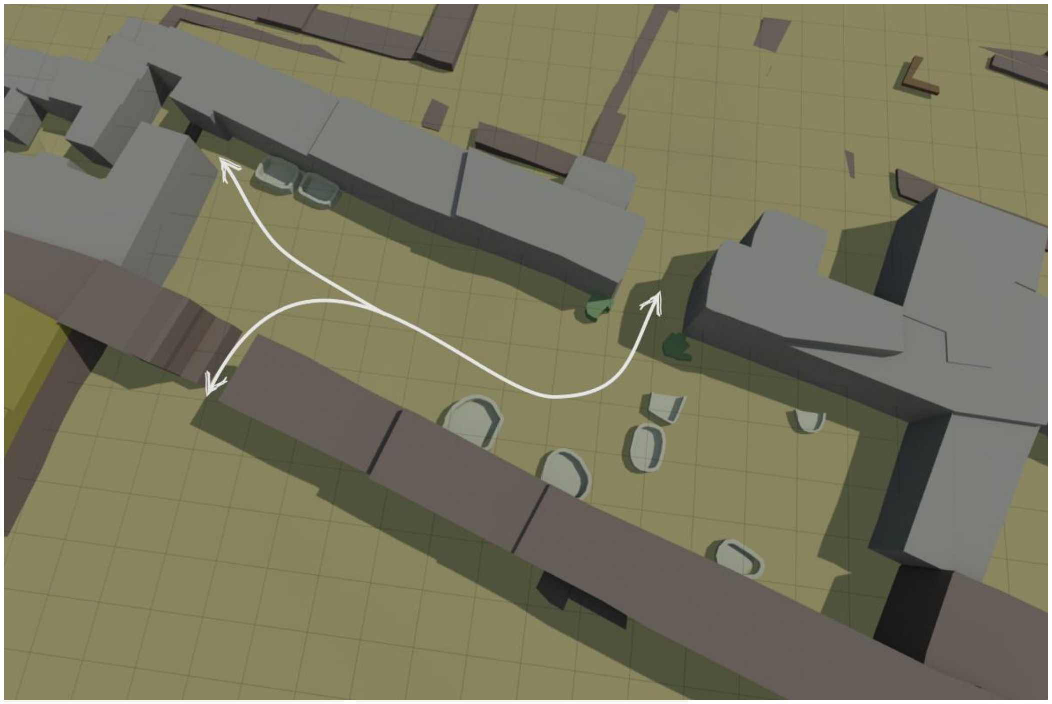

Figure 180. Bin cluster and path of movement in vestibule of the new gate.

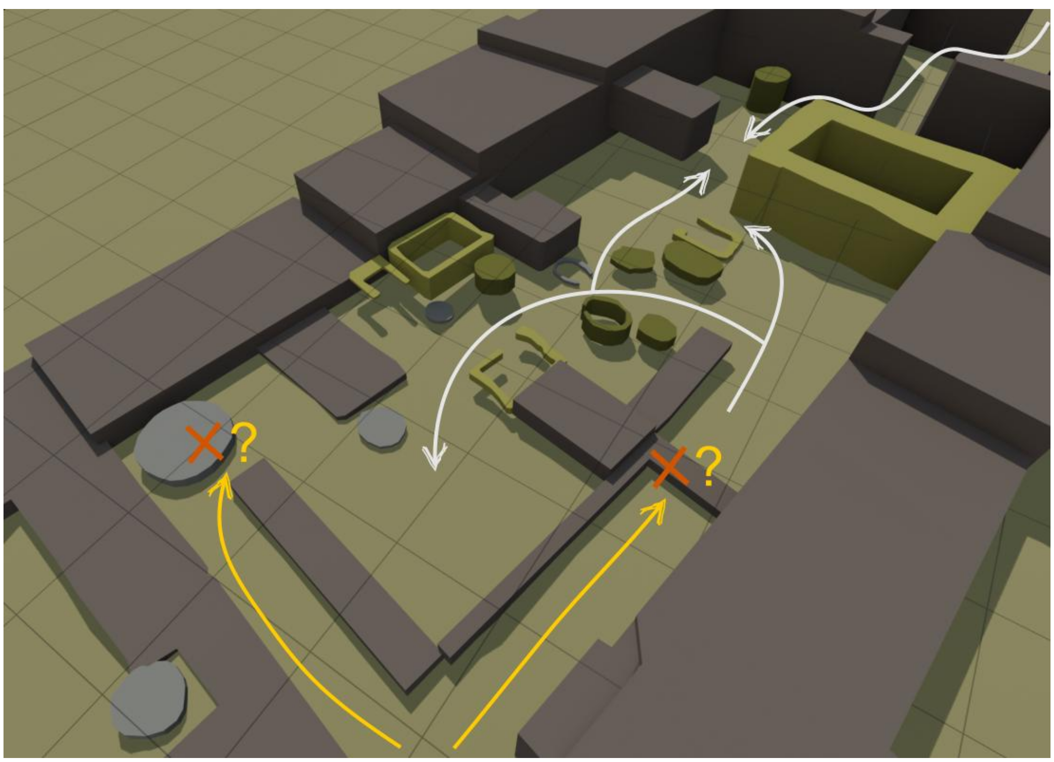

Figure 181. Cluster of bins and ovens in space SW-1a-d, which offers some interesting challenges in terms of access. Some sequencing is suggested by their stratigraphic order, allowing for more space per phase. At least two phases are visualised simultaneously.

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

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[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.

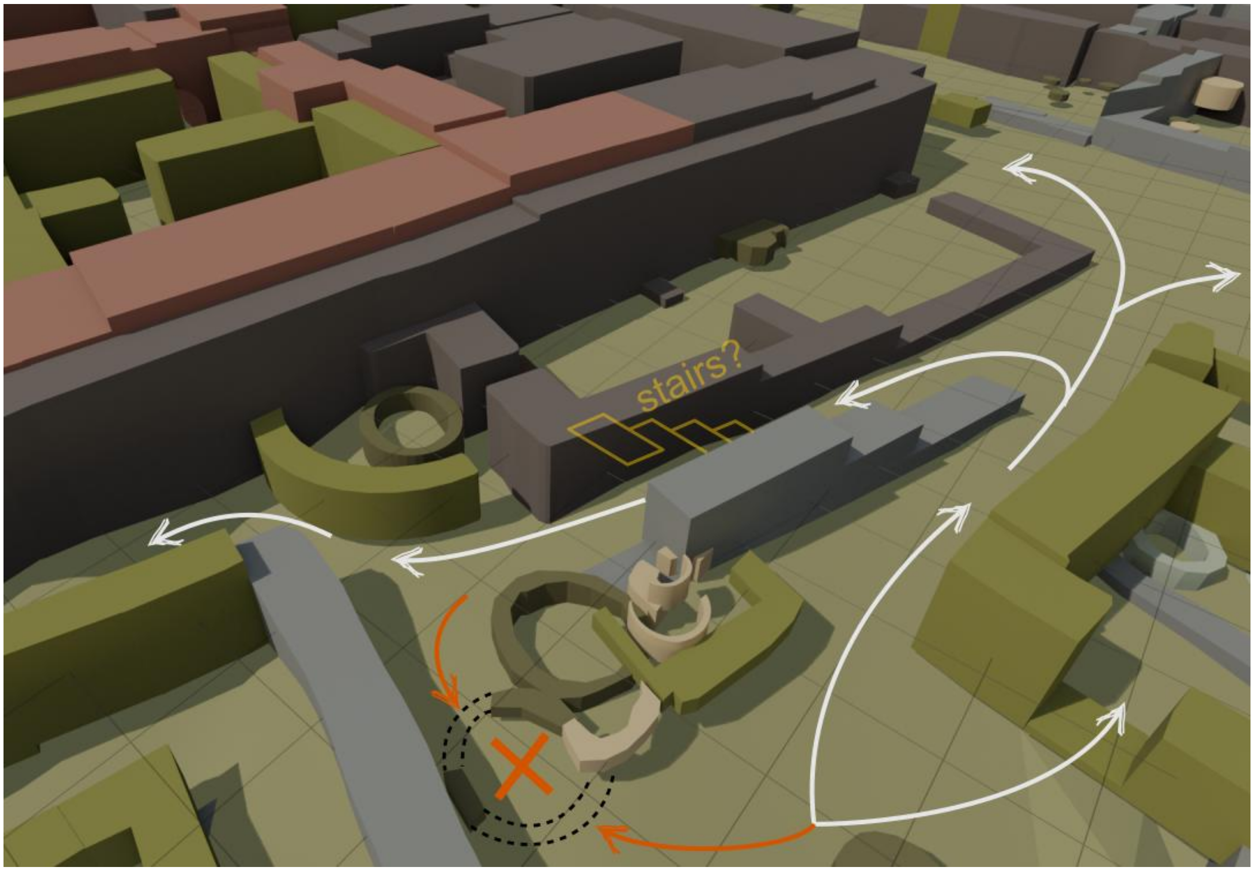

Figure 185. A series of fixed features, ovens and bins in space SE-7b in the south-eastern sector of the Dunnu.

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.

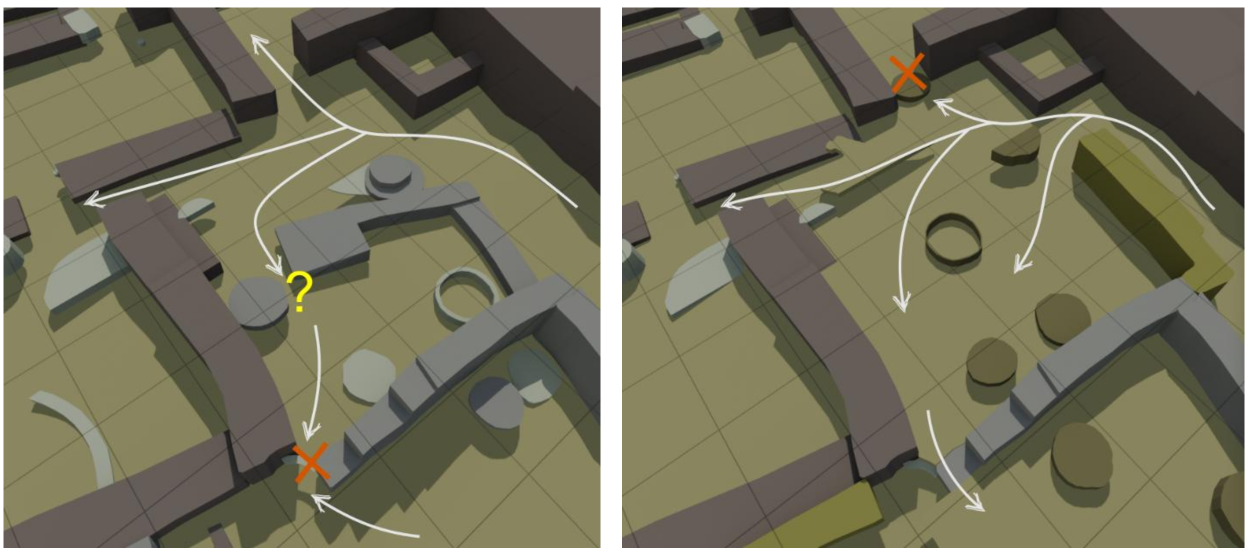

Figure 186. Two phases in the bread oven dominated area in the south-western corner of the Dunnu, with ovens possibly blocking routes.

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.

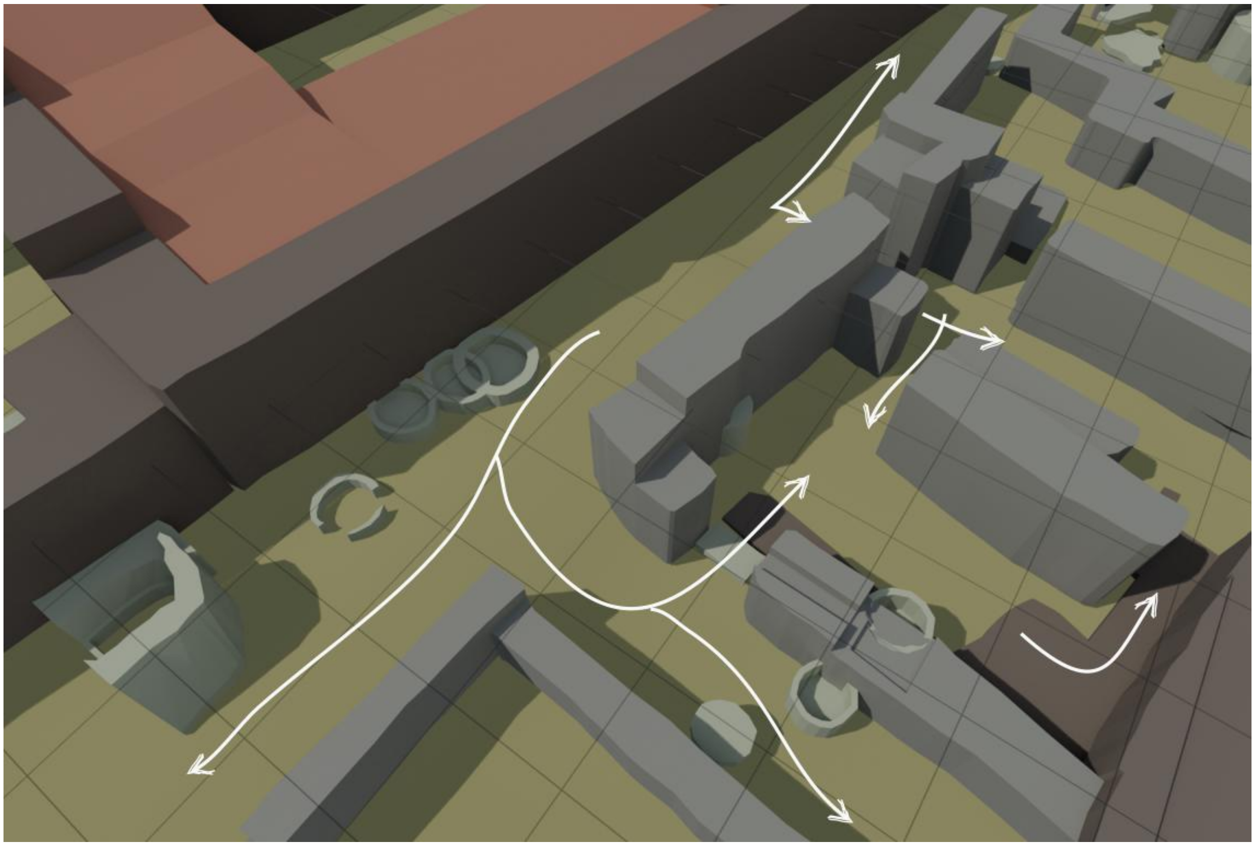

Figure 187. Occurrence of bins and ovens in the narrow alleys in the southern Dunnu. Although access is not blocked, it is certainly limited by the placement of these features. Grid size for scale = 1 m.

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.

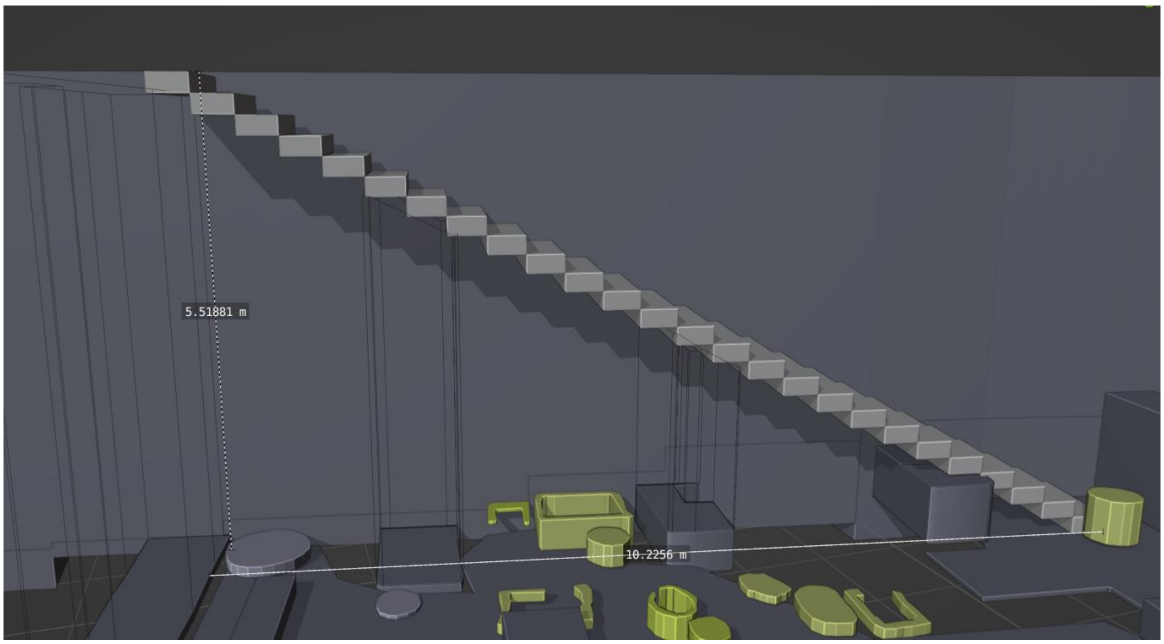

Figure 188. Hypothetical stairs supported by piers against the fortification wall in the south-western corner of the Dunnu. The spaces would have been bridged by timber beams, a manner of construction frequently seen in stairs construction.

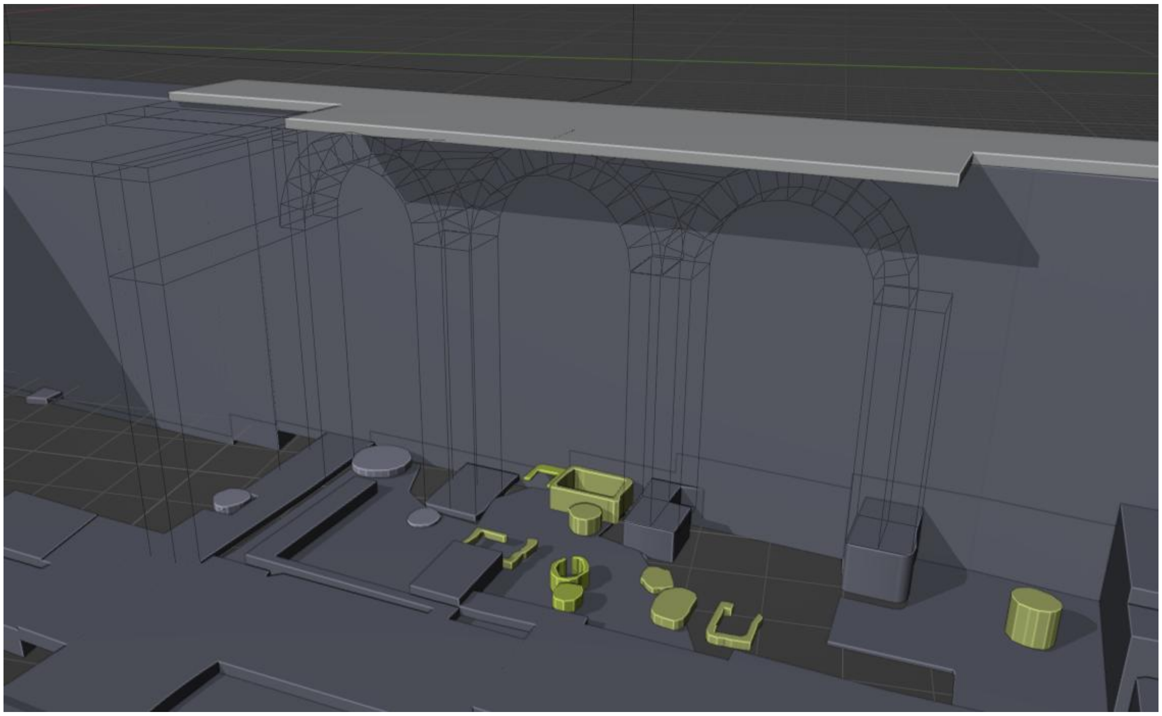

Figure 189. Alternative reconstruction option: extended surface supported by arched pier supported section..

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.

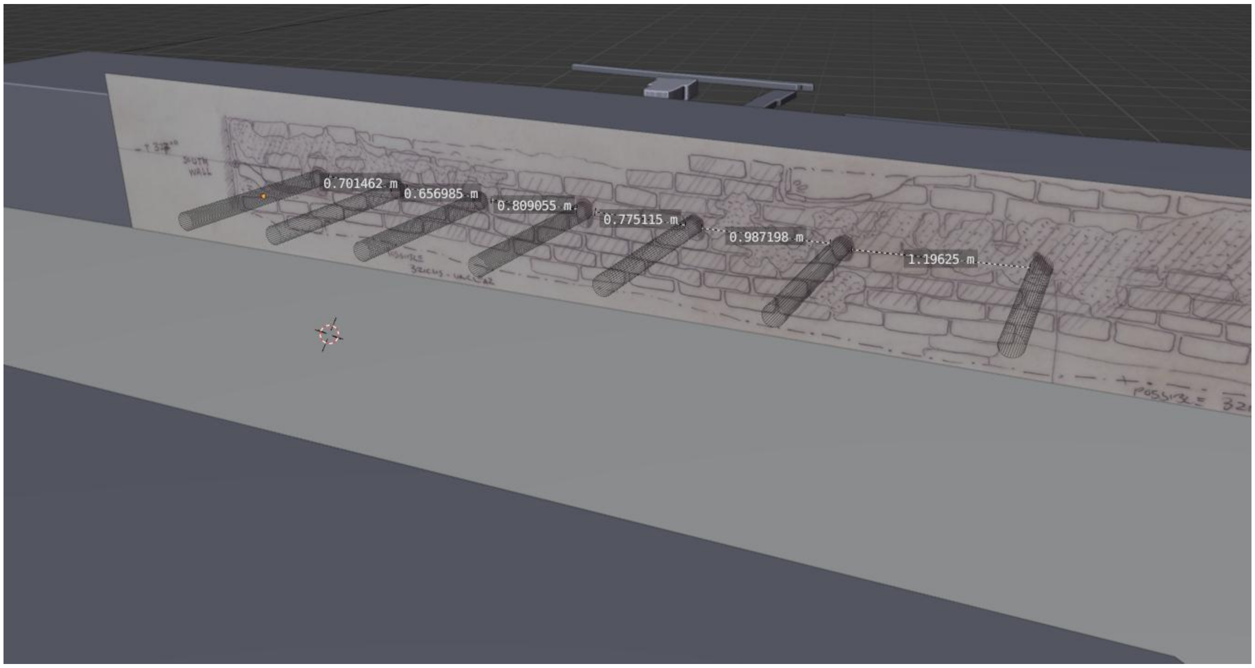

Figure 191. Drawing of the holes in 3D view with simple poles stuck into the holes.

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

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[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 (9^{th} or 11^{th} 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).

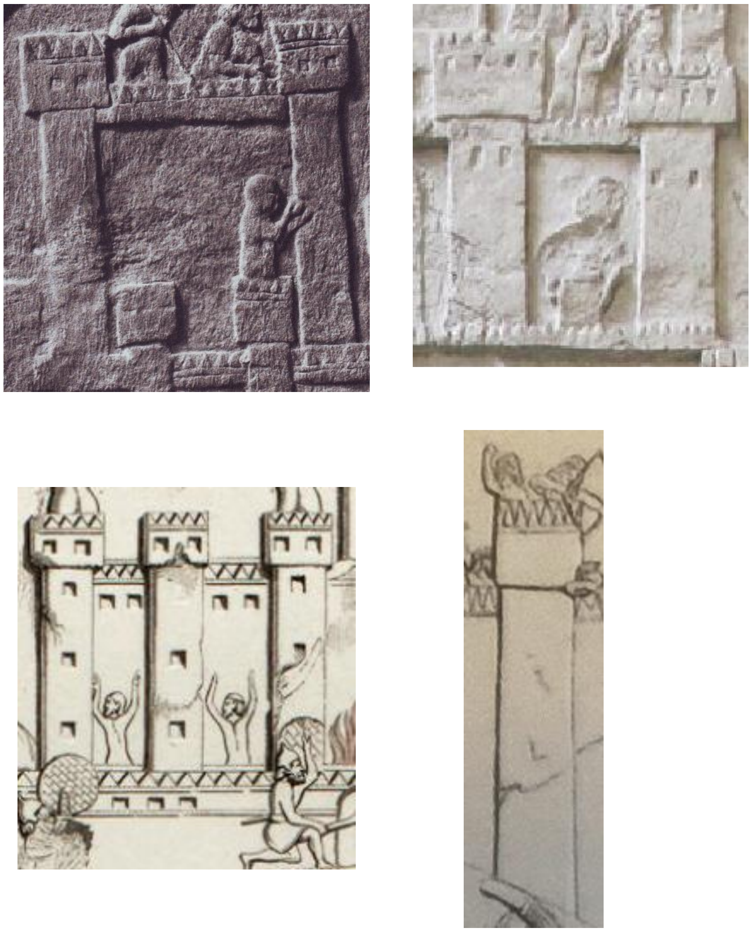

Figure 193. Towers type 2, depicted on the Assyrian bas-reliefs. There are many variations in height to width ratio and window configuration. Top left: Ashurnasirpal II, 865-860. Top right: Tiglath Pileser III, 730-727 BC. Bottom left: city in Urartu, Sargon II, 722-705 BC (Botta, 1850). Bottom right: High, windowless tower from a city besieged by Sennecharib, 700-681 BC.

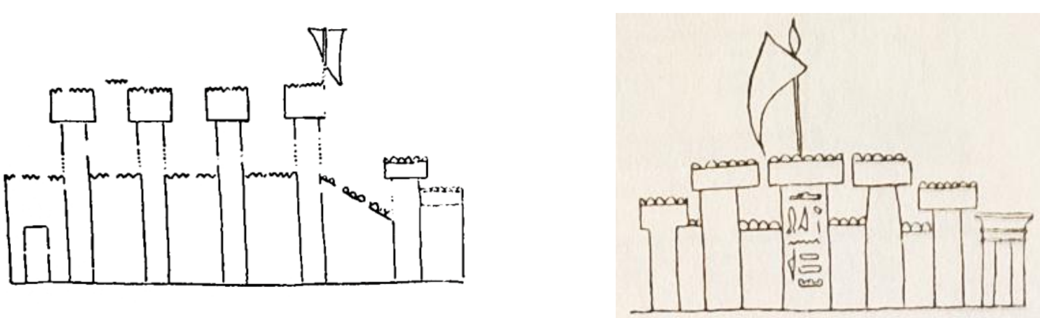

Figure 194. Two Egyptian representations of Kadesh. Left: from Luxor, around 1268 BC. Right: from Abu Simbel.(after Naumann, 1955, figs. 429 & 427)*. The representations seem to be each other's reverse, but the number of towers and location of gate matches.*

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.

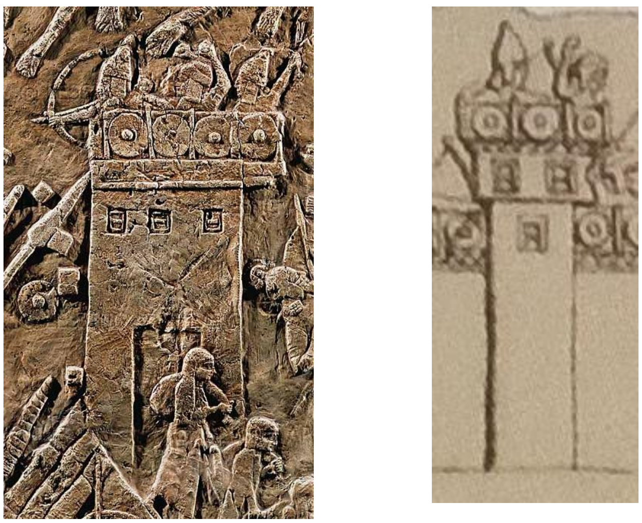

Figure 195. Left: a free standing tower on siege of Lachish with a platform. Note that the left side of the platform has already been destroyed by a siege machine. One of the shields and some bricks are shown falling. Right: one of the many towers in the city wall of Lachish.

[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.

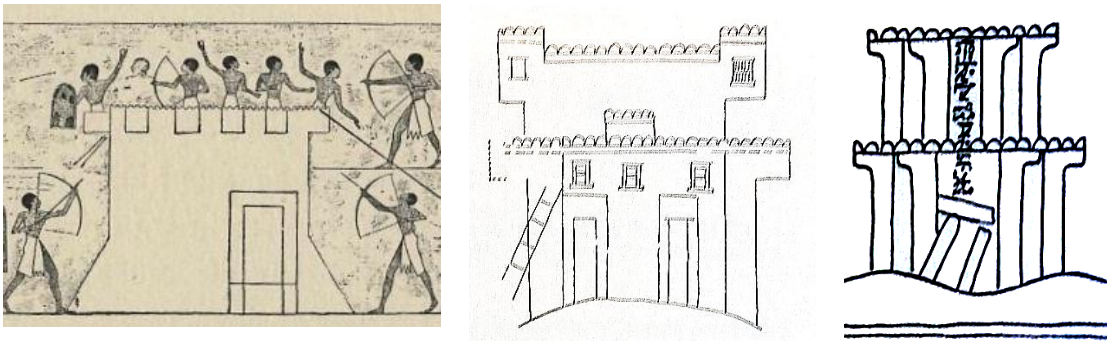

Figure 196. ‘Tower’ type 3: defensive balconies. Left: Middle Kingdom Egyptian depiction of a fortification under attack from the tomb of Amenemhet (20th century BC) (Maspero, 1903). Middle: city of Askalon, Karnak, Ramesses II (1279-1213) (after Naumann, 1955, fig. 423). Right: Syrian city of Geder, Seti I (1290-1279 BC) (after Naumann, 1955, fig. 417).

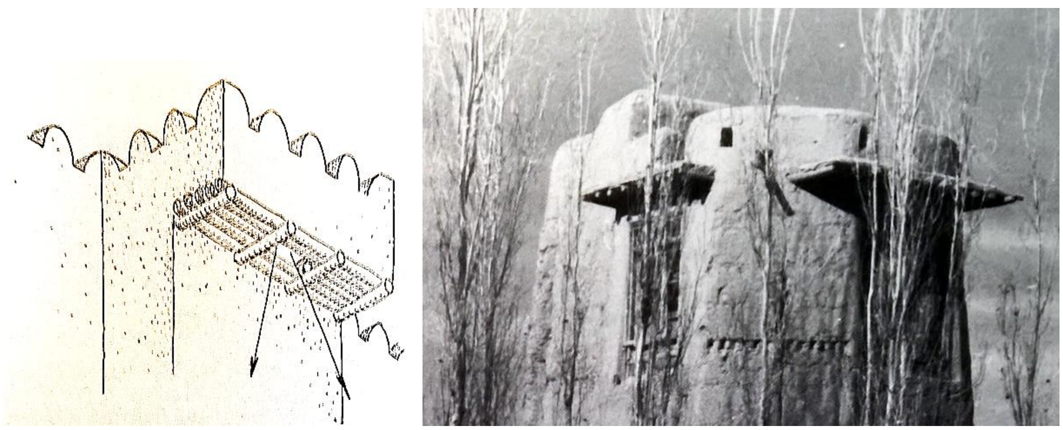

Figure 197. Left: Reconstruction of balcony by Rudolf Naumann (after Naumann, 1955, fig. 421). Right: similar cantilevered construction on a tower of an Afghan Qala (after Hallet and Samizay, 1980, p. 142).

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

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[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.

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[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

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[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.

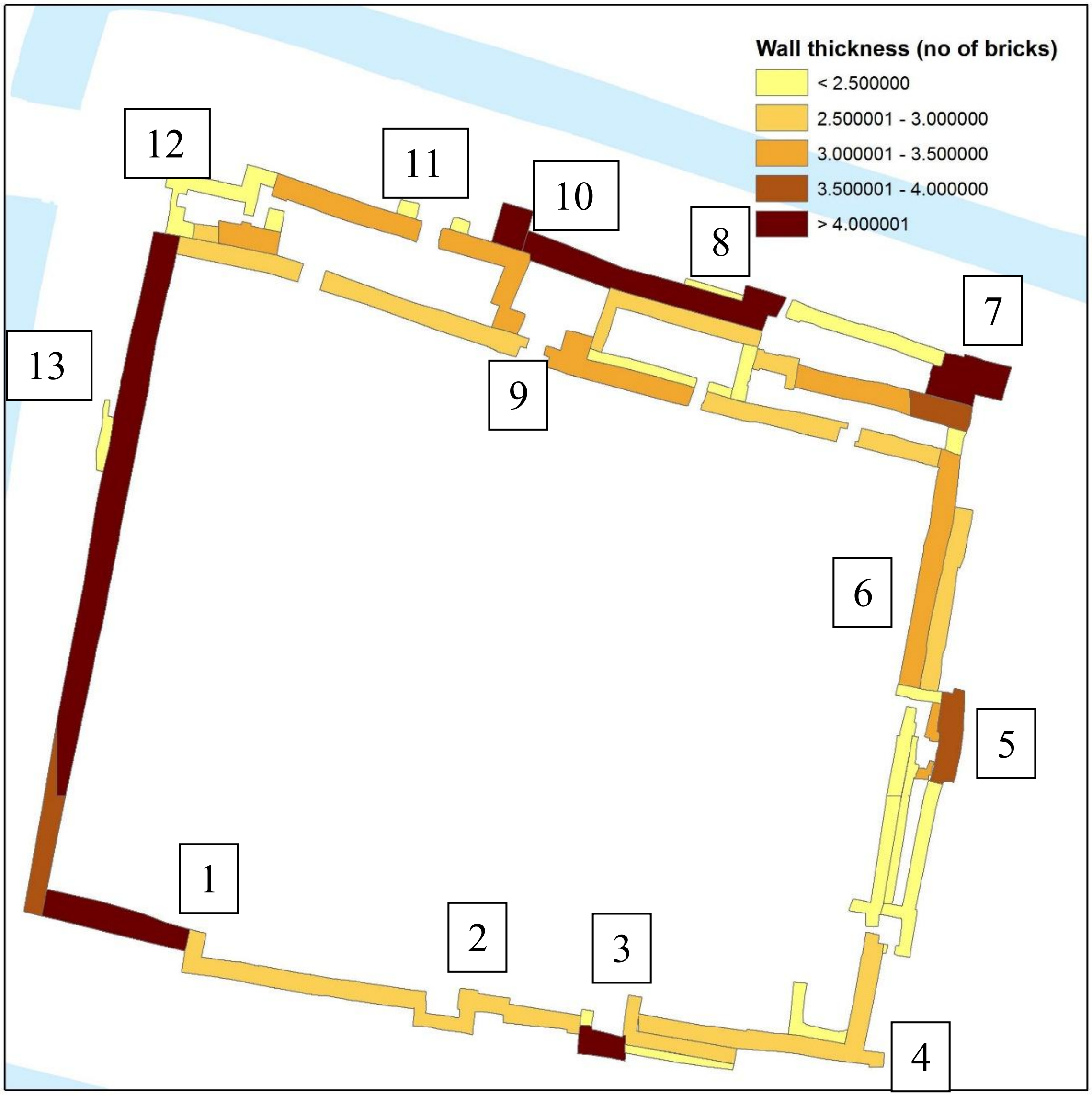

Figure 198. Fortification wall, coloured according to wall thickness in bricks. Numbers indicate special features referred to in the text.

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).

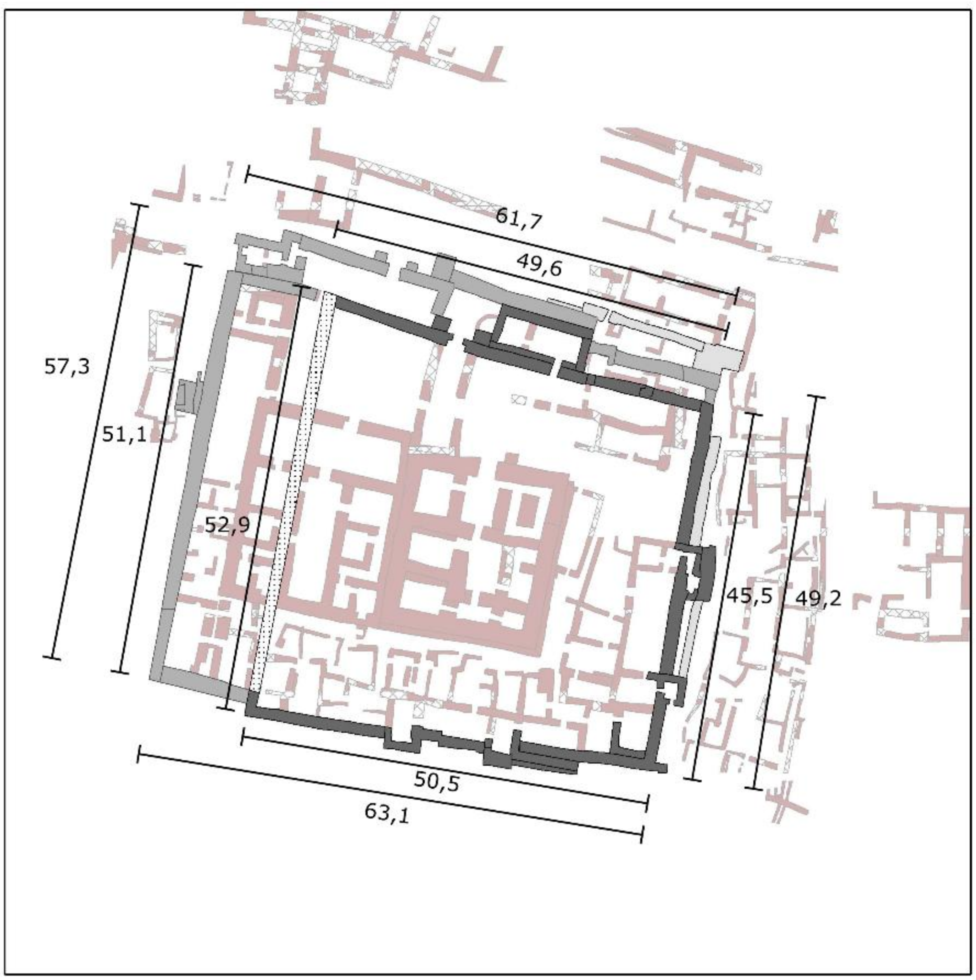

Figure 199. Dimensions of the fortifications, indicating a possibly smaller square, earlier phase.

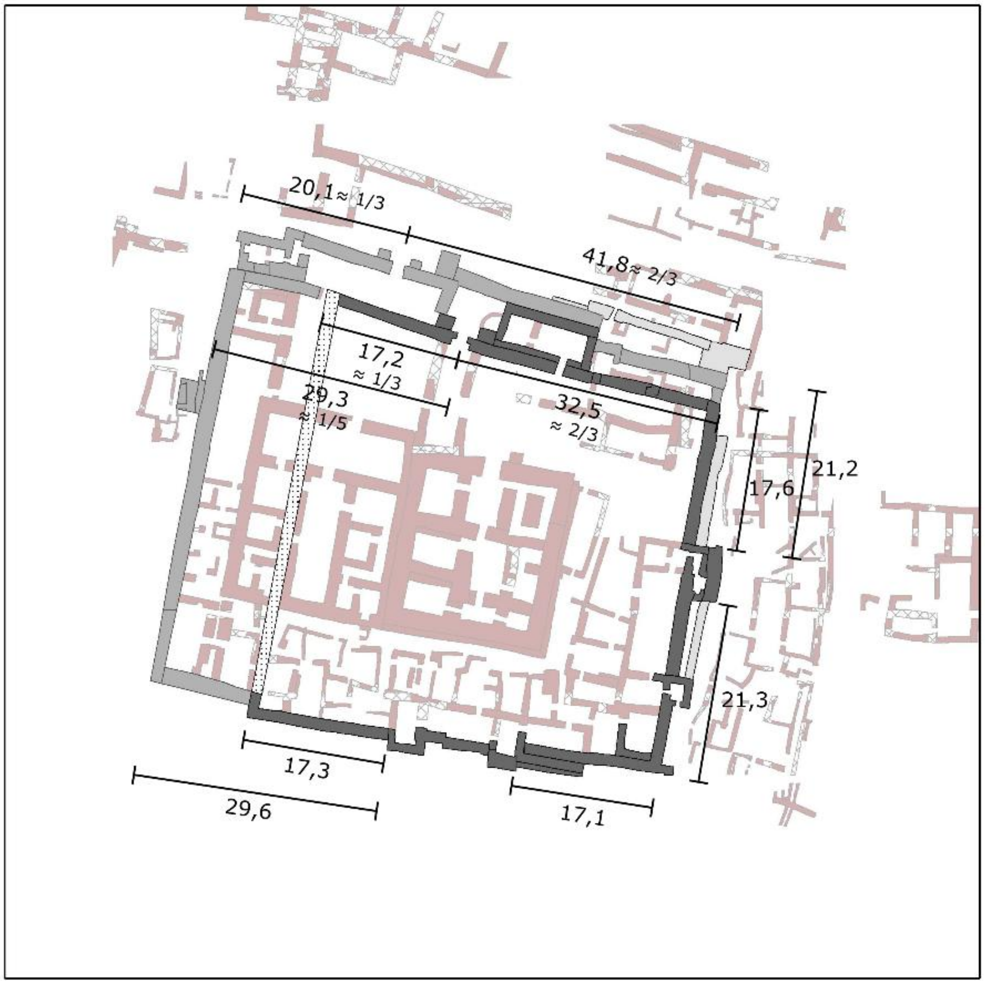

Figure 200. Dimensions of the fortification, indicating regularities with regards to placement of main gate (old and new) and other defensive features.

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.

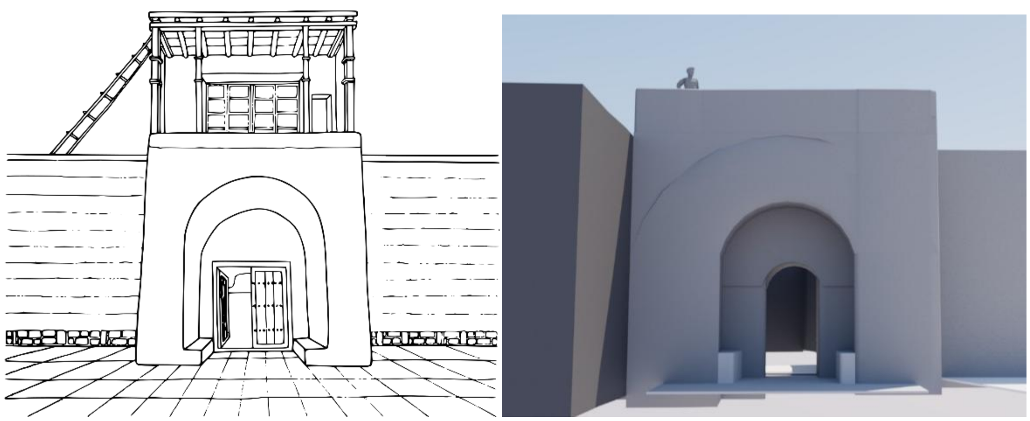

Figure 201. Left: Arched gateway of a fortified farm or Qala, in Logan, Afghanistan. Note the benches on the inside of the gate. Right: the old gate of the Dunnu reconstructed based on the Afghan model.

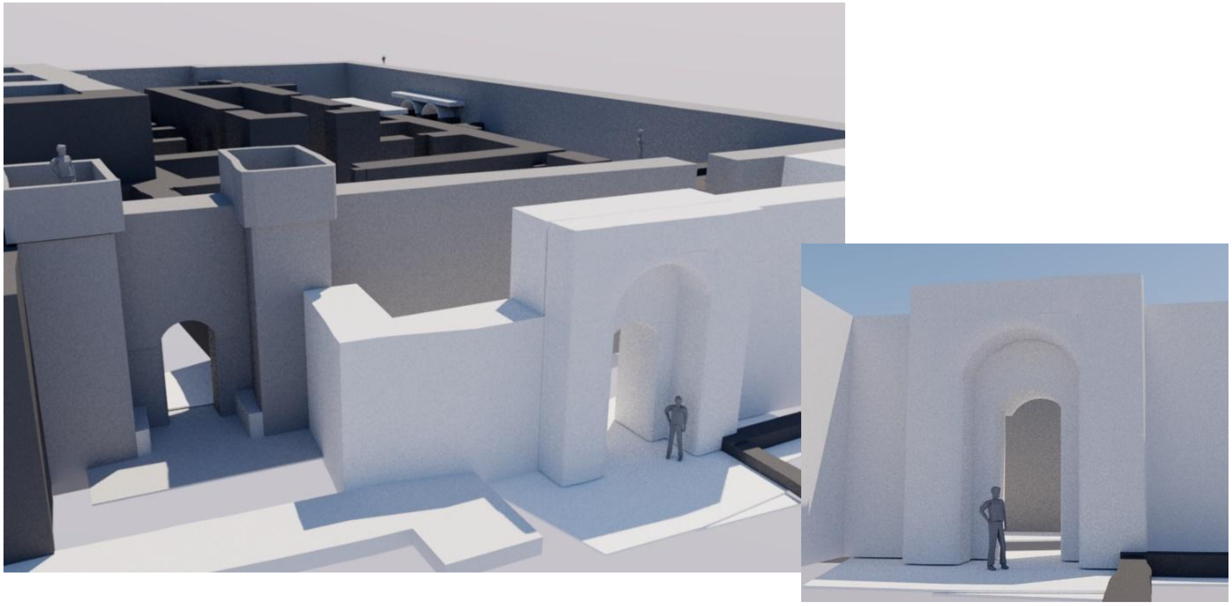

Figure 202. Left: the old and new gates side by side, with an alternative option for the old gate. The flanking towers are based on ancient iconography of city gates. Right: reconstructed new gate as seen from the northwest.

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.

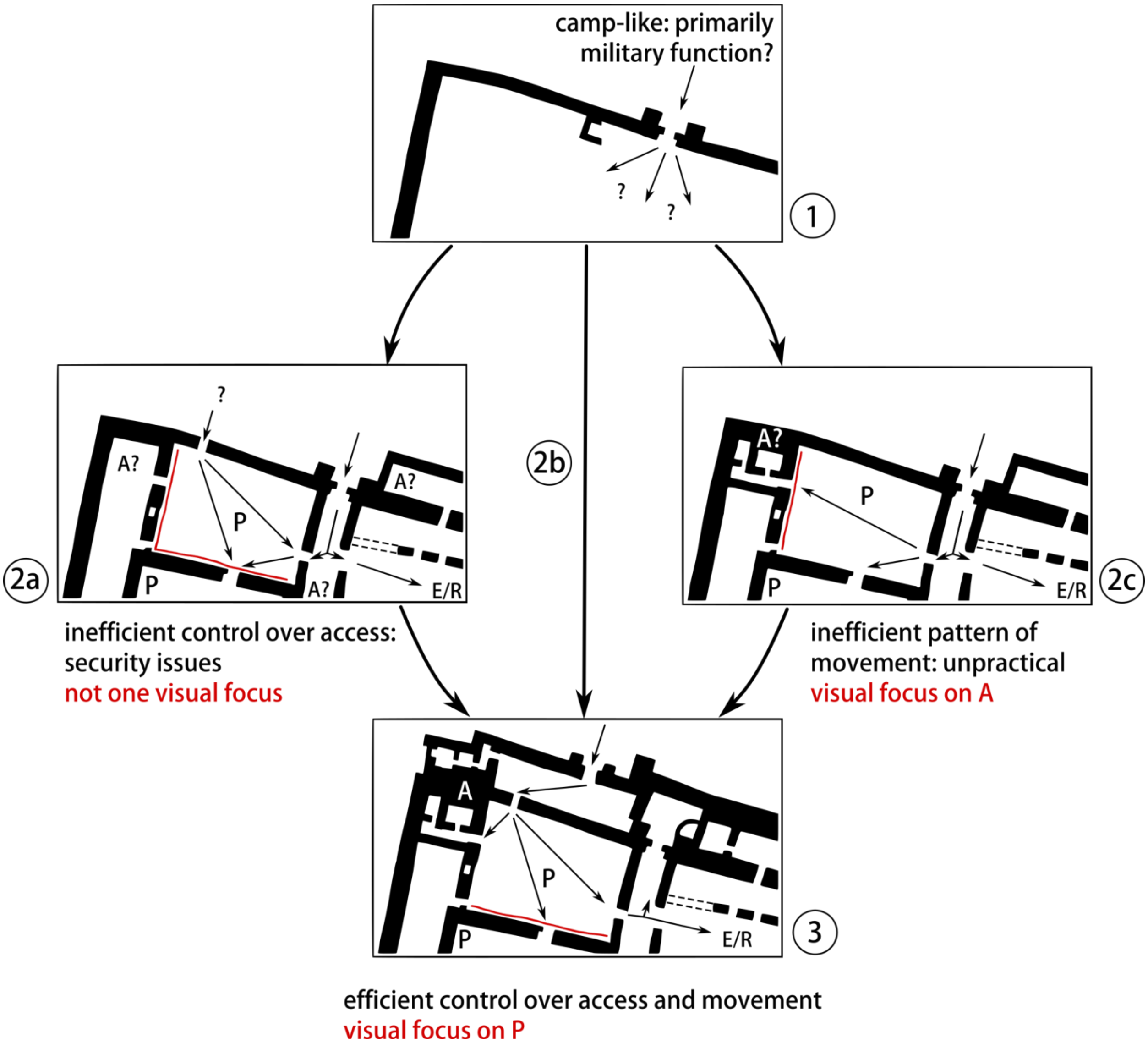

Figure 203. Model showing alternative pathways of architectural plan development, and their effect on movement, access and visual focus. Meaning of the letters: A =location building for administration; P = architecture representing & communicating Power; E/R = Economic/Residential area. It seems that 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.

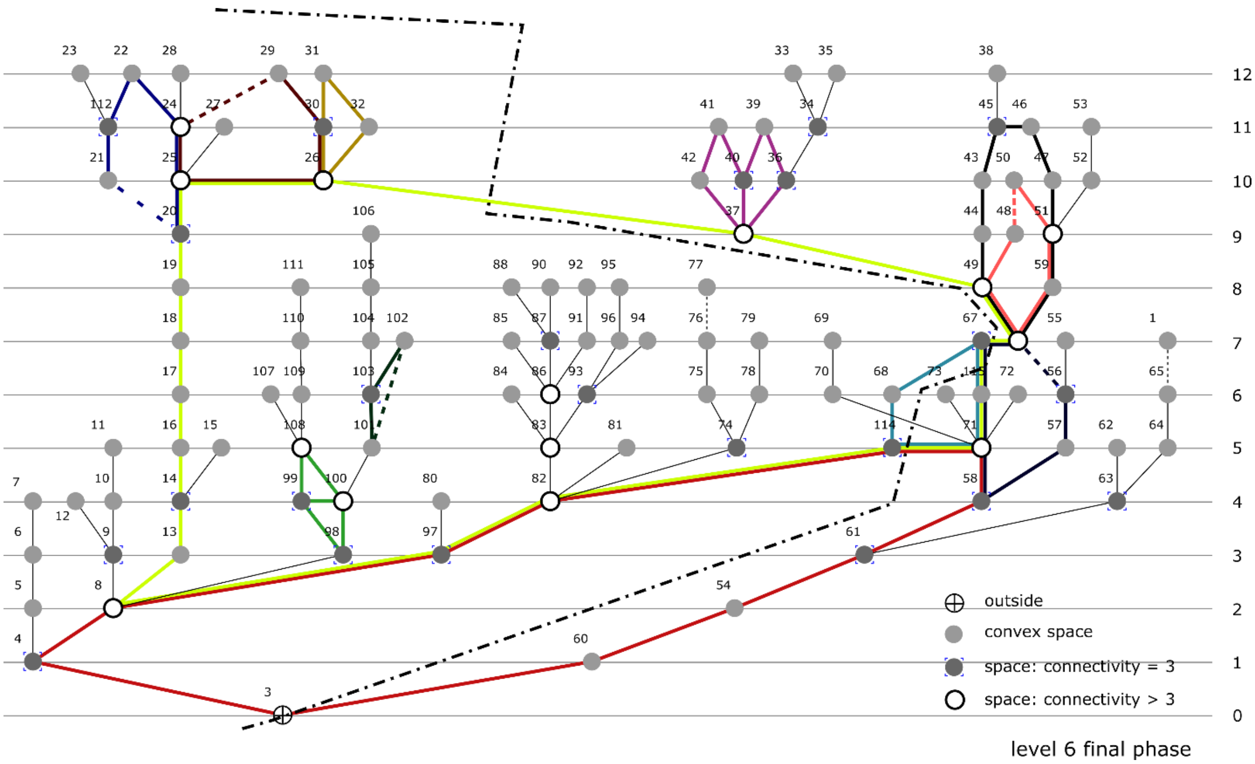

Figure 204. Access graph/ Justified Plan Graph, final phase level 6, starting on the outside. The axis on the right displays the depth of each node as measured from the carrier, here the outside. The coloured lines represent all possible circulatory movements. The hashed lines indicate doorways which 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.

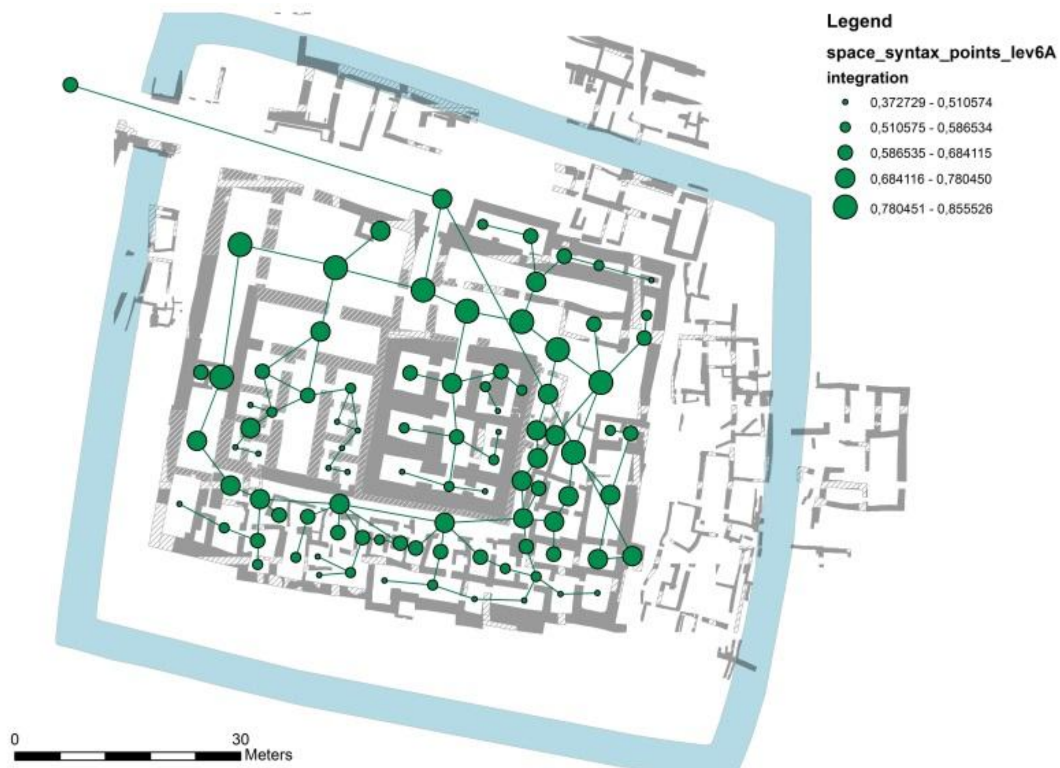

Figure 206. Integration, early phase Dunnu.

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).

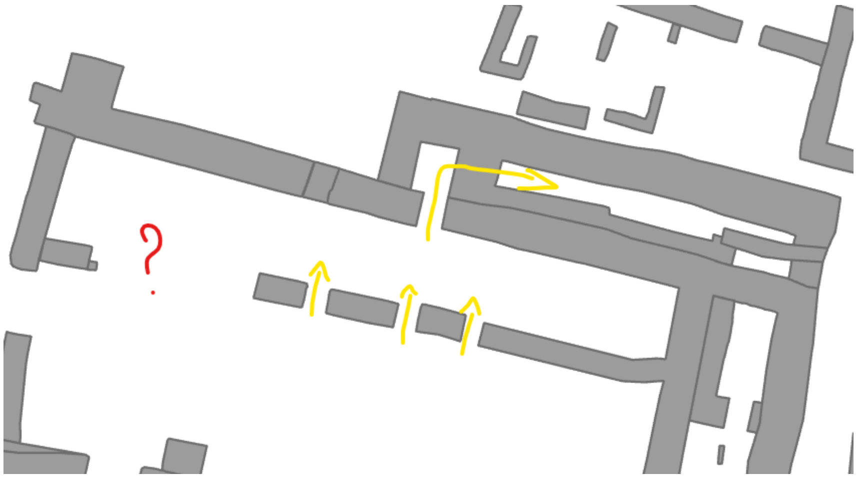

Figure 208. Access situation NW-sector, early phase. The elongated room was probably a staircase.

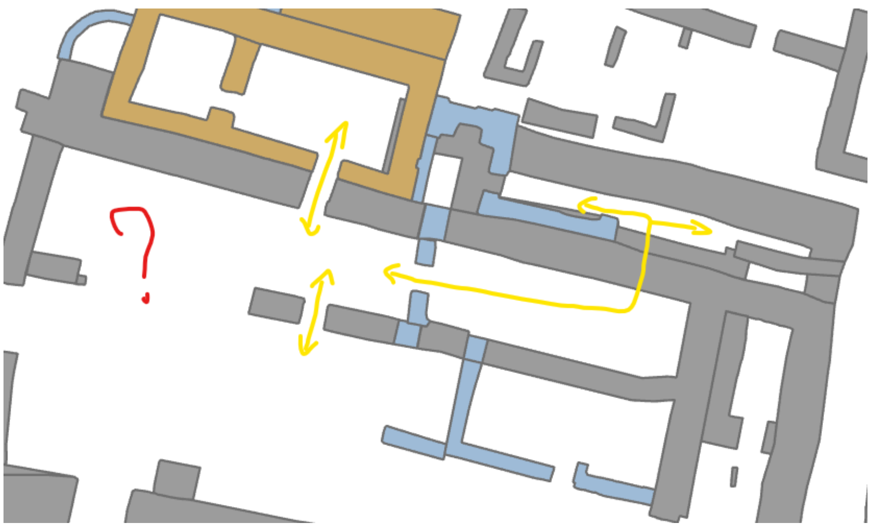

Figure 209. Access situation NW-sector, after various modifications. The elongated staircase rooms was turned into a bathroom.

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.

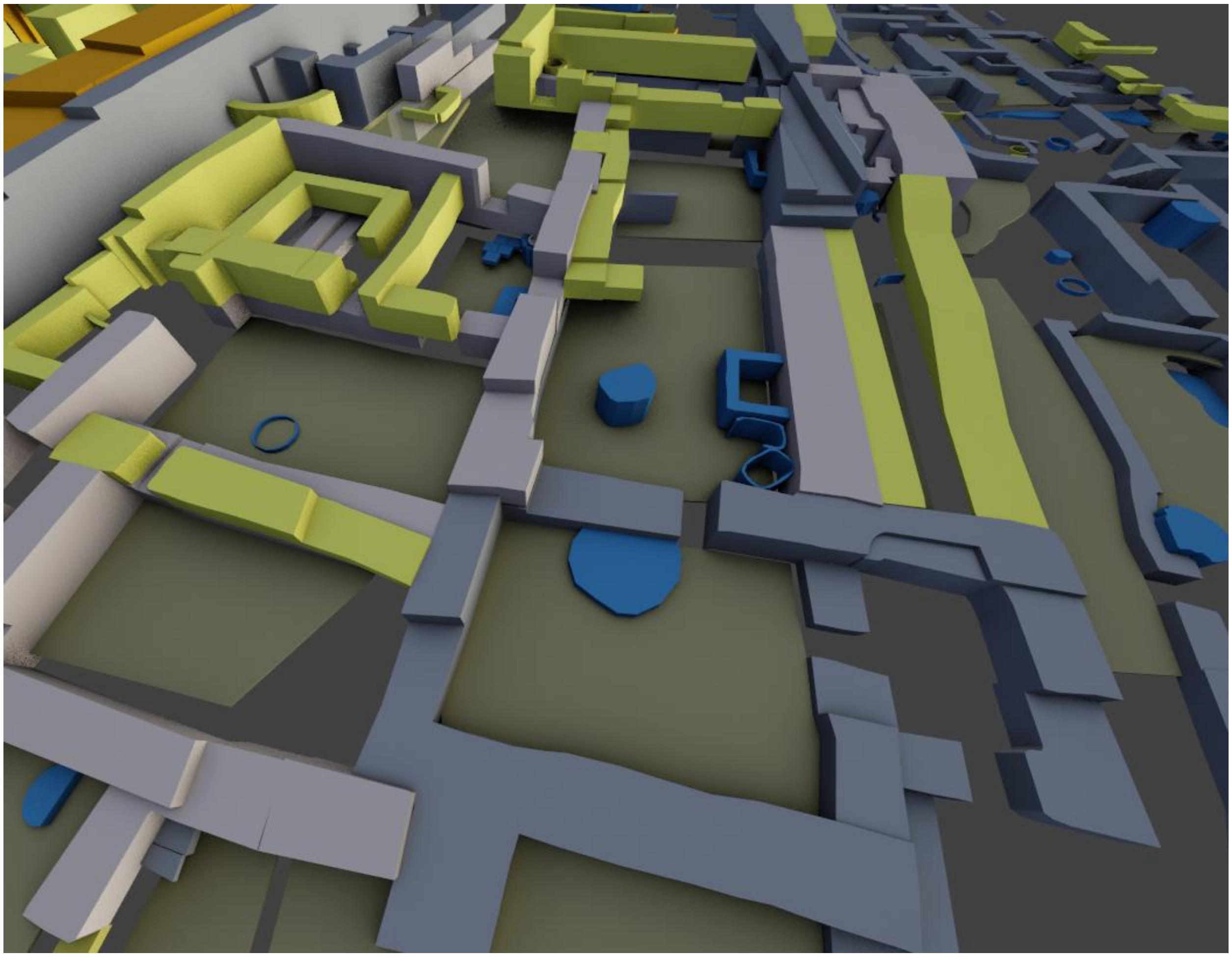

Figure 211. 3D view of the modifications in the south-eastern sector. Only the first phase floors are visualised in order to have a full view on the stratigraphic order of the architecture.

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.

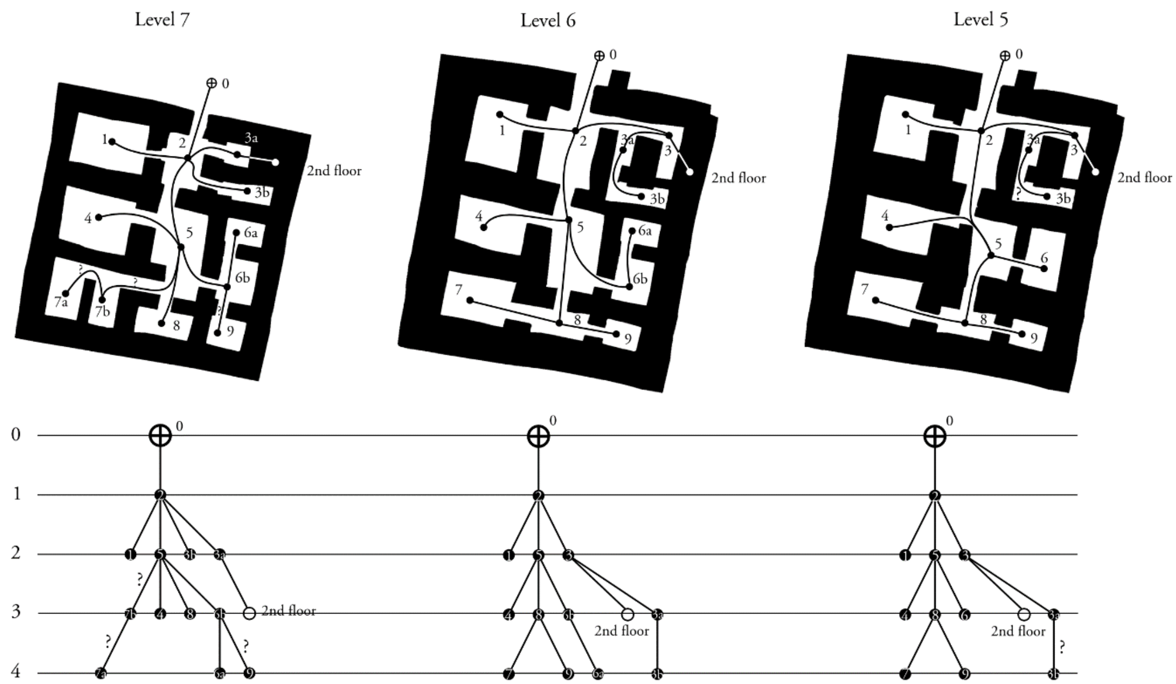

Figure 212. Spatial modifications of the tower.

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*.